A Lexicon for Outer Space Security

Edited by
Almudena Azcárate Ortega
& Victoria Samson

UNIDIR
UNITED NATIONS INSTITUTE
FOR DISARMAMENT RESEARCH

A Lexicon for Outer Space Security

Acknowledgements

The development of the first edition of the Lexicon for Outer Space Security was generously supported by the Government of the Republic of Korea.

The United Nations Institute for Disarmament Research (UNIDIR) and the Secure World Foundation (SWF) would like to thank all those who contributed to this Lexicon. Laetitia Cesari, Anuradha Damale-Day, Sarah Erickson, Xavier Pasco, Daniel Porras, Rajeswari Rajagopalan, James Revill, Sami Shihadeh, Cassandra Steer, Dmitry Stefanovich and Guoyu Wang provided instrumental expert contributions. The editors would also like to acknowledge Phillippa Biggs, Veronique Glaude, Niklas Hedman, Michael Spies, Alexandre Vallet, and Wen Zhou for their critical feedback. The editors also thank Peter Martinez, Brian Weeden, and Christopher Johnson from Secure World Foundation for their invaluable advice and assistance, as well as Hellmut Lagos Koller for his support of this project.

Photo credit on cover page and pages 4, 10, 12, 14, 16, 19, 21, 25, 27, and 36: NASA. Photo credit on page 2: claudioventrella. Photo credit on pages 24, 26, 30, and 37: SpaceX. Photo credit on page 17: Andrei Armiagov. Design and layout by Trifecta Content Studio.

About UNIDIR

UNIDIR is a voluntarily funded, autonomous institute within the United Nations. One of the few policy institutes worldwide focusing on disarmament, UNIDIR generates knowledge and promotes dialogue and action on disarmament and security. Based in Geneva, UNIDIR assists the international community to develop the practical, innovative ideas needed to find solutions to critical security problems.

About Secure World Foundation

Secure World Foundation is a private operating foundation dedicated to the secure and sustainable use of space for the benefit of Earth and all its peoples. It works with governments, industry, international organizations, and civil society to develop and promote ideas and action to achieve the secure, sustainable, and peaceful uses of outer space.

Note

Citation

Almudena Azcárate Ortega & Victoria Samson (Eds.) 2023, “A Lexicon for Outer Space Security”, UNIDIR, Geneva. https://doi.org/10.37559/WMD/23/Space/05.

Contents

CONTRIBUTORS 8

FOREWORD 11

INTRODUCTION 12

Methods 13
Structure 14

1. ACRONYMS 15

2. COMMON DEFINITIONS 17

2.1 Space Objects 17
2.1.1 Payload 17
2.1.2 Satellite 17
2.1.3 Spacecraft 17
2.1.4 Space Launch Vehicle (SLV) 18
2.1.5 Space Debris 18
2.1.6 Space Object 18
2.1.7 Space Vehicle 18
2.2 Space Orbits And Locations 19
2.2.1 Cislunar Space 19
2.2.2 Deep Space 19
2.2.3 Geostationary Orbit (GEO) 19
2.2.4 Graveyard Orbit 19
2.2.5 Geosynchronous Orbit (GSO) 20
2.2.6 Low Earth Orbit (LEO) 20
2.2.7 Medium Earth Orbit (MEO) 20
2.2.8 Molniya Orbit 20
2.2.9 Polar Orbit 21
2.2.10 Sun-Synchronous Orbit (SSO) 21
2.3 Space Services And Activities 21
2.3.1 Earth Observation (EO) 21
2.3.2 Global Navigation Satellite System (GNSS) 22
2.3.3 Positioning, Navigation And Timing (PNT) 22

2.3.4 Remote Sensing 22
2.3.5 Rendezvous And Proximity Operations (RPO) 22
2.3.6 Satellite Servicing 23
2.3.7 Space Domain Awareness (SDA) 23
2.3.8 Space Situational Awareness (SSA) 23
2.3.9 Space Activities 23
2.3.10 Space Surveillance And Tracking (SST) 24
2.3.11 Space Traffic Management (STM) 24
2.4 Space System Components 25
2.4.1 Data Links / Link Segment 25
2.4.2 Ground Segment 25
2.4.3 Space Segment 25
2.4.4 Space System 25

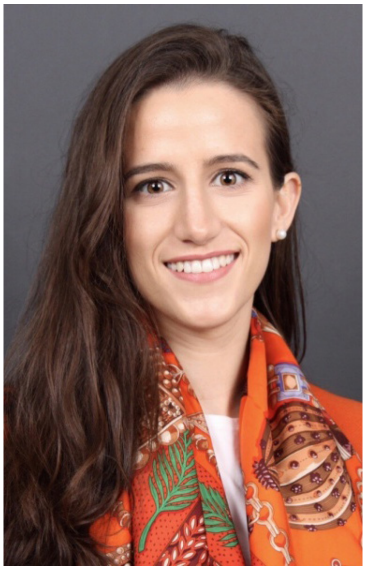
3 TERMINOLOGY USED IN SPACE POLICY DISCUSSIONS 26

3.1 Counterspace Capabilities 27
3.1.1 Anti-Satellite (ASAT) 27
3.1.2 Counterspace Capabilities 28
3.1.3 Electronic / Electromagnetic Counterspace Capabilities 28
3.1.4 Cyber Counterspace Capabilities 28
3.1.5 Kinetic Physical / Hard-Kill 29
3.1.6 Non-Kinetic / Soft-Kill 30
3.1.7 Non-Kinetic Physical 30
3.2 Principles & Concepts Of United Nations Space Treaties 30
3.2.1 Due Diligence 30
3.2.2 Due Regard 31
3.2.3 Exploration And Use Of Space As The Province Of All [Hu]Mankind 31
3.2.4 Harmful Contamination 32
3.2.5 Harmful Interference 32
3.2.6 Liability 33
3.2.7 Outer Space (Delimitation) 34
3.2.8 Peaceful Use And Exploration Of Outer Space / Peaceful Purposes 34
3.2.9 Registration 35
3.2.10 Responsibility 36
3.3 Space Policy Discussions (Misc.) 37
3.3.1 Critical Infrastructure 37
3.3.2 Dual-Use 37
3.3.3 Militarization / Military Use Of Outer Space 38
3.3.4 Monitoring 38
3.3.5 Reverberating Effects 39
3.3.6 Risk 39

3.3.7 Space Safety 39
3.3.8 Space Security 40
3.3.9 Space Sustainability 40
3.3.10 Space Weapon 40
3.3.11 Threat 41
3.3.12 Verification 41
3.3.13 Weaponization Of Outer Space 41

Contributors

EDITORS



ALMUDENA AZCÁRATE ORTEGA

is a Researcher in the Space Security and WMD Programmes at the United Nations Institute for Disarmament Research (UNIDIR). Prior to joining UNIDIR, Almudena was a Research Assistant at Georgetown University Law Center, where she is currently an S.J.D. (Ph.D. equivalent) candidate. She also holds an LL.M. in National Security Law from the same institution, where she was the recipient of Georgetown's Thomas Bradbury Chetwood, S.J. Prize for the most distinguished academic performance in the programme. Almudena received her LL.B. from the University of Navarra. She is admitted to practice law in Spain, and prior to her studies at Georgetown, she was a practicing attorney at Spanish law firm Uría Menéndez, where she specialized in international arbitration and litigation.

VICTORIA SAMSON

is the Washington Office Director for Secure World Foundation and has 25 years of experience in military space and security issues. Before joining SWF, Ms. Samson served as a Senior Analyst for the Center for Defense Information (CDI), where she conducted analysis and media commentary on space and security topics. Prior to her time at CDI, Ms. Samson was the Senior Policy Associate at the Coalition to Reduce Nuclear Dangers, a consortium of arms control groups in the Washington, D.C. area, where she worked on issues dealing with ballistic missile defence and nuclear weapons reductions. Before that, she was a researcher at Riverside Research Institute, where she worked on war-gaming scenarios for the Missile Defense Agency's Directorate of Intelligence.

Major contributions to the text and the development of this publication were made by a committee of geographically representative and linguistically diverse independent experts:

- **Laetitia CESARI**, External Consultant, UNIDIR
- **Anuradha DAMALE-DAY**, PhD researcher on 'Responsibility in Outer Space' - Third Nuclear Age Project at the University of Leicester; Independent Consultant
- **Sarah ERICKSON**, Research Assistant, Space Security Programme, UNIDIR
- **Xavier PASCO**, Director, Fondation pour la recherche stratégique
- **Daniel PORRAS**, Director of Space Sustainability Policy, Rogue Space Systems
- **Rajeswari RAJAGOPALAN**, Director of the Centre for Security, Strategy and Technology, Observer Research Foundation
- **James REVILL**, Head of Programme, Space Security Programme, UNIDIR
- **Sami SHIHADEH**, MA in Non-Proliferation and Terrorism Studies
- **Cassandra STEER**, Deputy Director (Research), Australian National University Institute for Space; Chair, Australian Centre for Space Governance
- **Dmitry STEFANOVICH**, Research Fellow, Primakov National Research Institute of World Economy and International Relations (IMEMO), Russian Academy of Sciences
- **Guoyu WANG**, Associate Professor and Dean of the Academy of Air, Space Policy and Law, Beijing Institute of Technology; Founder, Beijing HarmonizeSpace Consultancy

Valuable suggestions and review inputs were also provided by the following peer reviewers:

- Phillippa Biggs
- Veronique Glaude
- Niklas Hedman
- Michael Spies
- Alexandre Vallet
- Wen Zhou

Foreword

Hellmut Lagos Koller,
Chair of the United Nations Open-ended working group on reducing space threats through norms, rules and principles of responsible behaviours

“Without any doubt, we are witnessing a growing awareness of the importance of addressing threats and risks that may affect activities in space that are vital for the development of States and the wellbeing of their citizens, regardless of the level of the specific space programmes and national capabilities.

In the last couple of years, this concern has gradually mobilized government, academia, industry representatives and scientists and helped to ignite a number of discussions and diplomatic processes on space safety, security and sustainability. In these debates, and in particular in the sessions of the Open-Ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours (OEWG), it became evident that several of the specific terms used in the multilateral field are understood in different ways, and that in some cases, different terms are used to describe the same concept.

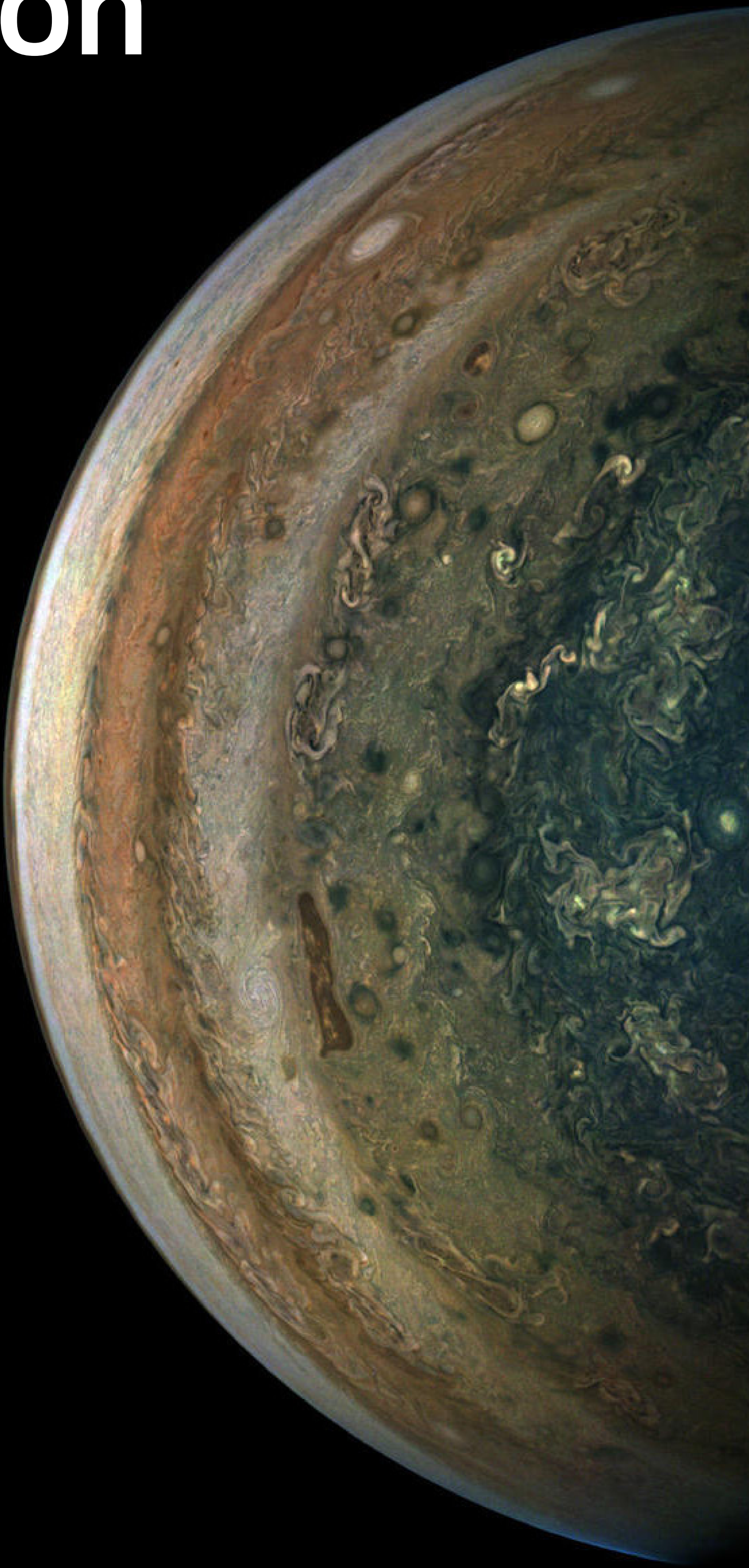
This dissimilarity does not only stem from the diverse disciplines that are involved in the discussions, but also from linguistical distinctions and different legal traditions, which have been acknowledged by several delegations during the discussions of the OEWG. It is no exaggeration to say that this absence of a common understanding around frequently used terminology constitutes an additional challenge to the difficult goal of making concrete progress in the debates on space security.

Certainly, this situation needs to be addressed adequately, in order to prevent misunderstandings and unnecessary difficulties in the discussions. This challenge can also be seized as an opportunity to seek the compatibility and even explore the possible complementarity among these different terminologies, and thereby pursue a commonly accepted glossary of terms related to space security.

Therefore, I am convinced that this Lexicon, developed by UNIDIR and the Secure World Foundation, with the valuable support of the Government of the Republic of Korea, can significantly contribute to the establishment of that missing common understanding. This initiative will also significantly help make space security debates more accessible to all by presenting explanations of what different actors mean when they use the terminology highlighted in the Lexicon, as well as raising the consciousness of the international community on the existence of different interpretations to encourage a more constructive discussion.

This effort will certainly be appreciated by all participants, both from governmental and non-governmental entities, as it can facilitate a shared understanding of the main space security topics and terms, by consolidating those terminological issues in an accessible global reference point. This will also be an invaluable tool for having a more inclusive multilateral discussion, in the OEWG process as well as in following debates in the international community tasked with advancing the common goal of preserving a peaceful, safe, secure, and sustainable outer space for the benefit and wellbeing of all humankind.”

Introduction



Introduction

One challenge to advancing space security is the absence of common understandings of frequently used terminology. To facilitate shared understandings of key topics and terms, the United Nations Institute for Disarmament Research (UNIDIR) and Secure World Foundation (SWF) have developed this Lexicon for Outer Space Security.

The Lexicon aims to serve as an accessible global reference point for terminological issues related to space security. To this end, every effort has been made to provide concise and concrete definitions. However, diverging perspectives on key terms are presented in the Lexicon where necessary to reflect different interpretations of space security terminology.

The Lexicon for Space Security is an evolving project. New terminology will be added in the future as the space landscape evolves.

This first edition of the Space Security Lexicon is generously funded by the Republic of Korea.

METHODS

The editors of the Lexicon, Almudena Azcárate Ortega and Victoria Samson, developed the list of terms to be included in the first edition of the Lexicon drawing from salient terms used in space security discourse at the multilateral level. The selection of terms was carried out after having analysed United Nations Member States statements and documents submitted to multiple multilateral fora. Initial analysis of English language documents was carried out, followed by subsequent analyses of documents in other United Nations languages where appropriate, to ascertain the use of terminology in the original languages of the relevant UN Member States. Through this exercise, the editors established a list of (i) commonly used acronyms; (ii) frequently used common terms; and (iii) terminology frequently used by States in space policy discussions that could benefit from further clarification to achieve a common understanding.

Subsequently, the selection of terms and their definitions were further developed through a geographically representative and linguistically diverse committee of 11 internationally recognized space and disarmament experts.

Through a series of online workshops and correspondences, the group reached agreement on both the selection of terms and definitions. The final draft was subsequently reviewed by external peer reviewers. English was the working language of the group through the development of this first edition of the Space Security Lexicon; however, the experts discussed and highlighted multiple linguistic differences of relevance.

Versions in all United Nations languages will be created, using the English version as a basis, and checked for consistency. Versions in other languages will not necessarily be exact translations of the present English version, as they will highlight important linguistic differences relevant to each individual language.

Where applicable, the Space Security Lexicon does not aim to impose interpretations of terminology, or otherwise determine how these terms should be defined, but rather seeks to highlight that the terminology contained herein can be interpreted in different manners. The goal is to facilitate international discussions on space security-related matters by identifying different definitions and interpretations (where relevant); it is hoped that this Lexicon will serve to enhance transparency and reduce potential misunderstandings. The Space Security Lexicon is an evolving project, and the list of terms contained herein does not seek to be exhaustive. UNIDIR will consider user feedback to add to the current list, and to improve and refine the existing definitions particularly as the user community evolves.

STRUCTURE

The terms selected to feature in the first edition of the Lexicon are divided into three main groups:

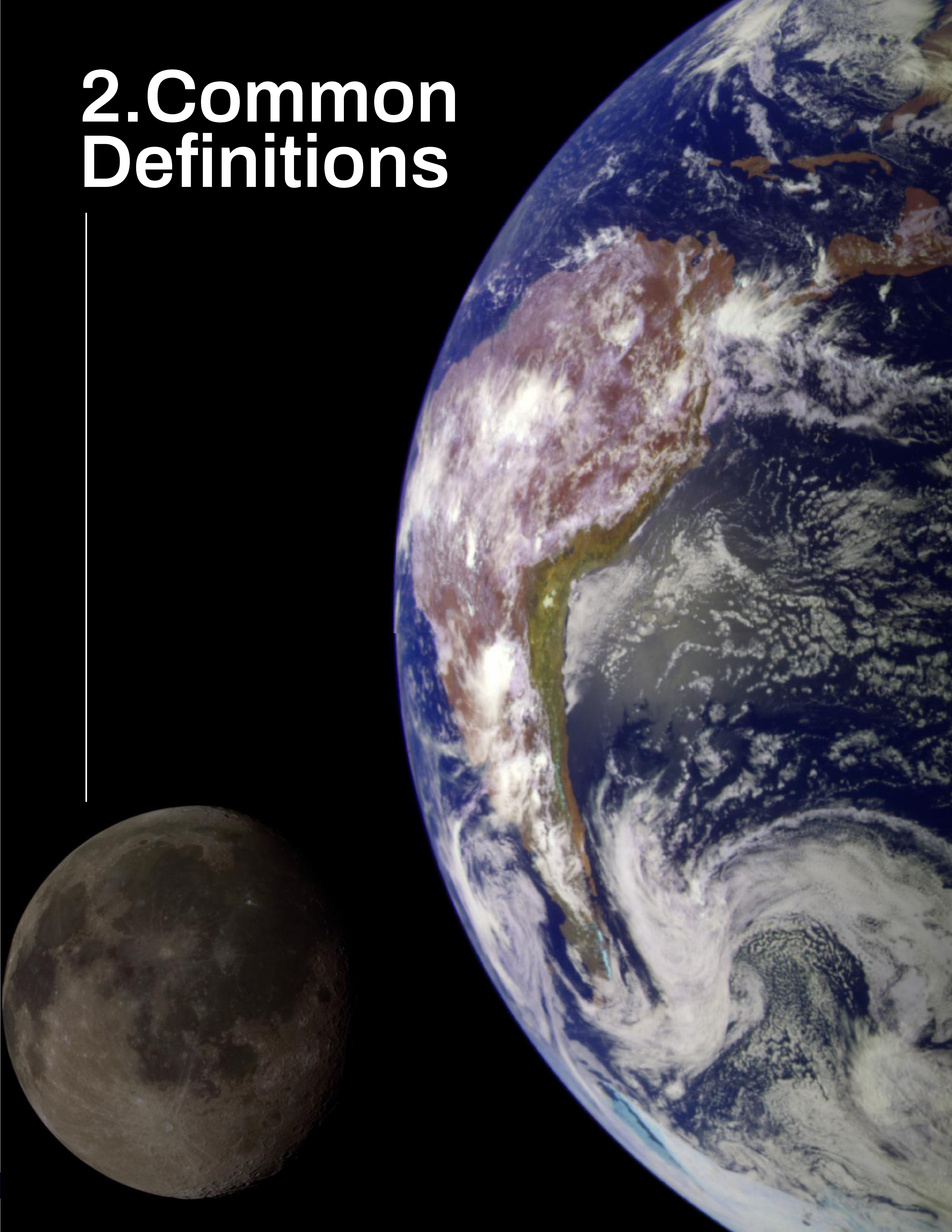
1. **Acronyms** commonly used in space security. The full names and different interpretations of several of these terms is further expanded on in sections 2 and 3.
2. **Common definitions** of frequently used concepts and acronyms in space security to facilitate a broad understanding of what can sometimes be a technical topic.
3. A selection of **terminology frequently used by States in space policy discussions** that could benefit from further clarification to achieve a common understanding.

Groups 2 and 3 have been subdivided into subcategories for increased clarity. All terms are ordered alphabetically within their own groups and subcategories. When a definition includes a term that is defined elsewhere in the Lexicon, a cross-reference is included.

1. Acronyms

ADR	Active debris removal
ASAT	Anti-satellite
COPUOS	Committee for the Peaceful Uses of Outer Space
EO	Earth observation
ESG	Environmental, social, and governance
GEO	Geostationary orbit or geosynchronous equatorial orbit
GGE	Group of Governmental Experts
GLONASS	Global'naya Navigatsionnaya Sputnikovaya Sistema (Global Orbiting Navigation Satellite System)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSO	Geosynchronous orbit
IOS	In-orbit servicing
ISAM	In-space servicing, assembly and manufacturing
ITU	International Telecommunication Union
LEO	Low Earth orbit
MEO	Medium Earth orbit
NavIC	Navigation with Indian Constellation
OEWG	Open-ended Working Group
OOS	On-orbit servicing
OSAM	On-orbit servicing, assembly and manufacturing
OST	Outer Space Treaty
PAROS	Prevention of an arms race in outer space
PNT	Positioning, navigation and timing
PPWT	Draft treaty on the prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects
RPO	Rendezvous and proximity operations
SDA	Space domain awareness
SLV	Space launch vehicle
SSA	Space situational awareness
SSO	Sun-synchronous orbit
SST	Space surveillance and tracking
STM	Space traffic management
TCBM	Transparency and confidence-building measure

2.Common Definitions



2.Common Definitions

This section contains common definitions of frequently used concepts in space security to facilitate a broad understanding of what can sometimes be a technical topic. Subsections are displayed alphabetically, as are the terms within each subsection.

2.1 SPACE OBJECTS

2.1.1. Payload

Payload refers to the elements or parts of the **spacecraft** that perform the desired functions of the **space object**. It can also refer to the cargo of the **space vehicle**, which can be, for example, humans headed for the International Space Station (ISS), or a **satellite**.

2.1.2. Satellite

A body, either natural or artificial, which orbits another body in space. Artificial satellites are placed in orbit around planets for many purposes, including collecting information, navigation, or communication. Natural satellites are celestial bodies that orbit planets, other celestial bodies or stars.

2.1.3 Spacecraft

A human-made vehicle or machine designed to operate, with or without a crew, beyond the major portion of the Earth's atmosphere, in outer space. The nature, complexity, and capabilities of spacecraft are diverse. Spacecraft can operate in Earth's orbit or beyond it. Sometimes used as a synonym for **space vehicle**, the term 'spacecraft' however is generally understood to be less specific than the term 'space vehicle', and to refer to any human-made machine designed to operate in space.

2.1.4 Space Launch Vehicle (SLV)

A space launch vehicle is a rocket-propelled vehicle that is used to carry **payloads** from Earth's surface to space, usually to Earth orbit or beyond. Concerns have been raised regarding the similarities between SLVs and ballistic missiles, and in fact some States developed their SLVs from ballistic missile technology, while others have used elements of SLV programmes to develop ballistic missiles. While these technologies are similar, they also have some key differences, such as their propellants, guidance systems or their use of re-entry vehicles.

A space launch vehicle is different from a **space vehicle**. The former is used to carry payloads to space, whereas the latter is used to transport those payloads in space or on celestial bodies.

2.1.5 Space Debris

Also known as space junk or space waste, this term encompasses both natural meteoroid and artificial (human-made) orbital debris. Human-made debris is also known as 'orbital debris', as it is found orbiting the Earth. Orbital debris refers to any human-made object that no longer serves a useful function that was previously in orbit, including non-functional **spacecraft**, expended launch vehicle stages, mission-related debris, and fragmentation debris from kinetic counterspace activities.

2.1.6 Space Object

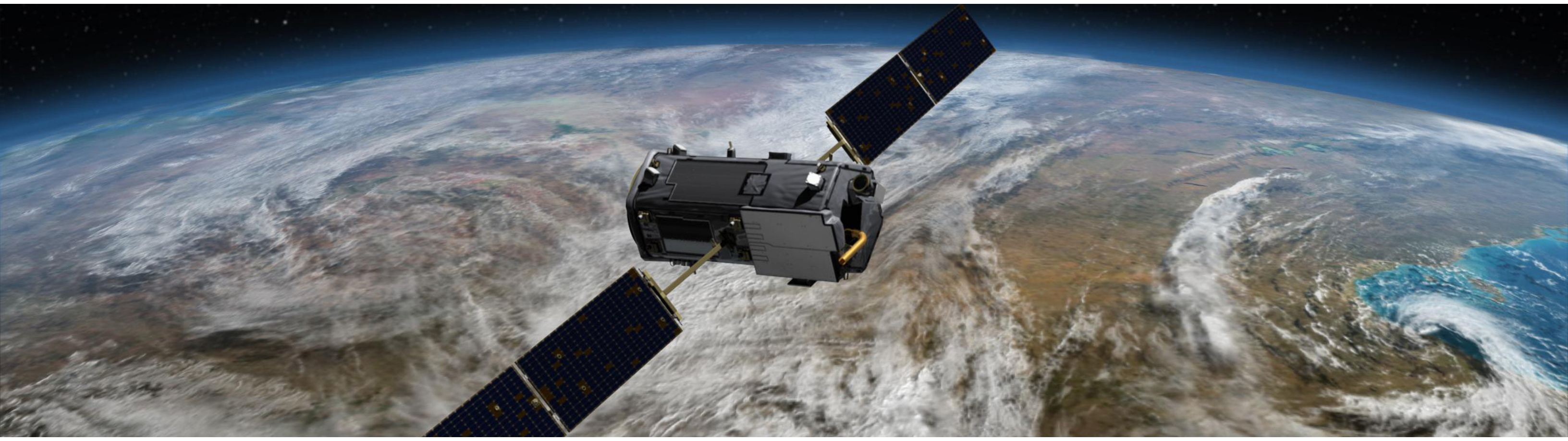
Space object refers to any object launched into orbit from the Earth, the Moon, or other celestial bodies to travel to, in or through outer space. The term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof (see Liability Convention, article I.d). It should not be confused with **space systems**, which also include segments not located in space.

2.1.7 Space Vehicle

Space vehicle refers to a spacecraft that is used to transport crew or a separate **payload** in space, as well as on celestial bodies. A space vehicle is different from a **space launch vehicle**, as the former is used to transport payloads in space and on celestial bodies, whereas the latter is used to carry those payloads into space.

Sometimes the term 'space vehicle' used as a synonym for '**spacecraft**', however it is generally understood that space vehicle is a more specific term, used for **space objects** that transport payloads, whereas spacecraft refers to any human-made machine designed to operate in space.

2.2 SPACE ORBITS AND LOCATIONS



2.2.1 Cislunar Space

The region of space that exists between the Earth and the Moon, including the Moon's own orbit.

2.2.2 Deep Space

Deep space generally refers to areas beyond Earth's orbit and **cislunar space**, specifically space at distances from the Earth equal to, or greater than, 2 × 106 km, although some definitions also consider the Moon to be part of deep space.

2.2.3 Geostationary Orbit (GEO)

Geostationary orbit is a specific **geosynchronous orbit (GSO)**, whose circular and direct orbit lies in the plane of the Earth's equator which differentiates it from other GSOs, where **satellites** can have any inclination. Satellites in this orbit revolve around Earth, above the equator from west to east, at the same rate as the Earth rotates. This makes them appear stationary above Earth. GEO satellites are placed at an altitude of approximately 35,786 km (22,236.39 miles). Telecommunications satellites are commonly found in this orbit. Weather satellites are also found in this orbit for real-time imagery and data collection of the Earth's surface and atmosphere for observation, oceanography, and atmospheric tracking. Moreover, navigation satellites in this orbit provide a known calibration point which serves to enhance **GNSS** accuracy.

2.2.4 Graveyard Orbit

Graveyard orbit, also called a junk orbit or disposal orbit, refers to orbits located above operational orbits (particularly beyond **GEO**), where **satellites** that are no longer operational are moved to reduce the probability of collisions with operational **space objects** and avoid the creation of **space debris**.

2.2.5 Geosynchronous Orbit (GSO)

Geosynchronous orbit synchronizes with the rotation of the Earth and has an orbital period that matches one sidereal day (23 hours, 56 minutes, and 4 seconds). GSO **satellites** are placed at an altitude of approximately 35,786 km (22,236.39 miles) and have a period of revolution that is equal to the period of rotation of the Earth around its axis. Telecommunications satellites —particularly broadcast TV and low-speed data communication— are commonly found in this orbit. Similarly, weather satellites can also be found in this orbit. **GEO** orbit is a specific type of GSO that lies on the same plane as the equator. In other GSOs, satellites can have any inclination.

2.2.6 Low Earth Orbit (LEO)

Low Earth orbit refers to the area situated closest to the Earth, below **GEO** and MEO. **Satellites** in LEO are located at an altitude of less than 2,000 km but could be as low as 80 km above Earth according to some experts (although there is some contention over whether a satellite can be considered to be in LEO at that low of an altitude). LEO satellites can be inserted into any plane bisecting the equator, meaning their orbit can be tilted relative to the rotational motion of the Earth. This is the orbit that is most commonly used for satellite imaging of Earth, due to its proximity to the surface of the Earth, which allows for higher resolution images. Certain communications satellites are also placed in this orbit; in fact, LEO is the orbit where very large constellations of satellites are being launched to provide Internet on Earth, and is the orbit where all of the **kinetic anti-satellite (ASAT)** tests have been held. It is also the orbit where the International Space Station (ISS) and the Tiangong Space Station are located.

2.2.7 Medium Earth Orbit (MEO)

Medium Earth orbit refers to the area situated between **LEO** and **GEO**. As with LEO, **satellites** located in MEO do not have to have a specific inclination. Navigation satellites are commonly found in this orbit, generally at an altitude of around 20,000 km. MEO is also used for **GNSS** and navigation applications. There are also certain constellations or satellite networks that can be found in MEO which deliver low-latency and high-bandwidth (high-speed) data connectivity This is useful to provide optic fibre-like performance to remote areas, where laying fibre is not possible, such as cruise, commercial maritime, aero, offshore platforms, network backhaul in difficult terrain, and humanitarian relief operations.

2.2.8 Molniya Orbit

Molniya orbit is a highly elliptical orbit named after the Molniya communication **satellites** used by the Soviet Union and, later, the Russian Federation. This orbit is used to provide communication and **remote sensing** services to high latitude areas in the northern hemisphere. The Molniya orbit has an inclination of 63.4 degrees, an argument of perigee —the angle between the point on the orbital path where an object crosses the equator and the point of its closest approach to the Earth— of 270 degrees, and an orbital period of approximately half a sidereal day.

2.2.9 Polar Orbit

Polar orbit passes over the Earth's polar regions, from north to south. Any orbit that passes within 20 to 30 degrees of the poles is considered to be a polar orbit. Polar orbits are used for reconnaissance and **Earth observation**.

2.2.10 Sun-Synchronous Orbit (SSO)

Sun-synchronous orbit, also known as heliosynchronous orbit, it is a specific kind of **polar orbit**. **Satellites** in this orbit are synchronous with the Sun, meaning that they pass over the same area of Earth at the same solar time, in a fixed position relative to the Sun.

2.3 SPACE SERVICES AND ACTIVITIES

2.3.1 Earth Observation (EO)

Earth observation is a form of **remote sensing** consisting in the gathering of information about Earth's physical, chemical, and biological systems through different forms of **satellite** imaging. Earth observation is used to monitor and assess the status of, and changes in, the natural and human-made environment, and has a growing number of applications including monitoring of infrastructure and the environment (for example, atmospheric gases, pollution, polar ice caps and sea level), urban planning, and damage assessment in conflict zones or after natural disasters, among others.

2.3.2 Global Navigation Satellite System (GNSS)

Global Navigation Satellite System refers generically to a network of **satellite** and ground stations used for **navigation**, through linking **positioning** and **timing** data, which can help to determine a location on the ground, in flight, or in space. Satellites transmit the positioning and timing data to GNSS receivers, which then use this data to determine location. There are several GNSS systems, including China's BeiDou, Europe's Galileo, the Russian Federation's GLONASS (Global'naya Navigatsionnaya Sputnikovaya Sistema), and the United States' GPS (Global Positioning System). GNSS can provide global coverage or service a particular region.

2.3.3 Positioning, Navigation And Timing (PNT)

Three distinct capabilities enabled by **space systems** which can be used separately or jointly. They are commonly used together to enable services such as **GNSS**.

- **Positioning** refers to the ability to accurately and precisely determine location and orientation. It is mostly done in two-dimensions, but can be done three-dimensionally as well.
- **Navigation** refers to the ability to determine the current and desired position of an object or person and determine corrections to course, orientation, and speed to attain a desired position anywhere around the world, from sub-surface to surface and from surface to space.
- **Timing** refers to the ability to acquire and maintain accurate and precise time from a standard (Coordinated Universal Time, or UTC), anywhere in the world and within user-defined timeliness parameters.

2.3.4 Remote Sensing

Remote sensing is the process of obtaining data about an area or object by detecting and monitoring its physical characteristics without making physical contact with it, but rather at a distance through the measurement of its reflected and emitted radiation (from a **satellite**, although it can also be done from an aircraft). This can be achieved using sensor technologies and can be active or passive:

- Active remote sensing wherein a signal is emitted by a satellite or aircraft to the object or area being monitored and its reflection is detected by the sensor.
- Passive remote sensing measures energy that already exists, like sunlight, instead of emitting energy.
- **Earth observation** is one form of remote sensing.

2.3.5 Rendezvous And Proximity Operations (RPO)

Rendezvous and proximity operations are usually mentioned together, but they are two separate concepts.

- Rendezvous operations refer to the exercise two (or more) **space objects** carry out to manoeuvre in order to approach one another in a way that makes their orbital trajectory, plane, altitude, and phasing match. This places them very close to one another, usually to eventually join through docking —the joining of two free-flying objects— or berthing —the joining of two objects with the assistance of a robotic arm.

- Proximity operations refer to the manoeuvring of a space object to place and maintain it in the vicinity of another space object on a relative planned path for a specific time duration to accomplish mission objectives.

2.3.6 Satellite Servicing

Satellite servicing refers to the act of performing technological upgrades, repairs, refuelling, and/or inspections of **satellites** currently in orbit. Such activities require the ability to undertake a **rendezvous and proximity operation (RPO)**. Acronyms used to refer to this practice include: ISAM (in-space servicing, assembly and manufacturing), OOS (on-orbit servicing), OSAM (on-orbit servicing, assembly and manufacturing), and IOS (in-orbit servicing).

2.3.7 Space Domain Awareness (SDA)

Space domain awareness refers to the capability of tracking and characterizing **space objects** within the space domain —in particular, Earth's orbits— through the use of multiple **space situational awareness (SSA)** activities as well as consideration and assessment of the intent of actors, space policies, and strategies. Some use the term 'space domain awareness' (SDA) to refer to space situational awareness (SSA) when SSA is used in a military context. Others make a distinction between the two, and understand SSA as related to specific tasks, missions or objectives, whereas SDA takes a holistic approach and includes all the means available to the actor, including SSA's technical data but also assessment of intent, and awareness of activities, space policies, and strategies, and other means of analysis and understanding the behaviour and intent of other actors.

2.3.8 Space Situational Awareness (SSA)

Space situational awareness refers to the capability or practice of tracking and characterizing specific **space objects** and their operational environment in order to understand their current position, as well as to predict their future positions. SSA data can aid in identifying future conjunctions between objects and notifying space operators of potentially dangerous close approaches to enable them to carry out collision avoidance operations. SSA can be used for civil as well as military applications. Some use the term '**space domain awareness (SDA)** to refer to space situational awareness (SSA) when SSA is used in a military context. There are others that make a distinction between the two, and understand SSA as related to specific tasks, missions or objectives, whereas SDA takes a holistic approach and includes all the means available to the actor, including SSA's technical data but also assessment of intent, and awareness of activities, space policies, and strategies, and other means of analysis and understanding the behaviour and intent of other actors.

2.3.9 Space Activities

Space activities refers to operations and acts directly related to the exploration and use of outer space, including the Moon, other celestial bodies, and **deep space**, including, but not limited to scientific space research; the use of space technology for communications, television and radio broadcasting; Earth **remote sensing** from space, including State environmental sensing and meteorology; use of satellite navigation and surveying systems; crewed space flights; use of space equipment, space materials and space technologies in the interests of defence and security; observation of objects and phenomena in outer space; testing of equipment in space conditions; production of materials and other products in space; creation (including development, manufacturing and testing) and use (operation) of space equipment, space materials and space technologies and the provision of other services related to space activities; as well as the use of the results of space activities and international cooperation in the exploration and use of outer space.

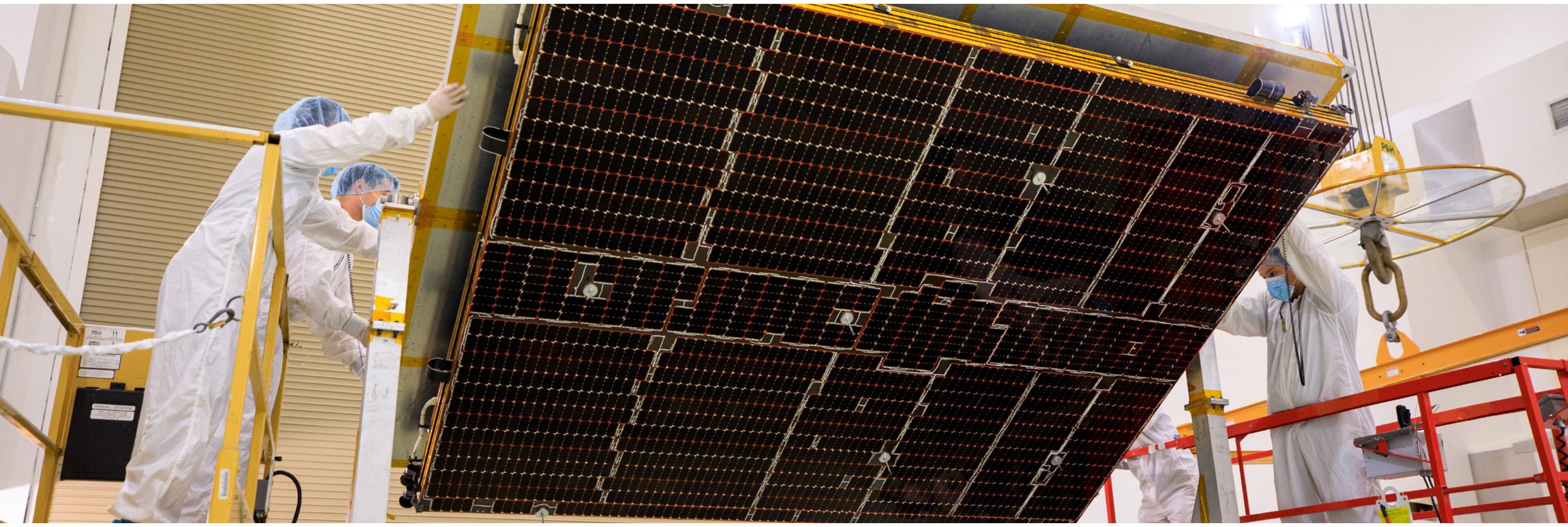
2.3.10 Space Surveillance And Tracking (SST)

Space surveillance and tracking refers to the use of sensor technology, including radars, telescopes, laser-ranging stations, and data centres, for the purposes of finding and tracking **space debris** and issuing alerts when evasive action may be necessary. A space surveillance and tracking system detects space debris, catalogues debris objects, and determines and predicts their orbits. It is considered to be a segment of **SSA** technology use specifically focused on debris identification and **monitoring**.

2.3.11 Space Traffic Management (STM)

Space traffic management refers to a series of technical and regulatory provisions and also, according to some actors, the common or customary operational practices, for promoting safe access to outer space, the conduct of operations in outer space, and the return of **space objects** from outer space in a manner that is safe, secure, and sustainable. It requires coordination among space actors as well as accurate **SSA** data.

2.4 SPACE SYSTEM COMPONENTS



2.4.1 Data Links / Link Segment

Data links refers to the connection that shares information between the space and **ground segments** of a **space system**. This includes the uplinks and downlinks, as well as services provided to the end users.

2.4.2 Ground Segment

Ground segment refers to the terrestrial part of a **space system**, which includes all the facilities and elements needed to operate a **space object** and deliver services to users. Examples of ground segment components include satellite dishes and receiving stations.

2.4.3 Space Segment

Space segment refers to **space objects**, which can be described as any object launched into orbit from the Earth, the Moon, or other celestial bodies to travel to, in or through outer space. The term 'space segment' includes component parts of a space object as well as its launch vehicle and parts thereof. Examples of space segment components are **satellites** and **space launch vehicles**.

2.4.4 Space System

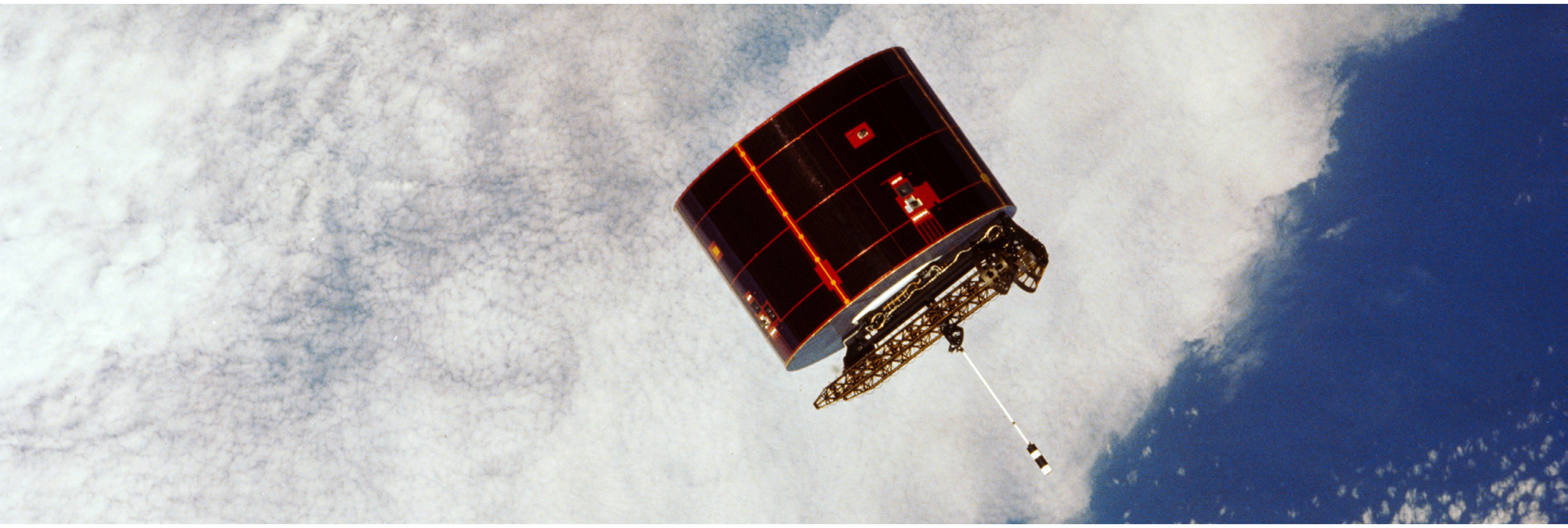
Space system refers to all the devices, components and infrastructure that work together to perform a task involving the space environment. This is an evolving concept, which has been used as a synonym of **space objects**, and nowadays it is increasingly understood by most States and other stakeholders that not all of the components have to be located in space in order for them to be considered part of a space system. The different components of space systems are generally classified into three different groups, any of which can be interfered with and hamper **space security**: **space segment**, **ground segment**, and **data links**.

3. Terminology Used In Space Policy Discussions

3. Terminology Used In Space Policy Discussions

This section contains a selection of terminology frequently used by States in space policy discussions that could benefit from further clarification to achieve a common understanding. The explanations below do not intend to offer only one possible definition, but rather to illustrate different interpretations of the terminology. When employing the below terminology, the user should indicate the intended meaning being attributed to the term in order to foster clarity and reduce misunderstanding. Subsections are displayed alphabetically, as are the terms within each subsection.

3.1 COUNTERSPACE CAPABILITIES



3.1.1 Anti-Satellite (ASAT)

Anti-satellite is often used as a synonym of **counterspace capabilities**, but it is more commonly understood to refer to a subset of counterspace technology, as it focuses on targeting one component of **space systems** (the **satellite**). While most consider ASATs to refer to any form of counterspace capability that targets the **space segment** of a system, there are some that use this term to refer only to kinetic or destructive (hard-kill) counterspace capabilities.

3.1.2 Counterspace Capabilities

Counterspace capabilities refers to capabilities, techniques, or assets that can be used against another **space object** or a component of a **space system** in order to deliberately deny, disrupt, degrade, damage or destroy it reversibly or irreversibly, so as to gain advantage over an adversary. Counterspace technologies or capabilities can be offensive and defensive, and can be further classified into different groups including **kinetic physical**, **non-kinetic physical**, **electronic**, and **cyber**. This is not a closed list, nor are these terms universally used by all States, and there are some lists that include other categories.[1] Another common classification is the division into **hard-kill** (which generally refers to physical hostile operations —especially those that use kinetic force— that result in the destruction of space objects), and **soft-kill** counterspace technologies (which refers to non-physical interference that renders space assets impaired, ineffective, or inactive). Neither of these terms, nor their definitions, are universally accepted or used.

3.1.3 Electronic / Electromagnetic Counterspace Capabilities

Electronic counterspace technologies, sometimes also known as electromagnetic technologies, can target the electromagnetic spectrum used by **space systems** to transmit and receive data, causing **harmful interference**.

- Jammers generate noise on 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 is used to trick the system into believing a fake signal produced by a hostile party, thus enabling the hostile party to insert false information into the system including, but not limited to, false data or false commands which can disrupt operations or cause any of the components of a space system to act in a way other than how it was intended.

Hostile operations using these technologies are generally reversible, and are difficult to attribute to a perpetrator.

3.1.4 Cyber Counterspace Capabilities

These technologies can target data and the systems that use, transmit, and control the flow of data. Information and communication technologies can be used to target **satellites** as well as ground stations or even end-user components, such as modems, with the objective of interfering with services (such as Internet coverage), intercepting information, or inserting false or corrupt data into a system. Hostile operations that use cyber means or methods are generally reversible; however, a malicious or hostile operation that targets the command and control system of a satellite could render it inoperable in an irreversible way, as the hostile party could cause a stoppage of the satellite's functions permanently, and cause it to waste its fuel or damage its sensors. Such a step could have a large impact radius and potentially affect **critical infrastructure**. The use of information and communication technologies against **space systems** can be conducted in a

1. For other terms used to refer to these capabilities, see Report of the Secretary-General A/76/77, on Reducing space threats through norms, rules and principles of responsible behaviours (13 Jul. 2021), https://undocs.org/en/A/76/77.

relatively cheap manner, compared to other **counterspace capabilities**. Cyber counterspace capabilities can be difficult to predict, detect, and attribute.

3.1.5 Kinetic Physical / Hard-Kill

Also known as simply ‘kinetic’, or ‘kinetic impactors’, these technologies can be used to strike a **space system** component directly or to detonate a warhead near it. Although most deem kinetic and hard-kill to be synonyms, there are some that consider the former to refer solely to those capabilities dependent on the destructive power generated by their motion and interception trajectory, instead of an explosive. Hard-kill, on the other hand, is a broader term that comprises kinetic physical capabilities, but also includes the aforementioned explosive **payloads**. Kinetic physical capabilities are sometimes referred to as hit-to-kill. It should be noted that official United Nations nomenclature does not use the terms ‘kinetic physical’ or ‘hard-kill’.[2]

A kinetic physical or hard-kill hostile act can be carried out in different manners:

- **Direct-ascent ASATs** are launched from the Earth (ground, sea, or air) to place a kinetic kill vehicle on a ballistic trajectory through space. Once the kinetic kill vehicle has separated from the launch vehicle, it tracks the targeted **space object** to strike it in a hypervelocity collision.
- **Co-orbital ASATs** place an interceptor into orbit, which is then manoeuvred using a **rendezvous and proximity operation (RPO)** to situate it close to its target. This manoeuvre does not necessarily take place immediately after the object is put in orbit and the co-orbital ASAT can remain dormant for some time. **Satellites** used as weapons by causing them to collide with another satellite, or the employment of projectiles by satellites, are also considered co-orbital ASATs, even if they are repurposed for this function despite having been designed for a benign and non-weapons-related application that is in line with the peaceful purposes principle. A kinetic co-orbital ASAT can damage or destroy its target through a direct collision, detonation in close proximity to the target to create shrapnel, the release of fragments that would collide with the target, or the use of a robotic arm to damage or disable the target. Certain concepts for co-orbital ASATs may employ various means or methods including, but not limited to, explosive fragmentation, harpoons, nets, chemical sprayers or adhesives.
- **Ground station** hostile actions consist of the targeting of sites located on Earth which are responsible for the command and control of a **satellite**, or the relay of satellite data.

The use of kinetic counterspace technologies is likely to cause irreversible damage to the target in a manner that is relatively easy to attribute. If the target is located in orbit, the use of these technologies produces **space debris**, which can be dangerous to other **space objects** as well, and can remain in orbit for weeks, months, or even years, depending on the altitude of the strike and the mass of the target.

2. For other terms used to refer to these capabilities, see Report of the Secretary-General A/76/77, on Reducing space threats through norms, rules and principles of responsible behaviours (13 Jul. 2021), https://undocs.org/en/A/76/77.

3.1.6 Non-Kinetic / Soft-Kill

These technologies can be used to disable or destroy a **space system** or one of its components without necessitating a direct strike. They can be further classified into **non-kinetic physical**, **electronic**, and **cyber**. Soft-kill capabilities are usually hard to detect and attribute, and can be both reversible and irreversible.

3.1.7 Non-Kinetic Physical

These technologies have physical effects on **satellites** or **ground segments** without making physical contact. They include lasers, high-powered microwaves (HPM), and electromagnetic pulses (EMP). These technologies can blind or dazzle sensors or cause damage to electrical circuits and processors in a satellite. Non-kinetic physical hostile acts operate at the speed of light and, in some cases, can be less visible to third-party observers and more difficult to attribute. These acts can be reversible or irreversible.

3.2 PRINCIPLES & CONCEPTS OF UNITED NATIONS SPACE TREATIES

3.2.1 Due Diligence

Due diligence is generally understood as a duty of States to not “allow knowingly their territory to be used for acts contrary to the rights of other States”. This principle was articulated in the International Court of Justice’s Corfu Channel decision, and was a predecessor to the more general and all-encompassing idea of ‘**due regard**’. In the context of **space activities**, the principle of due diligence obliges States to observe certain conduct with respect to a particular activity, in line with the obligation enshrined in article VI of the Outer Space Treaty (OST) which mandates States to carry out “continuing supervision” of the space activities of their nationals. The concept of due diligence is used in conjunction with fault standards applicable to space activities when analysing **fault-based liability** for damages being caused elsewhere than on the surface of the Earth under article III of the Liability Convention.

3.2.2 Due Regard

Article IX of the OST establishes the obligation for States to conduct space operations with "due regard to the corresponding interests of all other States Parties". This due regard obligation is an explicit limitation on the freedom to use and explore outer space guaranteed by article I of the OST. The concept of 'due regard' is not defined in the OST, and as such there is no uniform consensus regarding its meaning. However, under other sources of international law, such as the law of the sea —which States have expressed can be adapted and applied to outer space[3] — 'due regard' means that States are bound to refrain from any acts that might adversely affect the use of a domain by other stakeholders prior to and while conducting activities in that domain. Under the due regard principle, States are obligated to take the rights of other States into account when exercising their own rights. Related to the concept of 'due regard' is the duty of States to undertake international consultations before proceeding with any activity that might cause **harmful interference** with activities of other State parties. Under article IX of the OST, other States may also request consultations if they have reason "to believe that an activity or experiment planned by another State Party in outer space [...] would cause potentially harmful interference with activities in the peaceful exploration and use of outer space" either prior to or during the performance of the space activity.

3.2.3 Exploration And Use Of Space As The Province Of All [Hu]Mankind

Article I of the Outer Space Treaty states that

> "The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.
>
> Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies."

At the time of the drafting of the OST in 1967, there were very few spacefaring States, and thus the intention of this article was to ensure that non-spacefaring States would also be able to benefit from the discoveries and use of outer space.

The OST establishes outer space as a domain that is free for exploration and use by all States, but those freedoms are not unbridled. The benefits of space exploration are to be shared on the basis of equality and non-discrimination, irrespective of whether a State is spacefaring or not. Article I of the OST should be read in conjunction with article IX, which establishes the duty of **due regard**, by which States are obligated to refrain from any acts that might adversely affect the use of outer space by other stakeholders in space prior

---

3. Chair's Summary of discussions under agenda items 5 and 6 (a) (advance unedited version) A/AC.294/2022/3, Open-ended working group on reducing space threats through norms, rules and principles of responsible behaviours (20 May 2022), https://undocs.org/en/A/AC.294/2022/3.

to and while conducting **space activities** and take the rights of other States into account when exercising their own rights.

Due to this article, outer space is often referred to as “the province of all [hu]mankind”, particularly in policy circles; however, legal experts often note that what the OST establishes as “the province of all [hu]mankind” is not outer space itself, but rather its use and exploration. This distinction has gained particular relevance in the context of determining the legal status of resource extraction.

3.2.4 Harmful Contamination

Under article IX of the OST, States are obligated to avoid the harmful contamination of space. This concept is generally understood in a broad sense, covering all possible changes of the outer space environment —unintentional or deliberate— that would result in harm to the activities of other actors. In this sense, the creation of **space debris** would be an example of a form of harmful contamination. It should be noted, however, that article IX does not specify what measures would be appropriate to avoid harmful contamination and when such measures should be adopted, that is to say, what degree or level of care is required of States to avoid harmful contamination.

Harmful contamination can also refer more specifically to adversely changing outer space and celestial bodies with contaminants from Earth. Similarly, article IX of the OST establishes the obligation of avoiding “adverse changes” to Earth’s environment through the introduction of extraterrestrial matter. Some consider harmful contamination and adverse changes to be separate legal concepts —the former referring exclusively to space and celestial bodies, and the latter referring only to Earth— however there are others that consider both of these concepts to be contained under the umbrella of harmful contamination; having distinguished between two types of contamination stakeholders should be aware of and seek to avoid:

- **Forward contamination** refers to the introduction of Earth microbes to other planets.
- **Backward contamination** refers to bringing extraterrestrial matter back to planet Earth in manner that would create “adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter”.

3.2.5 Harmful Interference

Harmful interference is generally understood to mean the external blocking or lessening of services provided by **space systems**, which can be accidental or intentional, and includes interference with any space services ranging from commercial services to critical safety-of-life applications. Article IX of the OST establishes that if a State believes that its activity or an activity of its nationals would cause “potentially harmful interference” with the activities of other States Parties, then it shall undertake “appropriate international consultations” before proceeding with the activity. Moreover, the OST gives a potentially affected State the opportunity to request consultations if it has reason to believe that another State’s activity could cause potentially harmful interference with its peaceful exploration and use of outer space. This consultations process is recognized as a prerequisite for the effective environmental protection of outer space. However, it has never been used and there is no guidance on what constitutes a consultation.

While the OST does not define the concept of harmful interference, the concept is defined in both No. 1.169 of the Radio Regulations and in No. 1003 of the ITU 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".

3.2.6 Liability

Liability generally refers to the legal obligation to compensate another for injury following an event that causes damage. The Outer Space Treaty establishes a liability obligation in article VII, by which "Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies".

There is a fundamental, substantive difference between the concept of article VI (international responsibility) and article VII (international liability). This difference can create interpretative difficulties as some languages use the same word to refer to both concepts —for example Spanish (*responsabilidad*) and French (*responsabilité*).

The liability obligation is financial or pecuniary in nature, thus entailing a duty to compensate (pay money to) another State for damages caused by its **space objects**. **Responsibility** involves a State's duty to authorize and continually supervise the activities of its nationals, and to ensure that the "national activities are carried out in conformity" with the provisions of the OST.

The Convention on International Liability for Damage Caused by Space Objects expands further on this obligation, distinguishing between two distinct types of liability:

- **Absolute liability** (article II): if a space object causes damage to an object "on the surface of the Earth or to aircraft in flight", the launching State of that space object shall be absolutely liable. Under this absolute standard, a State must compensate a victim State for damages, whether or not the launching State was at fault.
- **Fault-based liability** (article III): when there is a "damage being caused elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State", the standard is fault-based liability. To determine the existence of fault, a tribunal (or commission) applying the Convention would assess the specific facts of the case, as well as the conduct of the launching State.

A launch may involve multiple launching States and, according to the Liability Convention, each may be held jointly and severally liable for damage. Specifically, a claimant may pursue its claim against any of the launching States, each of which could be 100 per cent responsible for paying the claim. After the claimant is compensated, any division or proportion of liability among the defendant launching States could be addressed subsequently.

3.2.7 Outer Space (Delimitation)

Outer space refers to the region or expanse that exists beyond the Earth and between celestial bodies. There is no international consensus as to where airspace ends and outer space begins, particularly since these terms have not been properly defined in international law. Some experts have argued that space extends down to 100 km above sea level. This is so because at their lowest orbital point, or perigee, some **satellites** have operated at around 100 km (328,000 feet or 62 miles). This approximate altitude is known as the von Kármán line, commonly referenced as the point for air versus space demarcation and the point at which it is believed an aircraft would have to reach orbital velocity to produce enough lift to remain aloft. There are others, however, who argue that the delimitation should be lower, establishing the delimitation altitude at 80 km above sea level in order to account for suborbital **spacecraft** as well as hybrid aerospace vehicles capable of operation both in airspace and outer space.

There are currently two main schools of thought that have emerged with the objective of answering the delimitation question. On the one hand, 'spatialism' essentially argues for a fixed line, at a set altitude, for the division of airspace and outer space. On the other hand, 'functionalism' focuses on the nature of the craft in question: the applicable law will depend on the functions it serves.

It should be noted that some domestic space law definitions establish a specific delimitation for the purposes of licensing.

3.2.8 Peaceful Use And Exploration Of Outer Space / Peaceful Purposes

Under the OST, outer space shall be used for "peaceful purposes". This is stated in the non-binding preambulatory text, which states that there is a "common interest of all [hu]mankind in the progress of the exploration and use of outer space for peaceful purposes", and also in article IV, which establishes that "[t]he Moon and other celestial bodies shall be used by all State Parties to the Treaty exclusively for peaceful purposes". Although the drafters of the OST chose not to establish the use of space for peaceful purposes as a more general obligation in the text of the Treaty, it has nevertheless been posited that such concept has now achieved the status of customary international law, due to the fact that it consistently appears in General Assembly resolutions that have garnered unanimous or near unanimous support from the international community. Moreover, the term's consistent appearance in domestic laws and policies relating to outer space is indicative of its prevalent recognition as a legal obligation.

While this is a generally accepted obligation, the meaning of "peaceful purposes" is not understood by all in the same manner. Many States understand "peaceful purposes" to mean non-aggressive or non-hostile uses or activities, rather than non-military. However, there are some that have argued this concept should be understood to mean 'non-military', in line with the understanding in other arms control domains, where the concept of 'military purposes' is always considered non-peaceful. Widespread State practice with regard to the use and exploration of space supports the former interpretation (that military space activities can be peaceful) and, as such, outer space is now filled with satellites used for military purposes such as intelligence gathering, reconnaissance, navigation, targeting over battlefields, early warning of missile and air hostile operations, or military communications, usually without protest from the international community. This interpretation has also allowed for the development and even testing of counterspace technologies, and several stakeholders have warned that this hints at a **weaponization of outer space** that could eventually lead to conflict.

3.2.9 Registration

States are obliged by the OST and the Registration Convention to provide certain information about their own **space objects** to (i) a domestic registry maintained by the State, and (ii) an international Register maintained by the Secretary-General of the United Nations.

The duty to establish a national registry is mentioned for the first time in article VIII of the OST which establishes that "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body". Space objects or their component parts "found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party".

Moreover, the Registration Convention establishes in its articles II–IV, (i) the duty of a State to "register the space object by means of an entry in an appropriate registry which it shall maintain. Each launching State shall inform the Secretary-General of the United Nations of the establishment of such a registry" (article II), and (ii) the duty of the international community to establish an international Register which shall be maintained by the Secretary-General (article III), in which certain information pertaining to the object shall be included. In particular (article IV):

- a) Name of the launching State or States;
- b) An appropriate designator of the space object or its registration number;
- c) Date and territory or location of launch;
- d) Basic orbital parameters, including:
  - (i) Nodal period;
  - (ii) Inclination;
  - (iii) Apogee;
  - (iv) Perigee;
- e) General function of the space object.

To date, over 85 per cent of all **satellites**, probes, landers, crewed **spacecraft** and space station flight elements launched into Earth orbit or beyond have been registered with the Secretary-General. States commonly call for better compliance with the international obligation to register objects, particularly at the international level, with some States even calling for the enhancement of the practice of States and international intergovernmental organizations in registering space objects. Registration is widely seen as a measure that could foster trust and confidence among States and which would facilitate the **verification** and **monitoring** of States' compliance with legal and normative frameworks.

In the context of the ITU, the Master International Frequency Register (the Master Register) contains frequency assignments together with their particulars as notified in accordance with the Radio Regulations. The international rights and obligations of national administrations in respect to frequency assignments shall be derived from the recording of those assignments in the Master Register or from their conformity, where appropriate, with a Space Plan. The term 'frequency assignment' refers either to a new frequency assignment or to a change in an assignment already recorded in the Master Register. For such an assignment, the right to international recognition means that other national administrations shall take it into account when making their own assignments, in order to avoid **harmful interference**.

3.2.10 Responsibility

The duty of responsibility with regard to activities in space is enshrined in article VI of the OST, which determines that States "bear international responsibility for national activities in outer space", whether they are carried out by governmental agencies or non-governmental entities. Furthermore, States are responsible for assuring that the activities of their nationals "are carried out in conformity with the provisions" of the OST. Article VI also obliges States to authorize and continually supervise the activities of its nationals (including non-governmental entities) and to ensure that the "national activities are carried out in conformity" with the provisions of the OST. It is distinct from the concept of **liability**, which imposes a financial (or pecuniary) obligation to compensate (pay money to) another State for damages caused by its **space objects**.

Article VI of the OST expressly stipulates that anything done by a non-governmental entity in outer space "is deemed to be an act imputable to the State as if it were its own act, for which it bears direct responsibility". Article VI's stipulation that a State is responsible for its national activities in outer space was a significant development in public international law, as it is a marked difference from the regime of State responsibility applicable to activities on Earth. In the context of space law, a State cannot avoid responsibility by disclaiming responsibility for the acts of its private persons. The way many States implement their article VI responsibilities is through the enactment of national laws and regulations.

The legal concept of responsibility should not be confused with the policy concept of 'responsible behaviour' which has been used by several States to encourage members of the international community to carry out **space activities** in a manner that seeks to preserve **space sustainability** and avoid the increase of tensions by negatively impacting other States and their **space activities**. The use of the term 'responsible behaviour' in the context of **space security** regulations has been criticized by some States as vague and difficult to assess or verify. There is no universally accepted definition of the term 'responsible behaviour'.

3.3 SPACE POLICY DISCUSSIONS (MISC.)

3.3.1 Critical Infrastructure

There is no universally accepted definition of critical infrastructure in the context of **space security**. In the context of cybersecurity, the UN General Assembly has highlighted that critical infrastructures include "those used for, inter alia, the generation, transmission and distribution of energy, air and maritime transport, banking and financial services, e-commerce, water supply, food distribution and public health—and the critical information infrastructures that increasingly interconnect and affect their operations".[4] Critical infrastructure is considered of fundamental importance and "the backbone of a society's vital functions, services and activities. If these were to be significantly impaired or damaged, the human costs as well as the impact on a State's economy, development, political and social functioning and national security could be substantial".[5]

As space technology is now integrated into almost all essential sectors and functions (including defence, agriculture, transportation, energy, and telecommunications), several stakeholders have called for its designation as a critical infrastructure sector, both at the domestic and international levels. Some States include **space systems** as critical infrastructure in their domestic legislation and policies.

3.3.2 Dual-Use

The term 'dual-use' is often used to refer to **space objects** that (i) have both military and civilian functions, on the one hand, or that (ii) can be repurposed to be used for aggressive objectives. Some have suggested distinguishing between utilizing the term 'dual-use' for the former and 'dual-purpose' for the latter. Under such distinction:

---

4. See UN General Assembly resolution 58/199 on the Creation of a global culture of cybersecurity and the protection of critical information infrastructures (30 Jan. 2004), available online at: **https://digitallibrary.un.org/record/509571**.

5. See Report of the Group of Governmental Experts A/76/135, on Advancing responsible State behaviour in cyberspace in the context of international security (14 July 2021), **https://undocs.org/A/76/135**.

- **Dual-use** refers to those space objects that can have (i) military and security, as well as (ii) civilian and commercial functions (such as, for example, **GNSS**). These uses can be carried out either simultaneously or alternately (the latter is sometimes known as 'dual-capable'). Dual-use objects see the integration of military and civilian functions in one single object.
- **Dual-purpose** refers to those space objects that are designed to fulfil a benign objective (such as debris removal or **on-orbit servicing**), but they could potentially be repurposed to harm other space objects. Dual-purpose objects are in principle not designed or expected to perform military functions directly —although they may provide some form of support to military satellites through on-orbit servicing, for example— and they are also not intended to perform aggressive or hostile actions against other satellites.

Although dual-use and dual-purpose are different categories of objects, some overlap between the two is possible. In this sense, a dual-use object could also be a dual-purpose object if it possesses certain capabilities which could potentially be repurposed to harm another satellite (such as manoeuvrability, a capability that could be utilized to cause a satellite to collide with another).

The distinction between dual-use and dual-purpose is not universally accepted. Neither 'dual-use' nor 'dual-purpose' are terms of art in international law.

3.3.3 Militarization / Military Use Of Outer Space

Militarization of outer space refers to any military activity in outer space (whether hostile or not, or whether weapons-related or not) or any activity that supports military operations. Many argue that outer space has been militarized since the early days of space exploration, thus highlighting that military uses of space are not necessarily aggressive or hostile in nature, and therefore can be considered to be acceptable under the umbrella of **peaceful purposes**. It is generally understood that the concept of militarization of outer space must be distinguished from the concept of **weaponization of outer space**. This distinction, however, is not universally accepted, as a number of States argue that, due to the nature of **space objects** and the space environment, it is not possible to develop a meaningful definition of a **space weapon**. Moreover, it is important to note that there are languages which do not have a word for weaponization. In those instances, the word 'militarization' is often used to refer to both of these ideas, which can create further confusion.

3.3.4 Monitoring

The term 'monitoring' can hold different meanings depending on the context. In the context of **verification** for **space security**, it refers to the collection of various forms of data pertaining to States' implementation of an agreement or conformity with guidelines in order to build a picture of all relevant activities in a State. This can be undertaken unilaterally using national technical means (NTM) and other forms of intelligence collection; cooperatively through some form of agreement to enhance transparency; or multilaterally, something often achieved through the work of international organizations. Notably, monitoring does not necessarily require States to accept specific legally binding obligations. In this sense, monitoring State activities can play a role beyond assisting in the verification process for legally binding agreements by fostering States' adherence to their commitments. Monitoring is therefore an instrument that serves to build confidence and deter violations or irresponsible conduct.

In the context of radio frequency regulations, article 16 of the ITU Radio Regulations contains provisions related to international monitoring. National administrations agree to develop monitoring facilities and cooperate in the international monitoring system to help ensure efficient and economical radio-frequency spectrum use and eliminate promptly **harmful interference**. The international monitoring system consists of nominated monitoring stations operated by national administrations, public or private entities, common monitoring services, or international organizations. The national administrations conduct, as far as they consider practicable, monitoring requested of them by other administrations or by the ITU.

3.3.5 Reverberating Effects

Generally understood to mean the consequences or effects that are not directly caused by a specific action, but are nevertheless the product thereof. The concept of reverberating effects is commonly used in discussions relating to the use of force or armed attacks in the context of the conduct of hostilities. When conducting proportionality assessments prior to the use of force or armed attack, it is generally accepted that reverberating effects have to be considered to the degree in which they are reasonably foreseeable.

3.3.6 Risk

Risk refers to the probability of an outcome having a negative effect on people, systems or assets. When used in the context of **space security**, it generally refers to the danger to the safety of a **space system** or any of its components, that is to say, the possibility of accidental or unintended damage to space systems, or to people depending on the services provided by those systems. Risk is distinct from **threat**, which refers to the danger to the security of a space system or any of its components, that is to say, the possibility of intended or intentional damage (involving agency, or done deliberately) to space systems, or to people depending on the services provided by those systems. It should be noted that outside of the space policy discourse, the term 'risk' does have security-related implications. The nuclear field is an example of this.

3.3.7 Space Safety

Space safety is commonly understood to refer to measures aimed at preventing accidental or unintentional hazards to **space systems**. These hazards can be natural, such as geomagnetic storms, or stem from human-made objects, such as the accidental malfunctioning of a **satellite**, or collision with a piece of debris. Space safety measures therefore seek to mitigate any non-intentional damage to a space system. The possibility of such a damage is considered a **risk** (as opposed to a **threat**). Issues of space safety are generally understood to be a part of the broader topic of the peaceful uses of outer space, which is discussed at the Committee on Peaceful Uses of Outer Space (COPUOS) and under the purview of the General Assembly's Fourth Committee.

Space safety is generally regarded as distinct from **space security**, although the two are interrelated, and can intersect and overlap. Certain languages do not differentiate between 'safety' and 'security', and therefore can generate confusion in distinguishing the two.

3.3.8 Space Security

Space security is concerned with the relationship among **space objects** and **activities**, and the maintenance of international peace and security, and disarmament, including the prevention of an arms race in outer space. Space security discussions fall under the purview of the United Nations disarmament bodies, including the Conference on Disarmament, First Committee, and the Disarmament Commission. Space security is also commonly understood to refer to measures designed to prevent deliberate harms to a **space system**, including its component parts, from intended or intentional **threats** undertaken by another actor.

Space security is distinct from **space safety**, although the two are interrelated and can intersect and overlap. Certain languages do not differentiate between 'safety' and 'security', and therefore can generate confusion in distinguishing the two.

When discussing threats to space security, some actors have made the distinction between (military) danger and threat. The former precedes and can lead to the latter, and the latter refers to a situation closer to the use of force or the possibility of a conflict. More specifically, military danger refers to inter-State or intra-State relations characterized by the combination of factors, which may lead to a military threat under certain conditions. Military threat refers to inter-State or intra-State relations characterized by a real possibility of an outbreak of a military conflict between opposing sides and by a high degree of readiness of a given State (group of States) or separatist (terrorist) organizations to resort to military force (armed violence). This distinction, and this definition of military danger, is not universally accepted by the international community.

3.3.9 Space Sustainability

Space sustainability is commonly understood to mean stakeholders' ability to continue to be able to use and benefit from space. Space sustainability requires that space be kept safe and secure, so that stakeholders may be able to use, explore, and benefit from space "without discrimination of any kind, on a basis of equality and in accordance with international law" (article I of the OST). Space sustainability therefore seeks to preserve the usability of space.

3.3.10 Space Weapon

There is no universally accepted definition of the term 'space weapon'. Generally this term is used to refer to a capability or system used to deny, disrupt, degrade, damage or destroy or otherwise harm a system, infrastructure, person or group of people. Some consider that in order for a weapon to be classed as a space weapon, it has to be located in space, whereas others include non-space-based objects that can target space infrastructure. Moreover, there are some that consider that space weapons are those that target **space systems**, including the ground and **link segments**, as well as objects on the ground, sea or air.

There are certain States that have sought to establish a definition by which a space weapon is any outer **space object** or its component produced or converted to eliminate, damage or disrupt normal functioning of objects in outer space, on the Earth's surface or in the air, as well as to eliminate population, components of biosphere important to human existence, or to inflict damage to them by using any principles of physics. Others have criticized this definition as it does not include (i) objects not in space but which can be directed towards it to harm technology therein, and (ii) does not take into account that in some cases objects are capability-neutral and the intent of the actor is what determines whether they are used to harm another's space object or disrupt their **space activities**. This is the case of **dual-purpose objects**.

3.3.11 Threat

When used in the context of **space security**, 'threat' generally refers to the danger to the security of a **space system** or any of its components, that is to say, the possibility of intended or intentional damage (involving agency, or done in a deliberate manner) to space systems. Threat is distinct from **risk**, which refers to the danger to the safety of a space system or any of its components, that is to say, the possibility of accidental or unintended damage to space systems. The identification of threats is not a straightforward task, as threat perception can be subjective in nature, due to the diverse range of actors' and stakeholders' interests and views of what can constitute a threat, and the fact that globally **SSA** and **SDA** are not perfect tools to identify and address threats.

3.3.12 Verification

Verification refers to the process of collecting and assessing data with a view to informing judgements of a State's compliance with its treaty obligations. The primary goal of verification in this sense is not necessarily to detect all violations of any agreement. Rather, the objective is to foster mutual transparency and confidence between States party to an agreement and to deter violations by increasing the cost and difficulty of undertaking non-compliant activities. However, it is generally expected that an effective verification regime should be able to detect 'significant' violations of an agreement before such activities threaten the core security objectives of the States concerned.

The process of verification typically entails three phases: first, **monitoring** the activities of the parties to an agreement; second, undertaking technical analysis of information derived from monitoring; and third, drawing from the first two steps to reach a judgement as to whether a party is in compliance with its obligations.

3.3.13 Weaponization of Outer Space

There is no universally accepted definition of **space weapon**; however, weaponization of outer space generally refers to the proliferation, testing, deployment and use of weapons or **counterspace capabilities** located in or directed towards space or **space systems**. The term itself is also not universally accepted, as it does not readily translate into all languages. Moreover, in some instances the word '**militarization**' is used to refer to both military activities in space and to weaponization of space.

UNIDIR
UNITED NATIONS INSTITUTE FOR DISARMAMENT RESEARCH

@unidir
/unidir
/un_disarmresearch
/unidirgeneva
/unidir

Palais de Nations
1211 Geneva, Switzerland

WWW.UNIDIR.ORG