SPACEWAYS

1st STM Brief

A Congested Space and its Safety

The Importance of Space Traffic Management

May 2022

*This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101004208.

www.spaceways-h2020.eu

Spaceways will establish an assessment of technical and policy-related issues associated with Space Traffic Management (STM) and propose a set of recommendations and guidelines to the European Commission. A main goal will be to **characterise and understand the context of STM**, especially its international and domestic dimensions. The project focuses on an analysis of European capabilities and technology gaps and on a policy, legal and economic assessment of this domain, leading to recommendations and guidelines.
This **first Brief** focuses on introducing the STM topic and summarising the challenges.

WHAT IS SPACE TRAFFIC MANAGEMENT AND WHY IS IT IMPORTANT?

The space environment is rapidly becoming more congested at an exponential rate. Between 2018 and 2022, the number of active satellites in space more than **doubled.** At the same time **space debris** continue to orbit alongside functioning satellites. The result is a potentially dangerous situation in space, which lacks dedicated rules to manage this increase in traffic. **Space Traffic Management (STM)** is part of the solution in this multifaceted context, providing answers on many levels. Academic and national policy definitions of STM centre on the idea of **safety in accessing space and operating in orbit**.

New Space, a paradigm shift in space

Space enables many services on Earth, unlocking opportunities for climate research, meteorology, risk and disaster mitigation, communication, and navigation. All this information is useful to millions of people and users every day. Over the last few years, a rise in the number of space companies occurred. This trend, called New Space, exploits technological advances in the domain of space launch and small satellites to plan very ambitious architectures in space. Satellite mega-constellations, comprising thousands of satellites, are being deployed or planned. Recently, the number of active satellites in space more than doubled, from 2000 actives satellite in 2018 to more than 4700 today. This rise is exponential, and certain analysts forecast that more than 100 000 satellites could eventually be sent to space. This increases the congestion in Low Earth Orbit (LEO) and the risk of debris generation.

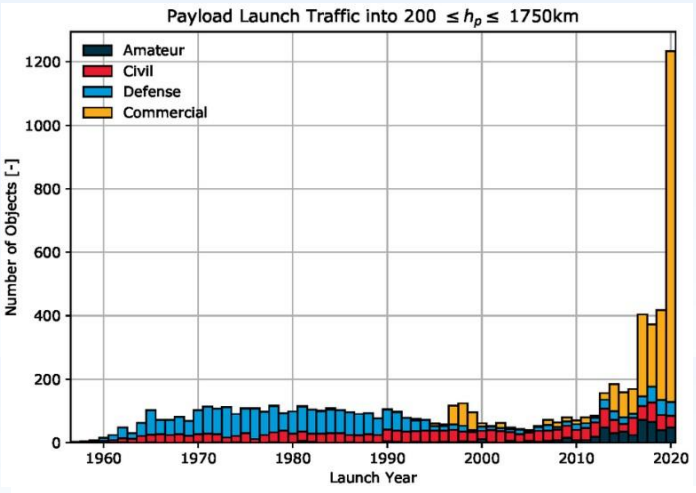

Figure 1 Space Environment Report 2021, ESA

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101004208. This document reflects only the view of the author(s) and the European Commission is not responsible for any use that may be made of the information it contains.

Moreover, the current trends of technology miniaturisation and easier access to space allow more and more state entities and private actors to put their own satellites into orbit. Human spaceflight is also entering a new era, due to an increase of crewed missions and the beginnings of space tourism. These trends of space commercialisation and the increase in the frequency of satellite launches represent a paradigm shift in space and may become the base of a thriving space economy. Yet, the envisioned value of **$1 trillion generated by the space sector by 2040**[1] **relies on the existence of a sustainable space environment**, where it is safe and secure to operate spacecrafts.

Space debris and space pollution: an alarming situation

Debris are made of inactive satellites, spent rocket bodies, and other types of waste space objects. According to the latest European Space Agency (ESA) estimates, there are 36,500 debris larger than 10 cm, 1 million between 1 and 10 cm, and 130 million between 1 mm and 1 cm, all capable of indiscriminately damaging satellites and spacecrafts.[2] These uncontrolled fragments travel at very high speed (up to 29,000 km/h). Irresponsible behaviours and space congestion could trigger cascading collisional events, known as the "Kessler syndrome", capable of limiting or prohibiting access and use of the orbit.

Anti-satellite weapons are also seeing a resurgence today. The Soviet Union and the U.S. primarily tested ASATs between the 1960s and the 1980s, but the overall frequency of ASAT tests increased in the last 15 years. Recent destructive tests by China (2007), the US (2008), India (2019) and Russia (2021) have created a large number of debris[3]. Overall, these trends are concerning, because the development of such capabilities comes with serious consequences regarding the multiplication of debris. Very few solutions exist to curb their multiplication. Technology is advancing in the fields of active debris removal and other in-orbit services, such as refuelling and life-extension of satellites. However, these devices are only beginning to be tested and will take a long time to find economic and commercial viability.

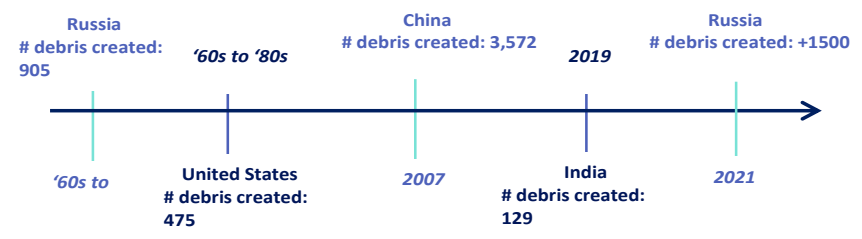

Figure 2 Timeline of major ASAT test (Data: Secure World Foundation)

Space Situational Awareness (SSA)

A holistic approach, including comprehensive knowledge and understanding of the main space hazards, encompassing collision between space objects, fragmentation, and re-entry of space objects into the atmosphere, space weather events, and near-Earth objects.

Space Surveillance and Tracking (SST)

A network of ground-based and space-based sensors capable of surveying and tracking space objects, together with processing capabilities aiming to provide data, information and services on space objects that orbit around the Earth.

[1] Space: Investing in the final frontier. Morgan Stanley, 2020. https://www.morganstanley.com/ideas/investing-in-space

[2] Space debris by the numbers, ESA. https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers

[3] Nevertheless, these tests are quite diverse in nature, considering also the altitude of the test – which is not represented in Figure 1 – and the transparency of the operations.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101004208. This document reflects only the view of the author(s) and the European Commission is not responsible for any use that may be made of the information it contains.

In this framework, states consider it a priority to develop capabilities that enable them to gain a clear picture of the environment in which they **operate,** and which are the natural and artificial risks the space assets encounter: see box on Space Situational Awareness (SSA) and enabling Space Surveillance and Tracking (SST) capabilities.[4]

The path to STM

No international treaty or regulation binds all space actors to coordinate in orbit and mitigate debris. There is often no attempt to deorbit satellites at their End of Life, as showed by datain Figure 3. Existing guidelines are not sufficiently applied to mitigate the creation of additional debris. As space evolves into a more congested environment, **the need for states to agree on a set of rules becomes urgent**.

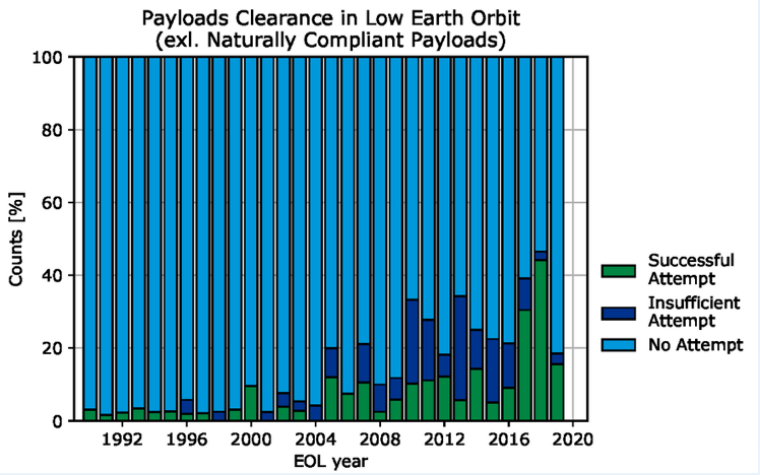

Figure 3 Space Environment Report 2021, ESA

The European Commission realises the importance of the STM topic. On 15 February 2022 together with the High Representative, the European Commission delivered a Joint Communication on **"An EU approach on Space Traffic Management - An EU contribution addressing a global challenge"**.[5]

Building on this dynamic, Spaceways is developing an inclusive method to involve European stakeholders in the definition of a Space Traffic Management framework. While the need for a coordinated approach might seem self-evident, we need to ensure that a cooperative approach is firmly embraced by each stakeholder.

Spaceways supports the efforts to address STM, through analysis of the best approach for Europe in terms of policy, legal and technical capabilities and regulations. Spaceways also organises dedicated workshops which involve the most relevant European stakeholders. The Spaceways project will provide the European Commission with actionable recommendations to ensure European interests are safeguarded in this new context.

[4] The definitions of SSA and SST are from the Regulation (EU) 2021/696 of 28 April 2021 establishing the Union SpaceProgramme and the European Union Agency for the Space Programme.

[5] https://ec.europa.eu/info/files/joint-communication-eu-approach-space-traffic-management-eu-contribution-addressing-global-challenge_en

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101004208. This document reflects only the view of the author(s) and the European Commission is not responsible for any use that may be made of the information it contains.

The strength of Spaceways lies in the partnership **between major European research institutes and European Space Industry players**, used to working together and capable of providing an end-to-end analysis of Space Traffic Management (STM) issues and the most appropriate answers and solutions.

Spaceways brings these key actors together to develop a collaborative European vision of STM. This consortium, coordinated by the Fondation pour la Recherche Stratégique, is able to provide a complete review of STM stakes at each stage of the analysis, from concepts to industrialization, taking into account the evolution of legislation, and its impacts on technologies, space infrastructure and satellite operations.

To ensure the study outputs are embraced by the whole European space community, external stakeholders are actively involved within a **Stakeholder Engagement Programme**, gathered in a series of six workshops with more than 100 participants from 24 European entities - including institutional actors (national agencies, Ministries of Defence, intergovernmental organisations, and EU institutions), public and private satellites operators, Space Surveillance and Tracking (SST) service providers, and R&D related entities (SME, start-ups, and a non-profit organisation).

The STM Briefs series is led by **Istituto Affari Internazionali (IAI).**

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 101004208. This document reflects only the view of the author(s) and the European Commission is not responsible for any use that may be made of the information it contains.