

Promoting Space Sustainability

Sustainability Case Study

Spacety Co., Ltd

February 9, 2021

Implementation of the Guidelines for the Long-Term Sustainability (LTS) of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space

I. DESCRIPTION OF OUTER SPACE ACTIVITY

Spacety is a fast-growing private NewSpace company with its headquarters in China and the European subsidiary in Luxembourg. Spacety is one of the world leaders providing innovative small satellite-based solutions and services to the world. Since founded in 2016, it has designed, built, launched and operated 21 satellites. These satellites provide low-cost and high-quality SAR and optical imagery to the world, and have also enabled fast, flexible, frequent, and low-cost space missions for scientists to do world class research in space, companies to flight test and demonstrate new space technologies and products. With many remarkable achievements in innovative small satellite technologies and Earth Observation solutions, Spacety has positioned itself to become a global satellite data provider with its low-cost high-performance SAR constellation of 300+ satellites.

Spacety successfully built, launched, and operated its first satellite, XIAOXIANG 1, a 6U cubesat, in November 2016, the same year as the company was founded, to demonstrate advanced satellite technologies and science instrument. This satellite was launched by China's Long March 11 rocket in Jiuquan, China. This is the first Chinese satellite which was designed, built, and operated by a private company in China. Only 3 months after the first launch, Spacety launched its second satellite, DIDO 2, on board India's PSLV launch vehicle in February 2017. This mission is an international collaboration between China and Israel.

Spacety's satellites have enabled scientists to do world class research in space, companies to flight test and demonstrate new space technologies and products, and satellite data to be provided to solve the problems we face on Earth every day. Among the payloads flown on board Spacety's satellites are: astronomy X-ray polarization detector, gravitational wave sensor, optical fiber sensing system, software defined radio, new satellite components, electric thrusters, and multi-spectral cameras. The results of the world leading research of detection in soft X-ray polarimetry of the Crab nebula were published in the world leading scientific journal **Nature Astronomy** with Spacety's satellite on the front page of the journal on May 11, 2020. On November 6, 2020, Spacety launched the world first ever iodine electric propulsion system, in

collaboration with ThrustMe. This was a very fast and flexible in-orbit demonstration service Spacety provided.

On December 22th, 2020, Spacety successfully launched the world's first miniaturized C-band SAR satellite with a phased-array antenna, Hisea-1, on the Long March 8 (LZ-8) rocket, from Wenchang, China. The development of the Hisea-1 satellite, including its SAR payload, only took one year to complete. It is characterized by its light weight, small volume, low-cost and high-resolution. It is a flat-panel foldable satellite with a mass of 185 kg but has 1 m resolution in spotlight mode. On December 27, 2020, only 5 days after launch, Spacety received the first batch of images from Hisea-1. The images have high resolution and good quality, comparable to those from a large SAR satellite such as Canada's Radarsat-2 or ESA's Sentinel-1. These images were produced in strip mode with a 3 m resolution. The SAR imaging areas covered include Asia, North America, South America, Europe and Antarctica, with typical landforms of cities, mountains, fields, forests, rivers, lakes, glaciers and coasts. These images demonstrate that Hisea-1 works excellently in space.

II. CONNECTION WITH THE LTS GUIDELINES

Although a new space company, Spacety has faced the challenges of space sustainability related issues since day one. We are a satellite operator to provide satellite-based service and satellite data service to the world. Space debris and radio frequency spectrum are the two big space sustainability issues that affect our ability to provide services and also our business sustainability.

Space debris is the biggest challenge the international space community is facing. The situation will get much worse very soon if no actions are taken now. It is extremely difficult to get rid of debris already in orbit. However, we can make our effort not to produce new debris in orbit, be it from launchers, satellites, or space stations. This will keep the space debris at current level and stabilized. This is very important and also feasible to do for space sustainability. In the near future, a lot of satellites will be launched for constellations. Low-cost launchers will drive more space missions. If active de-orbiting is not put into place properly, LEO orbits will soon be too crowded for any space missions.

Radio frequency spectrum is a resource that cannot be regenerated. It has already become very crowded. Space sector is competing with ground communication sector for the frequency spectrum, but the room is getting smaller for space because of 5G and 6G in the near future. Space sector needs to find new solutions. Laser communications technology is very promising and will not interfere with ground radio frequencies.

Spacety has been very conscientious of space sustainability. We have made our best efforts to integrate measures to support space sustainability into our space activities. Some of the most relevant links between our activities and the LTS Guidelines are summarized below.

Guideline D.1, part (3): Promote and support research into and the development of ways to support sustainable exploration and use of outer space. We are working with partners to develop and test in space the satellite laser communication technologies to reduce the use of radio frequency for satellites. RF spectrum is very crowded and use of RF signals for satellite has a risk to cause radio interference. For our SAR constellation, once the satellite laser communication technology becomes available for operational use, we will use it for our SAR satellites.

Guideline D.2, part (3) and part (4): Investigate and consider new measures to manage the space debris population in the long term. All our satellites, be it a 3u cubesat, or a 185 kg SAR satellite, have a de-orbiting mechanism or device, which de-orbits the satellite at the end of its mission life. We developed a deployable mechanical structure attached to deployable solar panels for our cubesats. Every cubesat has been equipped with this mechanism. An electric thruster is used with each of our SAR satellites to comply with the government regulations and also to make our space sustainable. We are also developing a micro system for active space debris removal in Luxembourg. This cubesat based servicing system can de-orbit space debris and help protect in-orbit space assets.

III. LESSONS LEARNED

Spacety has been aware of the importance of space sustainability since the company was founded. We have embedded consideration of space sustainability into our space activities. We de-orbit our satellites at the end of their missions using de-orbiting device to prevent it from becoming a space debris. We are developing innovative technologies to tackle the space debris issue and to reduce the use of RF signals for satellite communication.

One of the effective ways to ensure space sustainability is to develop and use new and innovative technologies. New technologies are enabler for sustainable space. Cost is a big hurdle. New technologies are required to lower the cost and make maintaining sustainable space feasible and viable financially. To develop and use these technologies, collaboration, including international collaboration, is required.

To make space sustainable for space activities is very complicated. Not a single organization nor a single country has the ability to do it. It needs an international coordinated effort from all the countries and all the space organizations. It involves laws, politics, investment, technologies,

public awareness, and interest, and so on. World-wide initiatives, led by UN, can provide solutions to make our space sustainable for long term.