



Promoting Space Sustainability

[Title of activity]

[Submitting entity]

[Date]

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

Operational Case Studies

"Contribution of the National Satellite System to the LTS guidelines"

I. Short description of the outer space activity

Over the years Chile has reached a technological base and institutional stability, aimed to develop the spatial activity in the country in a more autonomous way. This is especially relevant, because of the natural benefits given by its privileged position in the southern hemisphere, territorial extension, closeness to the south pole, and the diversity of weather specially in northern Chile.

The technology involved in the Space activity has a technological relationship with other areas, in which Chile has a protagonist role, internationally recognized, such as astronomy and Antarctic presence, which also benefits Space-related activities.

Regarding astronomy, the national Space development is benefited by the used of telescopes located in the astronomical centers. These elements can be used for Space debris monitory, Space weather studies, also for the exploitation of emergent technologies such as laser communications, exploiting their potential as regional centers for satellite services. It is important to mention that Chile concentrates near to 70% of the international astronomical assets in the world, which evidences the potential benefits by the exploitation of this technology in the Space-related activities. On the other hand, Chile had become a scientific pole at Antarctic territory, because of its historical presence in this continent. Specifically, the location of satellite ground stations in the Antarctic territory is a potential advantage for the space activity, because of the convergence of polar orbiting satellites in the south pole.

All of these activities make use of natural conditions, so sustainability is a fundamental topic to be included in any type of space development. Different efforts have been made in Chile to exploit these benefits and increase the space presence, which have been lead by scientific, academic and defense sector, aimed to support a local challenge. However, they do not fully contemplate the systemic and global gaze that space development requires. Additionally, sustainability is an aspect that little by little has been positioned as an "ethical requirement" adopted by countries with environmental awareness. This tendence aims to minimize the effects that

development may generate on the planet, in order to solve problems of the present generation and without compromising future generation's own needs.

The National Satellite System Program (SNSAT) is a project lead by the Chilean Air Force, which has an integral and collaborative vision about Space development in a national, regional, and international level. The products generated through space activity will be seen as a public resource for development, and national security. In this sense, the sustainability has been understood as a mandatory aspect for any of the planification and execution stages of the project, according to government guidelines through the Ministry of Science, Technology, Knowledge, and Innovation.

In this paper it is detailed the contribution of the National Satellite Project to the Long-term Sustainability (LTS) proposed by The Committee on the Peaceful Uses of Outer Space (COPUOS), described in a more accurate way in point II.

SNSAT has been segmented in four subsystems aimed to support different capabilities to be developed.

Subsystem 1 "Geospatial Information Management": This service is oriented to satellite imagery collection and reception, not only for optical but also for radar images. Its purpose is to strengthen the storage, processing, and distribution capabilities of geospatial information, through the development of a geoportal and mobile applications to facilitate access to geospatial information open and freely to anyone. This subsystem considers the implementation of a several Datacenters that shape a Data Lake for data from space-borne sensors. This is a way to complement information, also to minimize parallel efforts, or duplicity of technologies for the same purpose.

Subsystem 2 "National Production, and Development of Spatial National Capabilities": One of the main SNSAT project purposes, it is to increment the national autonomy for spatial technology development. This subsystem mainly involves an Assembly, Integration & Testing Laboratory, for local development of micro and nano satellites. In this sense, the Ministry of Science, Technology, Knowledge, and Innovation considers as axis mission, Space weather and Geospatial monitoring for environmental conservation, among others, so the payloads to be included in satellites will allow a permanent monitoring of this aspect, in order to plan the projects to be raised. Moreover, a permanent register about the national space objects it is considered, in order to monitoring their life cycle.

Subsystem 3 "National Satellite": The main national satellite, defined to replace the current Earth-Observation satellite FASat-Charlie, currently in orbit.

Subsystem 4, Telecommunications service: This subsystem is oriented to support the satellite communications services and the Ground Satellite Stations necessary for its exploitation.

The four subsystems of the project have been planned under the guidelines of the Ministry of Science, where the concept of sustainability is considered as an axis of mission within the national space institutions. These guidelines consider international recommendations proposed by UN and agreements that have been adopted by Chile.

II. Connection with the LTS Guidelines

The LTS have been approached from different aspects within the 4 SNSAT subsystems projects associated. The main guidelines included are detailed as follows:

Guideline [A.1 A.2] Adopt, revise and amend, as necessary, national regulatory frameworks for outer space activities: Chile's foreign policy has been characterized by decisively addressing existing global challenges, developing an active participation in the world agenda for sustainable development. Regarding space, Chile has had a permanent participation in Committee on the Peaceful Uses of Outer Space (COPUOS), not only in the technical, but also in the legal subcommittee. These instances evidence the interest to include the global recommendations in the national space affairs, which allows the inclusion of the national perspective in the international debate on the future of the outer dimension. In addition to current regulation, The National Satellite System Program has demanded the planification of new regulation about space development, and other related areas. For instance, there is a ministerial decree currently in revision, about the emission standard of light pollution, considering the valuable environmental and cultural heritage recognized internationally of our territory, especially in northern Chile. Finally, it is highlighted the invitation received by Chile, as a co-sponsor country of reports related to Still and Dark Skies for Science and Society.

Guideline A.5 Enhance the practice of registering space objects: This guideline has been adopted through a ministerial decree, which establishes the registry of space objects launched in orbit on earth or beyond it. According to this document, the register must include: a) Name of the space object and / or its registration number; b) Date and place of launch; c) Basic orbital parameters, including: i) Nodal period, ii) Inclination, iii) Apogee, iv) Perigee; d) General function of the spatial object. SNSAT program considers a new capability to lead space projects from design to launch, so it becomes a mandatory practice to be incorporated. SNSAT also considers the registration and monitoring of space debris at atmospheric entry, and the Ministry of Science is also making progress in regulating the space operations of mega-constellations and control access through ground stations to be located within national territory.

Guideline B.3 Promote the collection, sharing and dissemination of space debris monitoring information.

One of the purposes of Subsystem 1 (Geospatial Information Management) is to strengthen the capacity for storage, processing, and distribution of geospatial information. It also will be useful for space debris monitoring through a geoportal, in order to facilitate access for users in different areas of national development, as well as to form a unified space database. In this sense, and specifically as part of this guideline, the project called "All Sky" is currently in development, as collaborative research integrated by Chilean Air Force, Air Force for Scientific Research (AFOSR) of the USAF and the Colorado Center for Astrodynamics Research (CCAR) from the US. The objective of this project is to evaluate the feasibility to detect and classify near-Earth objects in the city of Punta Arenas, using an OmniSSA sensor arrays, concept based on combined Bayesian Super-Resolution and synthetic image stacking image fusion of lower resolution all-sky images. One of the main challenges of this project is the data collection and distribution from remote zones for processing purposes that will be addressed by the SNSAT program.

Guideline B.6 Share operational space weather data and forecasts

Through subsystem 2, SNSAT contemplates the locally developed payloads integration, aimed to different purposes, which includes space weather monitoring and forecast. Data collected by these sensors will be stored in a data lake as a national good for public use, in order to concentrate the data available for academic research, productive purposes, defense applications, among others. Additionally, the project contemplates the implementation of Environmental Ground Stations (EMAs) and Smaller Sub-Stations (STMs), which may be installed in different points of interest to complement the information obtained through on-board payloads used in the monitoring of space weather.

In general, LTS guidelines have been considered as a fundamental criterion for all SNSAT phases, in concordance with ministerial policies and international agreements adopted by Chile, which has demanded the creation of the space institutionalist. One of the objectives of this structure, is to promote and encourage the development of talent, technology and industry and their capacities for achieving a sustained, sustainable, coherent and inclusive capacity of the state and society as a whole, for the benefit of the development and interests of the state through the pacific use of outer space.

III. Lessons learned

Development can be achieved taking into consideration the Long-term Sustainability Guidelines. Current technology allows to develop space systems with both attitude and orbital control at a relative low cost for emerging countries and organizations seeking to achieve development and knowledge in space related areas, thus reducing the problem of populating lower orbits with spacecrafts with the inability to react to other objects in its nearby path.

Space 2.0 is happening faster than it could be anticipated, what we had only imagined a few years back is happening right now and is easier than it was expected. The entrance of many small actors to the space sector has encouraged development and efficiency, allowing new actors to associate or to resort to this exploitation to start alliances with mutual interests.

The trend indicates that the Electro-Magnetic spectrum will be more crowded every day, thus a policy for assignation and use must be implemented and revised in order to fit new users and to fit the constant changing panorama.

Chile's eyes have been turned to the skies for many years gazing at the stars, but now many of the world's eyes stare at chile from above. Our national territory is one of-a-kind land that, by his extent, predominant atmosphere and connectivity, makes it a perfect match for space communications and for the surveillance of space debris.