

Southern Space Studies
Series Editor: Annette Froehlich

Annette Froehlich *Editor*

Space Fostering African Societies

Developing the African Continent
Through Space, Part 4

 Springer

Southern Space Studies

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The volumes of the series are peer-reviewed.

Annette Froehlich
Editor

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Angola Space Strategy

Amaro Joao and Zolana Joao 

ABSTRACT

The African space sector is currently undergoing a phase of rapid and dynamic expansion. The Angola Space Strategy 2016–2025 establishes the goals that should govern space activities and is mainly divided into five pillars: the development of a space infrastructure, capacity building and promotion of the space sector, growth of industry and space technologies, international positioning in the space domain, and organization and cooperation. Angola successfully launched its first satellite, ANGOSAT-1, in 2017 and is currently building a second satellite, ANGOSAT-2, which is predicted to be launched in 2022. To launch a satellite, Angola had to create brand new satellite ground infrastructure, such as a satellite Mission Control Center and hub Vsat antennas for satellite communication. The challenges for implementing the different space and ground segments are presented in this contribution. Moreover, the orbital failure of ANGOSAT-1 and how it was overcome is discussed. We implemented a wide-range capacity-building program, training Angolan specialists at some of the best universities globally as well as with some of the best satellite companies in the region and of the world. Within nine years, we grew 70 space specialists, including individual specialists with Ph.D.s, master's, and bachelor's academic degrees. The present article discusses the progress and results of the Angolan Space Strategy.

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1 Overview and Background

In the African Union Agenda 2063,¹ the policy drivers for an African space program are expressed through a high-level approach, highlighting the goal to create a space program that is responsive to the social, economic, political, and environmental needs of the continent as well as being globally competitive.

Angola has a population of over 33 million, with more than half living below the poverty line, a quarter living in rural areas,² and only 36% using the internet.³ Internal studies in Angola in 2006 indicated that the cost of renting satellite communication every year was equivalent to the price of a brand-new national communication satellite. As such, the Angola government decided to produce an Angola satellite and to design an Angolan Space Strategy.⁴ In the short term, the objective was to reduce the digital divide and increase broadband access, particularly in rural areas. In the long term, the Angolan Space Strategy aims to guide the country's investments in space with a view to ensuring the effective use of space benefits, based on five pillars:⁵

- Development of a space infrastructure;
- Capacity-building and promotion of the space sector;
- Growth of industry and space technologies;
- International positioning in the space domain; and
- Organization and cooperation.

Besides supporting the socio-economic development of the Angola Government, the five pillars of the Angola Space Strategy were also designed to take regional and international integration into account in alignment with the existing African Space Policy principles and objectives.

2 Africa in Space: Overview

The African Space Policy goals are supported by a set of objectives and principles that articulate important aspects that need to be addressed in developing and maintaining a viable and sustainable space program. These policy objectives and principles form the core building blocks and the basis for all decisions and actions

¹ <https://au.int/en/agenda2063/overview>.

² National Statistics Institute, <https://www.ine.gov.ao/> (all websites cited in this publication were last accessed on 12 April 2022).

³ World Bank, <https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=AO>.

⁴ Angolan National Space Strategy (2016–2025), approved by Presidential Decree No. 85/17 (Angola: Government of Angola), pp. 7ff.

⁵ *Ibid.*, 16.

of the African Space Program's implementation plans and governance structure.⁶ The African Union created the African Space Agency (AFSA), adopting policies and coordination of the African Space Strategy, aiming to create a continental exchange platform for sharing knowledge and experiences.⁷

In the same path of emerging African initiatives in the space sector, the following are other examples of countries that also hold or operate at least one national large communication satellite: Egypt, Nigeria, Algeria, and Morocco. While South Africa, Ghana, Mauritius, Kenya have launched medium and small satellites that are notable in the development of space activities in the Regional Center for Mapping Resources.⁸

With the launch of ANGOSAT-1, Angola has contributed as one of the few countries in Africa that have successfully launched a large communication satellite in orbit. Angola currently chairs the satellite shared program network for SADC (Southern African Development Community), promoting regional integration and experience.

3 Angola Space Strategy Pillars: Current Outlook

For the Angola Space Strategy, the guidelines are the following:

- Implementation of space technologies should be used to respond to the needs of the country, including in the field of communications, in traffic management, and in monitoring and management of the territory; and
- Investment in major space projects of a scientific and technological nature that will guarantee the Angolan regional and international integration in the world space arena.

The abovementioned guidelines aim to ensure that Angola is endowed with a satellite communications network to cover the entire national territory, thereby ensuring access to communications for the entire population, reducing regional disparities, ensuring digital inclusion,⁹ and supporting regional and international integration. For each of these pillars/axes, the Space Strategy indicates strategies and action measures with concrete steps that will lead to the implementation of the broad guidelines, as presented below.

The diagram in Fig. 1 reveals the general schedule for implementing the strategic priorities according to the Angola Space Strategy. It shows the five pillars

⁶ "African Space Strategy", https://au.int/sites/default/files/documents/37433-doc-african_space_policy_isbn_electronic_.pdf.

⁷ Ibid.

⁸ Mustapha Iderawumi, Who are the Stakeholders in the African Space Ecosystem? in: Space in Africa", <https://africanews.space/who-are-the-stakeholders-in-the-african-space-ecosystem/>.

⁹ "White Paper on Information Technologies and Communication of the Republic of Angola, approved by Presidential Decree No. 129/19 (Angola: Government of Angola), pp. 18ff.

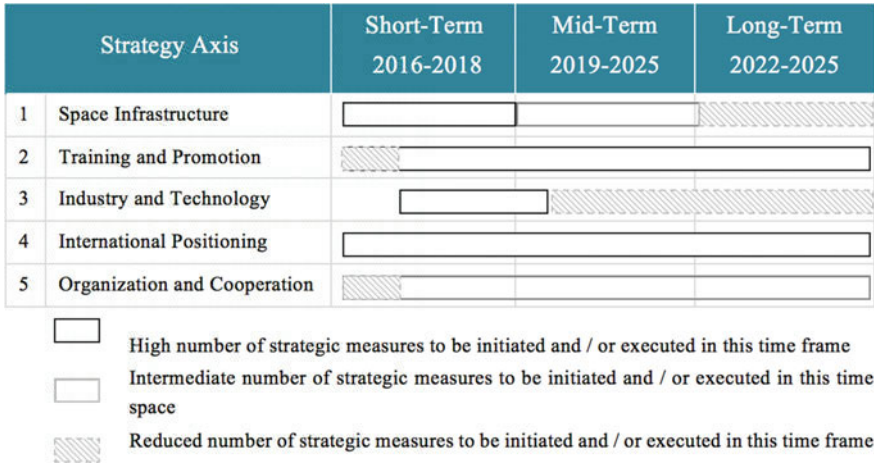


Fig. 1 Angola space strategy pillars: general schedule for implementing the strategic priorities

of the strategy and an implementation time schedule that is realistic in terms of Angola’s actual capabilities in the space domain.

Angola’s investment in space started with the ANGOSAT project as a genesis of the space program, being already preliminarily framed in the ICT White Paper. The ANGOSAT project is transversal to all five pillars of the strategy.

4 Legal and Legislative Perspective

After careful studies of how Angola could start its space activities in 2006, given the need for telecommunications infrastructures throughout the country, it was decided that the starting point for the creation of a national space program should be the construction, launch, and operation of a communications satellite named “ANGOSAT”. The success of the Space Strategy requires the creation of a stable structure that monitors and assesses the implementation and execution of the respective measures indicated within the timeframe suggested in this document while ensuring the alignment of all sectors, policies, programs, and projects around a common vision.

To create this legislation, the following steps were necessary:

- Presidential Decree No. 101/13 of 9 October 2013, which establishes the Inter-ministerial Commission for the General Coordination of the National Space Program (PEN);
- Presidential Decree No. 154/13 of 9 October 2013, establishing the Office for Space Affairs (GGPEN, in Portuguese); GGPEN’s primary mission is to promote the peaceful use of outer space as well as conducting strategic studies

aimed at establishing cooperation agreements with technical and scientific institutions in the space field, ensuring the creation of national technological and human skills and the transfer of technology and know-how within the PEN;

- Presidential Decree No. 152/21 of 9 June 2021, updating the initial terms of GGPEP creation; and
- Presidential Decree No. 85/17 of 22 June 2017, officially approved the Angola Space Strategy.

With the legal perspective in place, Angola had the basis to move forward with the Angolan Space Strategy, focusing on the development of space infrastructures and the necessary human resources to implement and manage the different space programs and projects.

5 Development of a Space Infrastructure

The ANGOSAT project was approved by Resolution no. 65/08 of 15 July 2008. This established that a satellite telecommunications infrastructure was necessary, taking into account the characteristics of the national territory (in particular its size and population density) and the need to harmonize economic growth. The project integrates not only the production, launch, and operation of the satellite, but also the creation of national capacities in human resources and infrastructure.

Accordingly, and in line with international practice,^{10,11} the ANGOSAT-2 project is composed of two main segments, namely the space and ground segments, including the payload mission in terms of the services to be provided.

The Strategy that the country defined to start its space activities followed nine years of evaluating the benefits and opportunities that space technology can provide to the Angolan people. In order to implement the main project of the Strategy, the following instruments were produced:

- Satellite technical requirements and specifications;
- Request of geostationary orbital position (GEO), including frequency coordination;
- Requirements and technical specifications of the Mission Control Center (MCC) in Luanda, Angola and a backup in the Russian Federation;
- Strategy to make the payload frequency resources (communication services) available; and
- Program for continuous training of the Angolan specialists with some of the biggest players of the world space industry.

¹⁰ Carl Eriksen, “Nigeria”, in: Annette Froehlich (ed.), *Integrated Space for African Society*, Southern Space Studies, Springer (2019), pp. 97–112.

¹¹ Kechil Kirkham, “An Exploration of the User Concept in Satellite Design and Its Implications for Social and Economic Development in Africa”, in: Annette Froehlich (ed.), *Space Fostering African Societies*, Southern Space Studies, Springer (2021), pp. 181–216.

To the present date, the above instruments continue to be the compass of the ANGOSAT project and Space Strategy. This is an important point for those developing countries that are planning to launch large communication satellites like ANGOSAT.

5.1 Space Segment

The process of creating the space segment presented the challenge of building, launching, and putting into orbit the first Angolan communication satellite, named ANGOSAT-1, as well as hiring for the orbital position. ANGOSAT-1 launched on 26 December 2017; it stopped sending telemetry data to MCC, but the separation of ANGOSAT-1 from the rocket Zenit-3SLBF/Fregat-SB was successful, and it reached a GEO transfer orbit with a high level of precision.

Although the spacecraft had first established communications with MCC main and backup, where Angolan and Russian specialists were located, the contact was soon lost. The telemetry stopped coming in during the deployment of the vehicle's solar panels. After the first Off Nominal Situation (ONS), ground control specialists continued efforts and were able to restore communications with the spacecraft more than two times during one week, until the complete loss of the communication, as reported by RKK Energia, the main manufacturer of the satellite, in January 2018.

Notwithstanding the above, based on the knowledge and experience obtained, it is notable that the process or procedure of changing the design must be done very rigorously, particularly categorizing the satellite units, systems, and subsystems. Thus it is tendentially preferable that the units to be used have a proven inheritance; otherwise, and depending on the categorization, units must be submitted to a rigorous qualification process. In addition, during unit qualification and assembly and integration of the satellite, quality control of processes and procedures must always be observed.

Figure 2 presents the conceptual structure, completion of satellite testing, and launch campaigns: (a) general ANGOSAT-1 design with focus on the payload and the platform; (b) ANGOSAT-1 during the antenna reflector alignment; (c) ANGOSAT-1 transported to the launch site; (d) ANGOSAT-1 inside the launcher and final verifications.

Table 1 reveals the main ANGOSAT-1 technical characteristics, highlighting the number of transponders in the C- and Ku-bands, including the in-orbit life expectancy.

5.2 ANGOSAT-2 Project

Based on the Angolan experience and the best industry practices, considering the risks that may exist, projects of this nature and complexity are recommended to have a contractual clause related to the guarantee after placement in orbit as well

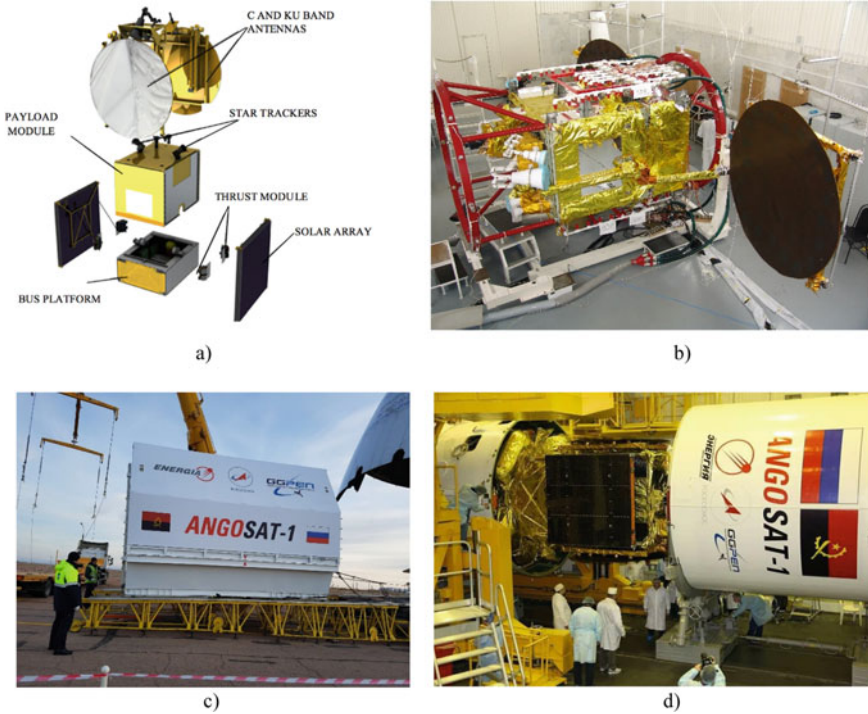


Fig. 2 ANGOSAT-1 satellite architecture, testing phase, and launch campaign

Table 1 ANGOSAT-1 satellite characteristics

Characteristics	Specifications
GEO position	13° E
Satellite weight	1.645 kg
Frequency bands	C and Ku
Number of repeaters/transponders	16C/6Ku
Life expectancy	15 years

as insurance in case of the total failure of the satellite in the act of launch or when it is already in orbit.

The present ANGOSAT-2 Project is a satellite intended for continuous round-the-clock data retransmission in the C-/Ku- and new the Ka-band in accordance with the frequency and polarization plan in its nominal GEO. The ANGOSAT-2 satellite is an assembly of two structurally and functionally integrated modules: platform and payload. All equipment is defined at the satellite level. The platform concept consolidates all satellite service subsystems and design solutions intended for supplying the satellite payload with needed resources and constitutes a high-level technological assembly.