

Status and Prospects of African States in the Use of Outer Space: A Media Review

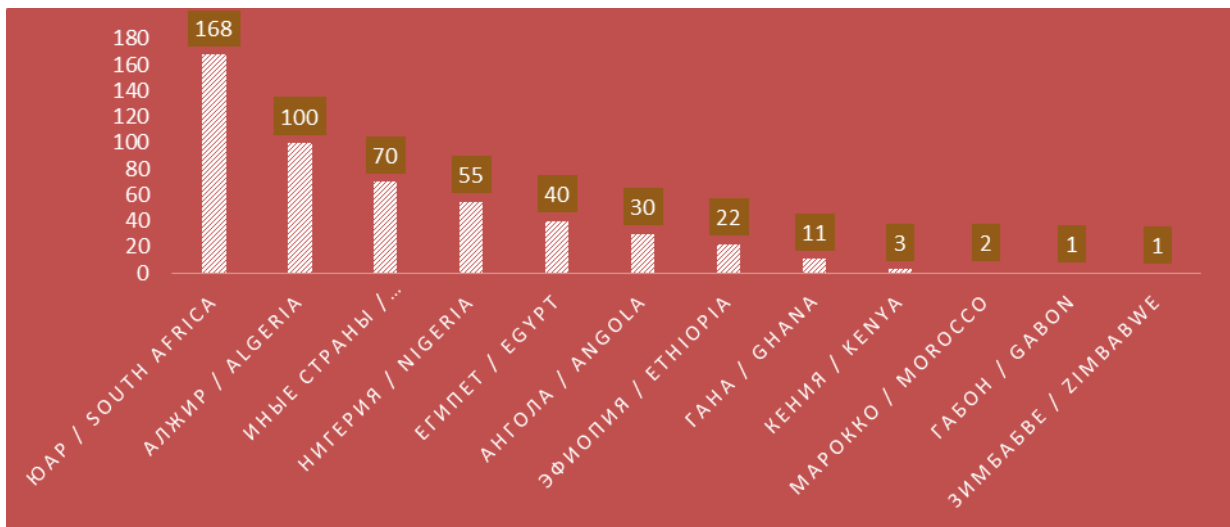
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For satellite operator services, Africa is likely to be the largest emerging market. This conclusion follows, firstly, from the size of the potential user base, where the resource is more than half of the continent's population that does not have access to the Internet. On the other hand, according to an analytical assessment, reducing the "digital divide" in the African region is almost impossible with terrestrial data networks only, including cellular communications, since the expected income from the provision of services in the interior of the continent does not compensate for capital investments in building infrastructure. Satellite communication is still regarded as the most efficient way to provide data transmission services to such regions. Expanding its use could increase the number of Internet users in individual African countries by more than 50 percent¹.

African countries are demonstrating a desire not to remain predominantly consumers of satellite services. This desire is expressed both by planning activities for the study and use of outer space and by attempts to form the basis for long-term multilateral inter-African cooperation in this area.

In 2020 compared to 2019, the total budget provided in African countries to finance activities for the study and use of outer space increased by 55 percent and amounted to about \$503 million. Although it is only 0.7 percent of related global spending, it would be unfair to consider it negligible, as it nearly doubled the cost of this activity in Canada.

¹ Bonface Osoro. Is Africa the New Battlefield for Low Earth Orbit (LEO) Constellations? [Electronic resource] // Space in Africa. – Mode of access: <https://africanews.space/is-africa-the-new-battlefield-for-low-earth-orbit-leo-constellations/>. – Date of access: 14.11.2021.



Amount of financial resources provided in individual African countries for the exploration and use of outer space in 2020 (million dollars)

Source / Source: 2020 Global space budget. ©Space in Africa, 2021

In 2022 compared to 2021, the budgetary expenditures of African countries provided for the needs of space activities increased by a rather modest amount - 2.2 percentage points, while the Asian and European regions saw a decrease in the such expenditures. In physical terms, their value amounted to more than half a billion, which, although significantly lower than in Asia, Europe and North America, is higher than in other geographical regions².

Between 2018 and 2020, **South Africa** had the largest average public investment in the exploration and use of outer space among countries in the African region. The value reflecting the ratio of GDP to the amount of government appropriations for the "space" industry in 2020 puts South Africa in second place in terms of this indicator on the continent.

In terms of the number of satellites launched into orbit, it ranks second among African states. Basically, they are nanosatellites created for the practical training of specialists in the field of space systems. Relying on Africa's own scientific and technical potential, historically the most significant in Africa, in creating satellite systems is an important feature of the South African space industry development strategy. Seven out of eight satellites of South Africa were created by the developers of this country³.

The strategic plan for 2020 - 2025 of the South African National Space Agency

² Joshua Faleti. How Africa's Budgetary Allocations have Fared with Other Regions Since 2020 [Electronic resource] // Space in Africa. – Mode of access: <https://africanews.space/how-africas-budgetary-allocations-have-fared-with-other-regions-since-2020/>. – Date of access: 22.08.2022.

³ Who Manufactured Africa's 41 Satellites? [Electronic resource] // Space in Africa. – Mode of access: <https://africanews.space/who-manufactured-africas-41-satellites/>. – Date of access: 14.11.2021.

provides for the priority development of activities for the exploration and use of outer space, which have already provided South Africa with a competitive advantage in the international market. These include: expanding the provision of services for the processing and analysis of Earth observation satellite data; modernisation of technical resources for space weather research; development of a tracking, telemetry and control centre for interaction with satellites; organisation of the provision of satellite radio navigation services through the introduction of a satellite-based system for differential corrections (using NigComSat resources).

The above plan also considers the possibility of setting up a South African satellite communications system, subject to the availability of necessary financial resources. The second condition for its creation is the ability to organise the development and production of components for space and ground segments in South Africa. It is planned to use the system for broadcasting TV contents, which is currently carried out by Sentech using foreign satellites, to provide broadband data transmission services, government communications, to ensure the implementation of e-education and e-medicine activities, and to provide satellite radio navigation services. It is assumed that functions of the system operator will be performed by the South African National Space Agency or a company established by it⁴. Thus, the need to develop a comprehensive investment project that provides for the broad participation and capacity building of national companies in its creation and operation can be considered a key issue in the development by South Africa of its satellite communications system. Commercial proposals based on the predominant use of ready-made solutions and services do not comply with the development strategy of the South African space industry.

Algeria ranked second in terms of average public investments in the exploration and use of outer space among the African countries in 2018-2020. However, although South Africa was more than twice as large as Algeria in terms of GDP in 2020, the size of the South African "space" budget differed from Algeria's by only 13 percentage points. In 2020, it was Algeria that was the leader in Africa in terms of the ratio of GDP to government spending on "space" purposes.

With 6 satellites launched into orbit, Algeria, together with Nigeria, ranks third in the African region. Four of them were microsatellites for earth surface remote sensing, one spacecraft was a nanosatellite intended for training and acquiring practical experience by specialists, and one was a communications satellite. Unlike South Africa, Algeria widely used the services of foreign developers and manufacturers when creating its satellites, while the purpose of their involvement was to increase the potential of the national space industry. The assembly of Alsat 2B launched into orbit in 2016 was carried out by a satellite systems development centre subordinate to the Algerian Space Agency.

⁴ SANSa South African National Space Agency. 2020 – 2025 SANSa Strategic Plan [Electronic resource]. – Mode of access: https://www.sansa.org.za/wp-content/uploads/2020/03/SANSa-Strategic-Plan-2020_2025.pdf. – Date of access: 14.11.2021.

We believe it possible to state that the Algerian Space Agency is open for cooperation in order to implement joint projects with organisations from various regions of the world based on the conditions offered to the Algerian side. Algeria collaborated with French and British companies in the creation of Earth observation satellites, the communications satellite was launched and launched into orbit in China. In addition, Algeria also interacted with India when launching satellites. The Agency concluded 3 cooperation agreements – with similar organisations from Argentina, Ukraine and France, signed 7 memorandums of understanding and cooperation⁵.

Algeria has developed a national program for the exploration and use of outer space for a twenty-year period – until 2040. The activities provided for by this program to be implemented in the near future include the launch of the AlSat-3 Earth observation satellite and the AlComSat-2 communication satellite. The exact date of their construction is not defined. AlComSat-2 is expected to have a payload for operation in the Ka band to provide data transmission services at 20 Mbps throughout the Algerian territory and in the Ku band to ensure the availability of data transmission services at 2 Mbps in the territories of countries located in the north-western part of the African continent⁶. In the event of development of work on the creation of the above satellite systems, which, of course, will require the involvement of foreign partners, the Senior Executives of the satellite industry in Algeria will certainly count on a very wide use of the national scientific and technical potential. Its core is formed by more than 1200 specialists in the field of development and operation of space systems trained as part of implementation of the state industry policy of Algeria⁷. Thus, this state, like South Africa, cannot be considered as a net consumer of technologies and services offered by foreign suppliers in the field of exploration and use of outer space.

Nigeria ranked third in terms of average public investments in the exploration and use of outer space among the African countries in 2018-2020, with the largest GDP in Africa. Their size has been relatively constant, but the federal budget for 2021 provided for an increase by 54 percentage points⁸. Of six satellites put into orbit by this country, three were Earth observation satellites (built by the British company Surrey Satellite Technology Ltd., while the NigeriaSat-X satellite was built by a Nigerian group of trainee engineers). Two Nigerian communications satellites (due to a malfunction, NigComSat-1 was replaced by NigComSat-1R) were built by China Great Wall Industry Corporation. The sixth satellite was created by the Federal Polytechnic University in cooperation with Japan for training and

⁵ Agence Spatiale Algerienne. La coopération bilaterale [Electronic resource]. – Mode of access: <https://asal.dz/bilaterale/>. – Date of access: 14.11.2021.

⁶ Several Algerian satellites to be launched under space programme 2020-2040 [Electronic resource]. – Mode of access: <https://www.aps.dz/en/health-science-technology/21871-several-algerian-satellites-to-be-launched-under-space-programme-2020-2040>. – Date of access: 14.11.2021.

⁷ AlSat-3 Satellite Currently In Definition Phase And Plans For AlComSat-2 Ongoing – ASAL Head [Electronic resource]. – Mode of access: <https://africanews.space/alsat-3-satellite-currently-in-definition-phase-and-plans-for-alcomsat-2-ongoing-asal-head/>. – Date of access: 14.11.2021.

⁸ State of the Nigerian Space Program – Interview with Dr. Halilu Ahmad Shaba , NASRDA New Director General [Electronic resource]. – Mode of access: <https://africanews.space/state-of-the-nigerian-space-program-interview-with-dr-halilu-ahmad-shaba-nasrda-new-director-general/>. – Date of access: 14.11.2021.

acquiring practical experience by specialists.

The National Space Research and Development Agency has about 3,500 employees. As of the beginning of 2021, they carried out 23 applied projects for the development of individual economic sectors. The scientific and technical potential of Nigeria allows the development of individual elements of satellite systems, in particular telemetry. However, when creating them, in general, interaction with foreign companies is necessary. The next announced tasks in the field of space use are the construction of NigeriaSat-3 and NigeriaSAR-1 earth observation satellites. As of 2020, a foreign contractor has not been selected for the construction order, and the start of work was scheduled for 2021⁹. At the same time, ensuring the possibility of independent performing all work related to the construction, testing and launch of satellites is called the strategic task of the agency¹⁰.

The Nigerian satellite communications system represented by Nigcomsat 1R is operated by the commercial company Nigerian Communications Satellite Ltd. Nigcomsat 1R has a payload in the C, Ka and Ku bands. In the broadcast segment, only 5 Nigerian multiplexes are distributed via Nigcomsat 1R¹¹. In the segment of data transmission services, Nigcomsat is scheduled to participate in the implementation of the Nigerian National Broadband Plan 2020 – 2025 for providing access to the Internet at 10 Mbps for about 3,000 access points and connecting 700 cellular base stations to data transmission networks at 15 Mbps in areas poorly accessible for the construction of terrestrial telecommunication networks¹².

Nigcomsat associates the possibility of expanding the sales of services with improvement of the job arrangement system, which has resulted in the creation of two subsidiaries: Satellite Infrastructure Company (aims to provide services to other operators) and Satellite Broadcasting and Broadband Company (is focused on providing services to end users).

Nigcomsat is also looking to take advantage of economies of scale from the launch of two communications satellites by 2025: NigComSat-2 and NigComSat-3. As of September 2021, the design of the NigComSat-2 satellite system was already underway, in particular, a request for quotation was sent. NigComSat-2 is planned by the customer as a high-performance satellite in the orbital position of 9.5°W. or 16°W with commercial payloads in

⁹ Nigeria to Begin Construction of Two New Satellites in 2021 [Electronic resource]. – Mode of access: <https://africanews.space/nigeria-to-begin-construction-of-two-new-satellites-in-2021/>. – Date of access: 14.11.2021.

¹⁰ State of the Nigerian Space Program – Interview with Dr Halilu Ahmad Shaba , NASRDA New Director General [Electronic resource]. – Mode of access: <https://africanews.space/state-of-the-nigerian-space-program-interview-with-dr-halilu-ahmad-shaba-nasrda-new-director-general/>. – Date of access: 14.11.2021.

¹¹ NigComSat 1R at 42.5°E [Electronic resource]. – Mode of access: <https://www.lyngsat.com/NigComSat-1R.html>. – Date of access: 14.11.2021.

¹² Nigerian National Broadband Plan 2020 – 2025 [Electronic resource]. – Mode of access: <https://www.ncc.gov.ng/documents/880-nigerian-national-broadband-plan-2020-2025/file>. – Date of access: 14.11.2021.

Ka and Ku bands¹³.

In general, the scope of the emerging areas in the exploration and use of outer space indicates the long-standing desire of Nigerian policy-makers to make this country a significant participant in at least the regional market for "space" services and technologies. However, an insufficient amount of budgetary expenditures allocated by the state for the development of the "space" industry, the conflict of commercial interests between suppliers and consumers of "space" services and technologies have resulted in the fact that, even 20 years after development of the "space road map", Nigeria remains at the initial development stage in this sphere¹⁴. Conflicts of commercial interests between various government agencies and investors appear to be a key problem for this industry, making it difficult to pursue a unified policy aimed at stimulating demand for services of national service providers. As a result, foreign satellite operators frequently become co-executors of investment projects in Nigeria, despite the availability of national service providers. Thus, in July 2022, a project was announced between the data provider Phase3 Telecom and operator Yahsat (United Arab Emirates) for the provision of Internet access in remote areas of the country¹⁵. In May 2022, the Nigerian Communications Commission issued two licenses to the US operator SpaceX to provide international telecommunications and Internet access services via the Starlink satellite system¹⁶.

The fourth country in the African region in terms of the average public spending on the exploration and use of outer space is **Egypt**. However, in 2018-2020 the spending volume was constant, amounting to 40 million dollars annually.

In terms of the number of space vehicles launched into near-Earth orbit, which amounted to nine units, Egypt became the regional leader (the actual number of space vehicles operated in orbit in the 4th quarter is 6 units).

Four out of six Egyptian satellites are designed for Earth observation. They are operated by the National Authority for Remote Sensing and Space Sciences. The current Earth observation satellite, EgyptSat-A, was created jointly by the Russian RSC Energia and a group of Egyptian specialists trained by the company, with the participation of the Belarusian

¹³ Mustapha Iderawumi. Nigeria Affirms Plan to Acquire Two Communication Satellites by 2025 [Electronic resource]. – Mode of access: <https://africanews.space/nigeria-affirms-plan-to-acquire-two-communication-satellites-by-2025/>.– Date of access: 14.11.2021.

¹⁴ State of the Nigerian Space Program – Interview with Dr Halilu Ahmad Shaba , NASRDA New Director General [Electronic resource]. – Mode of access: <https://africanews.space/state-of-the-nigerian-space-program-interview-with-dr-halilu-ahmad-shaba-nasrda-new-director-general/>.– Date of access: 14.11.2021.

¹⁵ Ayooluwa Adetola. YahClick and Phase3 Telecom Partner to Offer High-Speed Satellite Broadband to Nigeria [Electronic resource]. – Mode of access: <https://africanews.space/spacexs-starlink-approved-by-nigeria-and-mozambique/>.– Date of access: 22.08.2022.

¹⁶ Mustapha Iderawumi. SpaceX's Starlink Approved by Nigeria and Mozambique [Electronic resource]. – Mode of access: <https://africanews.space/spacexs-starlink-approved-by-nigeria-and-mozambique/>.– Date of access: 22.08.2022.

enterprises Peleng and Geoinformation Systems¹⁷. However, the next satellite, MisrSat-2, whose launch is tentatively scheduled for the first quarter of 2023, is planned as an Egyptian-Chinese project where the Chinese side is an investor and co-developer^{18 19}.

In 2019 the National Authority for Remote Sensing and Space Sciences organised the launch of two own picosatellites into orbit: NARSSCube-1 and NARSSCube-2. The launch of the first of the satellites provided for by the Next project carried out jointly with Germany was scheduled for December 2021²⁰.

Like in the other states listed above, Senior Executives of the Egyptian space industry have set the goal of ensuring the possibility of developing and manufacturing authentic satellites. The international space centre, the first one in the Arab world, whose opening date was announced by the director of the Egyptian Space Agency for September 2022, is called upon to contribute to the achievement of this goal²¹.

The satellite communication services segment in Egypt is represented by the commercial company Nilesat, which, as of 2021, operated a single communication satellite, Nilesat 201 (7°W) and two teleports. This satellite has a payload in Ka and Ku bands and is designed to serve users in North Africa and the Middle East. According to the operator, it delivers TV content to 270 million viewers and 56 million households. The key factor of the high load of the Nilesat 201 Ku-band beams can be considered the joint operation with Eutelsat in the orbital position of 7° W²².

For 9 months of 2021, Nilesat's revenues amounted to \$87 million. Throughout 2021, their decrease was noted compared to the same reporting periods of 2020. A gradual decrease in the operator's revenues has been observed since 2014, when their annual volume amounted to about \$200 million²³. The use of economies of scale to reduce operating costs and the development of new markets in Sub-Saharan Africa can be considered as the basis for the design of Nilesat 301. Its launch into orbit (in a similar position - 7° W) was carried out on

¹⁷ National Authority for Remote Sensing and Space Sciences [Electronic resource]. – Mode of access: https://en.wikipedia.org/wiki/National_Authority_for_Remote_Sensing_and_Space_Sciences. – Date of access: 30.11.2021.

¹⁸ Egypt to launch EgyptSat 2 satellite in 2023 [Electronic resource]. – Mode of access: <https://www.sis.gov.eg/Story/160174/Egypt-to-launch-EgyptSat-2-satellite-in-2023?lang=en-us>. – Date of access: 30.11.2021.

¹⁹ David Oni. Egypt To Launch Satellite By The End Of 2021 [Electronic resource]. – Mode of access: <https://africanews.space/egypt-to-launch-satellite-by-the-end-of-2021/>. – Date of access: 30.11.2021.

²⁰ Egyptian Satellite 'Next' to be launched in December, African Space Agency to be established in Egyptian Space City [Electronic resource]. – Mode of access: <https://www.sis.gov.eg/Story/160174/Egypt-to-launch-EgyptSat-2-satellite-in-2023?lang=en-us>. – Date of access: 30.11.2021.

²¹ Egypt to launch 'Next' satellite in December 2021 [Electronic resource]. – Mode of access: <https://satelliteprome.com/news/egypt-to-launch-next-satellite-in-december-2021/>. – Date of access: 30.11.2021.

²² Chris Forrester. Nilesat explains 301 craft's role [Electronic resource]. – Mode of access: <https://advanced-television.com/2021/09/29/nilesat-explains-301-crafts-role/>. – Date of access: 30.11.2021.

²³ Wale Adelanwa. NileSat's Net Profit Dropped by 22% in the First Nine Months of 2021 [Electronic resource]. – Mode of access: <https://africanews.space/nilesats-net-profit-dropped-by-22-in-the-first-nine-months-of-2021/>. – Date of access: 30.11.2021.

June 8, 2022. This spacecraft, as well as Nilesat 201, was manufactured by Thales Alenia Space. It was selected as a contractor according to results of an international competition with a total project budget of \$300 million²⁴.

According to the planned technical parameters, the payload of Nilesat 301 is designed to operate in Ka and Ku bands. The Ku band will allow the provision of services in the states of Eastern and Southern Africa²⁵. It can be assumed that in order to increase the degree of use of the payload of this satellite, Egypt expects to use pan-African projects through the African Space Agency, which was formed in 2018, but has not yet passed the organisational stage. It is expected to begin operation on the basis of the international space centre being created in Egypt²⁶.

Egypt, declaring its intention to become a regional space power both in Africa and the Middle East, is initiating other projects in the use of outer space that unite several states²⁷. The relevant information will be provided below. In general, Egypt has created a significant groundwork for acquiring a reputation as a competitive player in the market for space technologies and services in the African region. However, the problems of availability of resources for the implementation of its plans and projects, as well as the effectiveness of their management, significantly affect the process of the actual acquisition of this reputation.

The last one among the top five countries in terms of average investments in the study and use of outer space in 2018 – 2020 is **Angola**. But its ratio of GDP to government appropriations for the "space" industry puts this state in the third place on the continent.

The "space" history of Angola, unlike most other states in the region, began with the creation not of an Earth observation system, but of satellite communications. The Angosat 1 communications satellite was built by the Russian RSC Energia with the participation of Angolan specialists in its design, launched into geostationary orbit at a position of 14 °E in December 2017, but was not put into operation due to malfunctions in the power subsystem of the vehicle²⁸. The operation of this satellite network was included in the National Strategic Plan for 2016-2025, approved by the decree of the head of state on May 10, 2017, which also reflected such areas of development of the "space" industry as operation of the ground segment of the satellite communications system, construction of Earth observation satellites, navigation and positioning systems, as well as achieving significant autonomy in the

²⁴ NileSat Signs Contract To Build NileSat 301 Communications Satellite [Electronic resource]. – Mode of access: <https://africanews.space/nilesat-awards-contract-for-the-new-nilesat-301-communications-satellite/>. – Date of access: 30.11.2021.

²⁵ Nilesat 301 [Electronic resource]. – Mode of access: <http://www.nilesat.com.eg/pdf/Cabsat/Nilesat%20Brochure%202021.pdf>. – Date of access: 30.11.2021.

²⁶ David Oni. Egypt To Launch Satellite By The End Of 2021 [Electronic resource]. – Mode of access: <https://africanews.space/egypt-to-launch-satellite-by-the-end-of-2021/>. – Date of access: 30.11.2021.

²⁷ Egypt To Launch A Pan-African Satellite Development Initiative On Wednesday [Electronic resource]. – Mode of access: <https://africanews.space/egypt-to-launch-a-pan-african-satellite-development-initiative-on-wednesday/>. – Date of access: 30.11.2021.

²⁸ In Conversation with Zolana João, General Director of Angolan Space Office [Electronic resource]. – Mode of access: <https://africanews.space/zolana-joao-interview-angola-space-office/>. – Date of access: 10.12.2021.

development and operation of satellite systems²⁹. At certain stages, the implementation of this plan is determined by policy documents approved by the sectoral ministry of the Angolan government³⁰. Long before the completion of work on the creation of Angosat 1, in 2010, a state agency coordinating policy on the exploration and use of outer space was formed – the Angolan National Space Program Management Office (GGPEN)³¹.

As compensation for the payload of the lost satellite, the Angolan operator was provided with capacity on Express AM7 and Eutelsat 3B,³² which, however, are little used for broadcasting national media³³. At the expense of insurance funds paid in connection with the loss of Angosat 1, the manufacture of Angosat 2 was organised. JSC "Information Satellite Systems named after Academician M. F. Reshetnev" was determined as the contractor for its construction and launch, however, the payload is made by Airbus³⁴. According to information released in November 2021 by the Ministry of Telecommunications, Information Technologies and Social Communication of Angola, the launch of this satellite into orbit is scheduled for the first half of 2022, while the readiness of the vehicle is estimated at 60%³⁵. The payload of Angosat 2 compared to Angosat 1 has been increased – from 16 to 24 Ku transponders. In addition, the spacecraft will have a Ka-band payload that Angosat 1 did not have. The number of C-band transponders is planned to remain the same - 6³⁶. Thus, at no additional cost, Angola will receive a satellite with higher performance and broader capabilities for providing data services.

In accordance with the decree of the President of Angola, the satellite operation and flight control centre is being upgraded to provide services using the Ka-band frequencies³⁷. The mass training of technical personnel for servicing VSAT subscriber stations has been

²⁹ Ayooluwa Adetola. The Angolan National Space Programme [Electronic resource]. – Mode of access: <https://africanews.space/the-angolan-national-space-programme/>. – Date of access: 10.12.2021.

³⁰ Angola National Space Strategy Plan for 2019 – 2022 approved by the Ministry [Electronic resource]. – Mode of access: <https://africanews.space/angola-national-space-strategy-plan-for-2019-2022-approved-by-the-ministry/>. – Date of access: 10.12.2021.

³¹ Ayooluwa Adetola. The Angolan National Space Programme [Electronic resource]. – Mode of access: <https://africanews.space/the-angolan-national-space-programme/>. – Date of access: 10.12.2021.

³² Ayooluwa Adetola. The Angolan National Space Programme [Electronic resource]. – Mode of access: <https://africanews.space/the-angolan-national-space-programme/>. – Date of access: 10.12.2021.

³³ Free TV from Angola [Electronic resource]. – Mode of access: <https://www.lyngsat.com/freetv/Angola.html>. – Date of access: 10.12.2021.

³⁴ Angosat 2 will be launched in March 2022 [Electronic resource]. – Mode of access: <https://tass.ru/kosmos/9341547>. – Date of access: 10.12.2021.

³⁵ Joshua Faleti. “ANGOSAT-2 will be launched in the first half of 2022”, Reiterates Minister Manuel Homem [Electronic resource]. – Mode of access: <https://africanews.space/the-angolan-national-space-programme/>. – Date of access: 10.12.2021. – Date of access: 10.12.2021.

³⁶ Ibid.

³⁷ Angola to upgrade satellite ground station facility for AngoSat-2 [Electronic resource]. – Mode of access: <https://africanews.space/angola-to-upgrade-satellite-ground-station-facility-for-angosat-2/>. – Date of access: 10.12.2021.

organised³⁸.

Airbus has become the contractor for the construction of the first commercial Earth observation satellite for Angola. The relevant Angolan-French agreement was signed in May 2019 with a declared cost of \$179 million³⁹. Information about the expected launch dates of Angosat 3 as of November 2021 was not announced in the media. However, in 2021, the National Space Program Management Office carried out activities to analyse data obtained through foreign satellite systems for economic and environmental purposes.

To achieve the goal of independence in the development and operation of satellite systems, this body seeks to establish cooperation with partners from various regions of the world. Thus, the Office has concluded agreements with the European Space Agency, the University Space Engineering Consortium (UNISEC), Airbus and Thales Alenia Space⁴⁰. As part of the drought monitoring project, the National Space Program Management Office is collaborating with the University of Tokyo, the Massachusetts Institute of Technology and the International Space University (France)⁴¹. Since 2020, Angola has had an intergovernmental agreement on cooperation in the field of exploration and use of outer space for peaceful purposes with Russia⁴². It is planned to place a GLONASS measuring station in the territory of Angola⁴³. There is evidence of the intention of this state to secure the position of a regional leader in the development of the "space" industry, at least for Portuguese-speaking countries of Africa⁴⁴.

The development of activities for the exploration and use of outer space in Angola is considered at the highest state level as a significant factor of the national economic development. All directions of this activity are coordinated by the same organisation - the National Space Program Management Office. With the successful commissioning of Angosat 2, Angola will become an important player in the regional satellite communications services market.

³⁸ Mustapha Iderawumi. More than 80 Angolan Youths Trained in VSAT Antennas Installation and Maintenance [Electronic resource]. – Mode of access: <https://africanews.space/angola-to-upgrade-satellite-ground-station-facility-for-angosat-2/>. – Date of access: 10.12.2021.

³⁹ Angola signs agreement with Airbus to build \$179m AngoSat-3 [Electronic resource]. – Mode of access: <https://satelliteprome.com/news/angola-signs-agreement-with-airbus-to-build-179m-angosat-3/>. – Date of access: 10.12.2021.

⁴⁰ Ayooluwa Adetola. The Angolan National Space Programme [Electronic resource]. – Mode of access: <https://africanews.space/the-angolan-national-space-programme/>. – Date of access: 10.12.2021.

⁴¹ Ruy Blanes. Notes on the use of satellites to combat drought in Angola [Electronic resource]. – Mode of access: <https://secaangola.hypotheses.org/233>. – Date of access: 10.12.2021.

⁴² K. Redichkina. Russia and Angola will explore space together [Electronic resource]. - Mode of access: <https://www.pnp.ru/in-world/rossiya-i-angola-budut-vmeste-osvaivat-kosmos.html>. – Date of access: 10.12.2021.

⁴³ A Roscosmos company will deploy GLONASS monitoring stations in five countries [Electronic resource]. – Mode of access: <https://tass.ru/ekonomika/12427883>. – Date of access: 10.12.2021.

⁴⁴ Mustapha Iderawumi. Angola to Guide Mozambican Space Programme, Mozambican Delegation [Electronic resource]. – Mode of access: <https://africanews.space/mozambican-delegation-meets-angolan-space-programme/>. – Date of access: 10.12.2021.

Since 2019, **Ethiopia** has significantly expanded its activities in the exploration and use of outer space. This expansion occurred due to Ethiopia's cooperation with China. In 2019, the ETRSS Earth observation microsatellite was launched into orbit from the territory of China. Its construction was also carried out in China, but 21 Ethiopian aerospace engineers were involved in its design⁴⁵. In 2020, the ET-SMART-RSS Earth observation nanosatellite was launched into orbit⁴⁶. To receive data from Earth observation satellites, an earth station was equipped at the observatory of the Ethiopian Space Science and Technology Institute with the help of the Chinese company HEAD⁴⁷. In May 2019, an agreement between China and Ethiopia was signed on the construction of an Ethiopian communications and broadcasting satellite, with a significant scope of work planned to be performed in Ethiopia. The estimated launch date of this satellite was not specified⁴⁸. In 2021, a regulation was adopted on the establishment of a single organisation – the Institute of Space and Geoinformation Technology – on the basis of the Ethiopian Space Science and Technology Institute and the Ethiopian Geospatial Information Institute⁴⁹. According to a rough estimate, the total number of employees of the newly established institution is about 800 FTEs. As short-term and medium-term goals, the state plans to organise the production, assembly and testing of systems for Earth observation and communication satellites⁵⁰. At the same time, Ethiopia's budget expenditures on "space" activities in 2021 decreased by twice compared to 2020, amounting to \$10.4 million⁵¹. Thus, Ethiopia is another state in the African region that has large-scale plans for the use of outer space. They were partially implemented in 2019-2020 through a launch of two Earth observation satellites. Ethiopia announced its intention to create its own satellite communications system, moreover, using its own scientific and technical capabilities. However, the prospects for implementation of the state's plans in the space sector, as in most other countries of the African region, depend to a decisive extent on the possibilities and amount of external funding attracted.

According to our estimates, as of 2020, **Ghana** broadcast the largest number of TV channels in Sub-Saharan Africa. However, this state has no plans to launch its own communications and broadcasting satellites. The priorities of the Ghana Space Science and Technology Centre are radio astronomy (using a radio telescope opened as part of a joint project with South Africa), remote sensing, climate change monitoring, satellite observation

⁴⁵ Ethiopia Set To Launch Its First Satellite Next Year [Electronic resource]. – Mode of access: <https://africanews.space/ethiopia-to-launch-first-satellite-next-year/>. – Date of access: 23.01.2022.

⁴⁶ ESSTI Confirms Launch Details of ET-SMART-RSS Satellite, Built In Collaboration With Chinese Partner [Electronic resource]. – Mode of access: <https://africanews.space/essti-confirms-launch-details-of-et-smart-rss-satellite-built-alongside-chinese-partner/>. – Date of access: 23.01.2022.

⁴⁷ Inauguration of Ground Receiving Station of ESSTI in Ethiopia [Electronic resource]. – Mode of access: <https://www.head-aerospace.eu/post/inauguration-of-ground-receiving-station-of-essti-in-ethiopia>. – Date of access: 23.01.2022.

⁴⁸ Ethiopia signs communications satellite development agreement with China [Electronic resource]. – Mode of access: <https://africanews.space/ethiopia-signs-communication-satellite-development-agreement-with-china/> – Date of access: 23.01.2022.

⁴⁹ Ethiopian Government to Merge the Ethiopian Space Science and Technology Institute and Ethiopian Geospatial Information Institute [Electronic resource]. – Mode of access: <https://africanews.space/ethiopian-government-to-merge-the-ethiopian-space-science-and-technology-institute-and-ethiopian-geospatial-information-institute/> – Date of access: 23.01.2022.

⁵⁰ Ibid.

⁵¹ The Ethiopian Space Ambition; a Country-Level Analysis [Electronic resource]. – Mode of access: <https://africanews.space/the-ethiopian-space-ambition-a-country-level-analysis/> – Date of access: 23.01.2022.

and the implementation of educational programs⁵². The GhanaSat-1 picosatellite built with the assistance of Japan by employees of the National University has been in orbit since 2017–2019⁵³. Plans for the GhanaSat-2 and GhanaSat-3 satellites were announced in 2019⁵⁴. The Ghana Space Science and Technology Centre has developed a long-term program of activities for the exploration and use of space, which, in particular, provides for the use of satellite communications for the provision of e-health and telecommunication services in remote areas⁵⁵. We believe that goals specified in this program are for the "optimistic" scenario of the long-term economic development of Ghana. Their achievement, of course, will depend on the prospects for establishing partnerships with foreign investors and the interest of potential users of satellite services in the public and private sectors in the implementation of this program.

In 2020, the **Kenya** Space Agency developed a Strategic Plan for 2020-2025. This framework document defines the areas of activity for the exploration and use of outer space: Earth observation; navigation and positioning; satellite connection; development and operation of satellite systems; astronomy. Activities that fill the intended areas with specific content are not indicated in the published version of the program⁵⁶. The location of the cosmodrome and the European Space Agency satellite flight control centre in Kenya gives this state some advantages in the development of the national space industry. In 2018 - 2020, the first Kenyan picosatellite 1KUNS-PF built by a group of Kenyan engineers and students of the University of Nairobi with the assistance of Japan was in orbit⁵⁷. The launch of the TAIFA-1 Earth observation nanosatellite with software reconfigurable payload constructed according to a contract between SayariLabs (Kenya) and EnduroSat (Bulgaria) is scheduled for the 4th quarter of 2022⁵⁸.

Satisfying the national needs for satellite communications services is currently planned through the payload of foreign satellites. A long-term contract between the mobile operator Safaricom and Intelsat was signed in March 2022 to increase the coverage area of the LTE network⁵⁹. Kenya has declared its intention to create a national "space" industry, but is still at the beginning of this path. Like other countries in the African region, the prospects for their implementation will depend to a large extent on the availability of financial resources for specific projects.

⁵² A Government of Ghana institution mandated to coordinate all space science technology and related activities in Ghana. [Electronic resource]. – Mode of access: <https://gssti.org/#about>. – Date of access: 25.01.2022.

⁵³ GhanaSat-1 [Electronic resource]. – Mode of access: <https://en.wikipedia.org/wiki/GhanaSat-1>. – Date of access: 25.01.2022.

⁵⁴ GhanaSat-1, the first Ghanaian Satellite [Electronic resource]. – Mode of access: <https://www.spacelegalissues.com/space-law-ghanasat-1-the-first-ghanaian-satellite/>. – Date of access: 25.01.2022.

⁵⁵ David Kodjani. 10 Benefits Of The Ghanaian Space Program [Electronic resource]. – Mode of access: <https://afroaware.com/10-benefits-of-ghanaian-space-program>. – Date of access: 25.01.2022.

⁵⁶ Strategic Plan 2020 – 2025 [Electronic resource]. – Mode of access: https://ksa.go.ke/static/f8fc4c46eb15e203d1d36648dd7c7e1d/KSA_POPULAR_VERSION_October_Compressed.pdf. – Date of access: 25.01.2022.

⁵⁷ Kenya's 1KUNS-PF Cubesat Ready for Launch by Japan [Electronic resource]. – Mode of access: <https://spacewatch.global/2018/01/kenyas-1kuns-pf-cubesat-ready-launch-japan/>. – Date of access: 25.01.2022.

⁵⁸ Mustapha Idewarumi. TAIFA-1, the First Kenyan Software-defined NanoSat [Electronic resource]. – Mode of access: <https://africanews.space/taifa-1-the-first-kenyan-software-defined-nanosat/>. – Date of access: 23.05.2022.

⁵⁹ Mustapha Iderawumi. Safaricom Partners with Intelsat to Expand LTE Coverage in Kenya [Electronic resource]. – Mode of access: <https://africanews.space/safaricom-partners-with-intelsat-to-expand-lte-coverage-in-kenya/>. – Date of access: 23.05.2022.

Morocco has two national organisations responsible for activities in the exploration and use of outer space: the Royal Centre for Space Studies and Research (CRERS) and the Royal Centre for Remote Sensing (CRTS). In the development of this activity, Morocco seeks to use historical partnerships with France (it has a cooperation agreement with it) and with monarchies of the Arabian Peninsula (in 2021, Morocco joined the Arab Space Cooperation Group led by the United Arab Emirates⁶⁰). In 2017 - 2018 the Mohammed-VIA and Mohammed VI-B Earth observation satellites built in France, classified as small vehicles (with a mass of more than 1 ton), were launched into low Earth orbit. One of the most important tasks of using these satellites is to obtain intelligence data. Information about the state's plans to create communication and broadcasting satellites was not made public.

A specific feature of the "space" strategy of **Gabon** is the priority development of activities for the analysis of information received from Earth observation satellites and the acquisition of leadership among French-speaking states of Equatorial Africa in regional projects for the use of such information in the interests of sustainable use of natural, primarily, forest resources. Although the launch of its own Earth Observation satellite is a long-term goal for the period up to 2030⁶¹, the Gabonese Agency for Space Studies and Observation has already established 13 foreign partnerships⁶². It operates an earth station with 39 employees. The advantage of Gabon among other countries of the region can be considered the fact that this state has significant financial resources of its own (the GDP per capita in Gabon is the largest in continental Africa). Gabon is an example of long-term planning for the use of outer space within a predetermined niche, which is commensurate with the financial capabilities of this state.

In 2022, the **Zimbabwe** National Geospatial and Space Agency's budget is planned to increase by 368% compared to 2021 (to about \$2 million)⁶³. This state organisation has existed since 2018. The priorities of its activities are the compilation of specialized maps for planning projects in the economic field based on satellite images (soil, mineral deposits, promising locations for energy facilities, boundaries of epidemiologically disadvantaged areas)⁶⁴. The launch of the Zimsat-1 nanosatellite created at the National University with the assistance of Japan was scheduled for July 2022⁶⁵. The creation of a national communications and broadcasting satellite is currently not planned.

In 2020, the President of **Botswana** announced the initiation of a national space program involving the launch of an ultra-small Earth observation satellite and, in a longer

⁶⁰ Joshua Faleti. Morocco Signs Arab Space Cooperation Group's Basic Charter [Electronic resource]. – Mode of access: <https://africanews.space/morocco-signs-arab-space-cooperation-groups-basic-charter/>. – Date of access: 26.01.2022.

⁶¹ 2020 in Review – Gabon Space Program [Electronic resource]. – Mode of access: <https://africanews.space/2020-in-review-gabon-space-program/>. – Date of access: 26.01.2022.

⁶² L'Agence Gabonaise d'Etudes et d'Observations Spatiales [Electronic resource]. – Mode of access: <https://ageos.ga/index.php/ageos/>. – Date of access: 26.01.2022.

⁶³ The Zimbabwe National Geospatial and Space Agency (ZINGSA)'s 2022 budget saw a whopping 368% increase compared to its 2021 budget [Electronic resource]. – Mode of access: <https://ne-np.facebook.com/spaceinafrica1/posts/the-zimbabwe-national-geospatial-and-space-agency-zingsas-2022-budget-saw-a-whoop/965631730720422/>. – Date of access: 26.01.2022.

⁶⁴ Geospatial, Aeronautical and Space Science Capability Programme [Electronic resource]. – Mode of access: http://www.mhtestd.gov.zw/?page_id=3531. – Date of access: 26.01.2022.

⁶⁵ Zimbabwe's Scientists Look Forward to Country's First Satellite [Electronic resource]. – Mode of access: <https://eos.org/articles/zimbabwes-scientists-look-forward-to-countrys-first-satellite>. – Date of access: 26.01.2022.

term, the creation of an orbital constellation of nanosatellites⁶⁶. At the end of 2022, it is planned to complete the construction of an Earth mobile station for receiving data from meteorological satellites. It is carried out jointly with the Chinese company Space Star Technology⁶⁷.

In 2020, **Burkina Faso** announced the information about the start of creation of the first nanosatellite with an Earth station complex. The satellite construction was assumed to be carried out at the National University with the participation of qualified specialists from the burkinaise overseas diaspora⁶⁸.

The construction of two nanosatellites in 2021 was carried out in the small state of **Djibouti**. Its is supposed to be performed by 10 engineers sent by the Ministry of Higher Education and Science of this country to the University of Montpellier Space Centre in France. This project is partially financed by the above university⁶⁹. In May 2022, the Ministry of Science and Higher Education of Djibouti announced the search for a service provider to launch the Djibouti-1B picosatellite into orbit. Its launch is scheduled for 2023⁷⁰.

Senegal is cooperating with the University of Montpellier for the creation of the first national ultra-small satellite⁷¹. According to updated information, its launch into orbit is expected in the third quarter of 2023. Senegal has a national space program and the position of its coordinator, and the country has announced the creation of a space agency in the short term⁷². In May 2022, a decision was made to build a teleport in Senegal to provide high-speed data transmission services in the Ka band by the operator Avanti Communications (UK) in the territories of seven West African countries⁷³.

As of 2021, the possibility of launching a satellite to serve the needs of agricultural development was being studied in **Zambia**⁷⁴. In April 2022, a new project competition held as part of the NewSpace Africa conference named the Zambian nominee Ignitos Space as the

⁶⁶ Botswana Launches National Space Program [Electronic resource]. – Mode of access: <https://africanews.space/botswana-launches-national-space-program/>. – Date of access: 31.01.2022.

⁶⁷ The Detailed Design of Botswana Meteorological Satellite Transportable Ground System [Electronic resource]. – Mode of access: <https://africanews.space/the-detailed-design-of-botswana-meteorological-satellite-transportable-ground-system/>. – Date of access: 31.01.2022.

⁶⁸ Burkina Faso Unveils Ground Station, Begins Construction Of First Satellite BurkinaSat-1 [Electronic resource]. – Mode of access: <https://africanews.space/burkina-faso-unveils-ground-station-begins-construction-of-first-satellite-burkinasat-1/>. – Date of access: 31.01.2022.

⁶⁹ Mustapha Iderawumi. Djibouti is Launching its Space Program with Two Satellites [Electronic resource]. – Mode of access: <https://africanews.space/djibouti-is-launching-its-space-program-with-two-satellites/>. – Date of access: 31.01.2022.

⁷⁰ Mustapha Iderawumi. Call for Launch Opportunity for DJIBOUTI-1B [Electronic resource]. – Mode of access: <https://africanews.space/call-for-launch-opportunity-for-djibouti-1b/>. – Date of access: 23.05.2022.

⁷¹ Senegal Sets Two-Year Target To Launch Its First Nano-Satellite [Electronic resource]. – Mode of access: <https://africanews.space/senegal-sets-two-year-target-to-launch-its-first-nano-satellite/>. – Date of access: 31.01.2022.

⁷² Joshua Faleti. Senegal and Rwanda Disclose Plans to develop Space Infrastructure [Electronic resource]. – Mode of access: <https://africanews.space/senegal-and-rwanda-disclose-plans-to-develop-space-infrastructure/>. – Date of access: 24.05.2022.

⁷³ Mustapha Iderawumi. Avanti Communications and Free in Senegal Sign Landmark Agreement to Build and Host a New HYLAS 4 Satellite Gateway in Senegal [Electronic resource]. – Mode of access: <https://africanews.space/avanti-communications-and-free-in-senegal-sign-landmark-agreement-to-build-and-host-a-new-hylas-4-satellite-gateway-in-senegal/>. – Date of access: 22.08.2022.

⁷⁴ Two Satellite Projects for Djibouti and Zambia are Finalists for Arianespace Rideshare Mission [Electronic resource]. – Mode of access: <https://africanews.space/two-satellite-projects-for-djibouti-and-zambia-are-finalists-for-arianespace-rideshare-mission/>. – Date of access: 31.01.2022.

winner with the initiative to create and launch an Earth observation nanosatellite in 2023 for satisfying the needs of users in Zambia and South Africa⁷⁵

In 2019, information was published that the feasibility of developing a national space program was being considered by **Cameroon**. To carry out this work, the Ministry of Posts and Telecommunications of this state established a working group⁷⁶. Mozambique carried out similar activities in 2021⁷⁷.

In 2012, the **Democratic Republic of the Congo** also announced a plan to launch the Congo-Sat-1 communications satellite, but the last publication about this plan, due to the difficulty of its implementation, dates back to 2018⁷⁸.

In 2018, **Côte d'Ivoire** announced its intention to build a satellite to monitor coastal waters and combat piracy in the Gulf of Guinea by 2020⁷⁹. The President of this country, A. Ouattara, approved the relevant agreement with the European company Airbus Defense and Space, but as of January 2022, the planned satellite was not launched into orbit. In July 2022, a message was published on the preparations for the establishment of a national space agency in Côte d'Ivoire⁸⁰.

Despite the actual collapse of **Libya**, the Center for Remote Sensing and Space Science of this state managed to retain part of its team formed before the events of 2011 and maintain its qualifications thanks to the help of Pakistan, and to receive funding through the participation of the team in performing certain regional studies. However, the restoration of the Centre's operation for receiving satellite data and the launch of an Earth observation satellite remain an unattainable goal for this Centre⁸¹.

Until recently, the main direction of "space" activity in **Mauritius** was radio astronomy research using the telescope in Bras d'Eau. In 2018, the MIR-SAT 1 nanosatellite constructed by the National Research Council with the help of Japan was launched into orbit. Possible directions for further expansion of the space industry in Mauritius may be: the construction of a teleport, a cosmodrome and an astronomical observatory. In this case, the comparative advantage is considered to be the geographical position of the country at a distance from the continents in the Indian Ocean near the equator⁸².

In 2018, **Namibia** and China signed an agreement to build the first earth station to receive information from Earth observation satellites using borrowed financial resources of

⁷⁵ Joshua Faleti. Ignitos Space Zambia Emerges Winner of NewSpace Africa Startup Pitch Competition [Electronic resource]. – Mode of access: <https://africanews.space/ignitos-space-zambia-emerges-winner-of-newspace-africa-startup-pitch-competition/> – Date of access: 23.05.2022.

⁷⁶ Cameroon Plans To Launch A National Space Programme [Electronic resource]. – Mode of access: <https://africanews.space/cote-divoire-organises-workshop-towards-establishing-national-space-agency/> – Date of access: 22.08.2022.

⁷⁷ Mustapha Iderawumi. Angola to Guide Mozambican Space Programme, Mozambican Delegation [Electronic resource]. – Mode of access: <https://africanews.space/mozambican-delegation-meets-angolan-space-programme/> – Date of access: 31.01.2022.

⁷⁸ DR Congo's planned launch of CongoSat-1 still a mirage [Electronic resource]. – Mode of access: <https://africanews.space/dr-congos-planned-launch-of-congosat-1-still-a-mirage/>. – Date of access: 13.02.2022.

⁷⁹ Ivory Coast to become the 9th African Country with Satellite in Space [Electronic resource]. – Mode of access: <https://africanews.space/ivory-coast-to-become-the-9th-african-country-with-satellite-in-space/> – Date of access: 31.01.2022.

⁸⁰ Joshua Faleti. Côte d'Ivoire Organises Workshop Towards Establishing National Space Agency

⁸¹ David Oni. We have always wondered what the Space program in Libya looked like [Electronic resource]. – Mode of access: <https://africanews.space/telone-broadband-eutelsat-zimbabwe/>. – Date of access: 28.01.2022.

⁸² David Oni. Mauritius' Space Journey, Strategic Goals and Roadmap to the Future [Electronic resource]. – Mode of access: <https://africanews.space/mauritius-space-journey-strategic-goals-and-roadmap-to-the-future/>. – Date of access: 28.01.2022.

China. The symbolic act of the leadership of Namibia, which testified to the strategic nature of cooperation with China, was sending the national flag of this country to the Chinese orbital space station⁸³.

In 2019, the first picosatellite of **Rwanda** constructed in Japan by a group of 15 Rwandan engineers was launched into orbit⁸⁴. In 2021, the Rwanda Space Agency was established. In the short term, the priorities in its activities were the creation of an earth station for obtaining and analysing satellite images with the participation of the American company GlobalStar, as well as sending agency personnel for training to the United States and Israel⁸⁵.

In addition, in 2021, on behalf of Rwanda, an orbital-frequency application was submitted to the International Telecommunication Union for creating two satellite systems in non-geostationary orbits, but it is unknown whether such systems will really be created in this state or the applications were filed in the interests of a foreign business-project⁸⁶. According to updated information announced by the Minister of ICT and Innovation of Rwanda in April 2022, seven satellites of the Cinnamon-217 and Cinnamon-937 systems are expected to be launched into orbit by 2023⁸⁷. Later, the director general of the Rwanda Space Agency announced the commissioning of a geoinformation centre with an earth station designed, among other things, for virtual servicing of users from other countries by the end of this year⁸⁸.

In 2013, the Institute of Space Research and Aerospace was established at the National Research Centre in **Sudan**⁸⁹. In 2016, the intention of the government of this state to conclude contracts for constructing the SUDASAT-1 communications satellite and the SRSS-1 Earth observation satellite was announced⁹⁰. SRSS-1 built by the Chinese company Shenzhen Aerospace Dongfanghong HIT Satellite using a financial loan from the EXIM Bank of China, was launched into orbit in November 2019. It is classified as a microsatellite. An earth station was created near the capital of the state⁹¹. At the same time, preparation activities for building nanosatellites are being carried out at the leading national and technical

⁸³ The on-site investigation for Namibian Remote Sensing Satellite Ground Receiving Station is completed [Electronic resource]. – Mode of access: <https://africanews.space/the-on-site-investigation-for-namibian-remote-sensing-satellite-ground-receiving-station-is-completed/> – Date of access: 31.01.2022.

⁸⁴ David Oni. Rwanda and Egypt Launch Africa's Latest Satellites In Space [Electronic resource]. – Mode of access: <https://africanews.space/rwanda-and-egypt-launch-africas-latest-satellites-in-space/>. – Date of access: 30.01.2022.

⁸⁵ Daniel Iyanda. Rwandan legislature approves law establishing Rwanda Space Agency [Electronic resource]. – Mode of access: <https://africanews.space/rwanda-legislature-approves-law-establishing-rwanda-space-agency/>. – Date of access: 30.01.2022.

⁸⁶ Rwanda has submitted ITU filing for 27 orbital shells of 327,320 satellites [Electronic resource]. – Mode of access: <https://africanews.space/rwanda-has-submitted-itu-filing-for-27-orbital-shells-of-327320-satellites/>. – Date of access: 30.01.2022.

⁸⁷ Joshua Faleti. Rwanda to Launch Satellite Constellation at the End of 2023 [Electronic resource]. – Mode of access: <https://africanews.space/rwanda-to-launch-satellite-constellation-at-the-end-of-2023/>. – Date of access: 24.05.2022.

⁸⁸ Joshua Faleti. Senegal and Rwanda Disclose Plans to develop Space Infrastructure [Electronic resource]. – Mode of access: <https://africanews.space/senegal-and-rwanda-disclose-plans-to-develop-space-infrastructure/>. – Date of access: 24.05.2022.

⁸⁹ Inside Sudan's National Space Programme [Electronic resource]. – Mode of access: <https://africanews.space/inside-sudans-national-space-programme/>. – Date of access: 28.01.2022.

⁹⁰ Ibid.

⁹¹ Sudan Has Launched Its First Satellite; A Remote Sensing Satellite [Electronic resource]. – Mode of access: <https://africanews.space/sudan-has-launched-its-first-satellite-a-remote-sensing-satellite/>. – Date of access: 28.01.2022.

universities⁹². In order to provide broadband data transmission services, the telecommunications operator Sudatel Telecom Group decided in 2019 to use four Ka band transponders on the Saudi satellite Arabsat 6A⁹³.

In 2022, the United Nations Office for Outer Space Affairs and the Japan Aerospace Research Agency, as part of an initiative to help developing countries build ultra-small satellites, KiboCUBE, awarded the **Tunisian** Private Higher School of Engineering and Applied Technology for the TUNSAT-1 educational satellite project⁹⁴. The development plans for the space industry in Tunisia provide for a constellation of 30 nanosatellites in low Earth orbit by 2023 to ensure the functioning of the Internet of Things services. The launch of the first satellite, Challenge ONE, took place in March 2021⁹⁵. The satellite operator, TELNET, emphasises that this satellite was designed and built in Tunisia, considering this program as an important factor in preventing the leakage of young qualified specialists abroad⁹⁶. In 2018, the first Earth station of the Chinese BeiDou satellite navigation system in Arab countries was opened on the territory of this state⁹⁷.

In August 2022, **Uganda** expects to become one of the “space” states of Africa due to the anticipated launch of the PearlAfricaSat-1 picosatellite built jointly with Japan⁹⁸. In May 2022, the manufacture of this spacecraft carried out on the territory of Japan by three student trainees was completed, it is planned to be launched into orbit from the International Space Station in September 2022. During the period up to 2024, it is planned to complete the construction of a second satellite of a similar class, mainly using the brain power of specialists trained abroad, as well as modernisation of the Earth station⁹⁹.

As a result, according to our assessment, out of fifty states of the African region, approximately 25 are already engaged in the design, construction and/or operation of satellite systems, or are planning it for the future. As of May 2022, Benin, Burundi, Gambia, Guinea, Guinea-Bissau, Cape Verde, Comoros, Republic of Congo, Lesotho, Liberia, Mauritania, Madagascar, Malawi, Mali, Mozambique, Niger, Sao Tome and Principe, Seychelles, Somalia, Sierra-Leone, Tanzania, Togo, the Central African Republic, Chad, Equatorial Guinea, Eswatini, South Sudan do not have or have not announced their plans for the exploration and/or use of outer space. With some exceptions, these are small states or economically least developed countries with extremely limited financial and human resources,

⁹² Inside Sudan’s National Space Programme [Electronic resource]. – Mode of access:

<https://africanews.space/inside-sudans-national-space-programme/>. – Date of access: 28.01.2022.

⁹³ Sudatel Telecom partners Arabsat to deliver 6A satellite services across Sudan [Electronic resource]. – Mode of access: <https://africanews.space/sudatel-telecom-partners-arabsat-to-deliver-6a-satellite-services-across-sudan/>. – Date of access: 28.01.2022.

⁹⁴ Joshua Faleti. Tunisian Engineering University ESPITA Emerges as an Awardee of KiboCUBE’s 6th Round [Electronic resource]. – Mode of access: <https://africanews.space/tunisian-engineering-university-espita-emerges-as-an-awardee-of-kibocubes-6th-round/>. – Date of access: 24.05.2022.

⁹⁵ Tunisia launches first satellite [Electronic resource]. – Mode of access: <https://africanews.space/tunisia-launches-first-satellite/>. – Date of access: 30.01.2022.

⁹⁶ Challenge One: Tunisia’s first homebuilt satellite [Electronic resource]. – Mode of access: <https://www.africanews.com/2020/05/13/challenge-one-tunisia-s-first-homebuilt-satellite/>. – Date of access: 30.01.2022.

⁹⁷ BeiDou Navigation Satellite System Centre opens in Tunisia [Electronic resource]. – Mode of access: <https://africanews.space/beidou-navigation-satellite-system-centre-opens-in-tunisia/>. – Date of access: 30.01.2022.

⁹⁸ Joshua Faleti. Uganda to Launch its First Satellite in 2022 [Electronic resource]. – Mode of access: <https://africanews.space/uganda-to-launch-its-first-satellite-in-2022/>. – Date of access: 31.01.2022.

⁹⁹ Joshua Faleti. Uganda’s PearlAfricaSat-1 Satellite to Launch to the ISS in August [Electronic resource]. – Mode of access: <https://africanews.space/uganda-to-launch-its-first-satellite-in-2022/>. – Date of access: 24.05.2022.

countries that are in a state of internal armed conflict, or have a combination of these unfavourable factors.

Activities for the use of outer space in the vast majority of African states are aimed at creating and (or) improving the possibilities for obtaining and analysing data from Earth observation satellites. Satellite communication systems are currently operated by only 3 states of the African region: Algeria, Egypt and Nigeria. Information about plans to create or expand satellite communication systems is available for eight states. These states are: Algeria, Angola, the Democratic Republic of the Congo, Egypt, Nigeria, Sudan, Tunisia, Ethiopia, South Africa.

It should be noted that the countries operating or planning to build satellite communications systems, with the exception of Sudan and Tunisia, are among the top ten African states *in terms of GDP*. Algeria, Egypt, Tunisia and South Africa are among the regional states with a high value and Angola with an average value of the *Human Development Index*. However, the Democratic Republic of the Congo, Nigeria, Sudan and Ethiopia belong to the group of states with a low Human Development Index. Thus, the possibility of the operation of satellite communication systems by certain states is, of course, associated with the Human Development Index achieved, but is not determined by this indicator. All countries operating or planning to build satellite communications systems, except for Tunisia, are in the TOP-15 regional leaders in terms of the *territory size* and/or *population*.

The desire of the majority of African states to increase the knowledge intensity of national economies is obvious, the creation of their own satellite systems is considered to be the means of achieving this goal. Therefore, the success of proposals for cooperation with countries of this region in the field of the use of outer space to a decisive extent depends on the degree of influence on the strengthening of their sovereign scientific and technical potentials.

And the efforts made cannot be considered fruitless. As of 2021, experts counted almost 300 African companies serving the space exploration and use industry, and their total sales volume is expected to exceed \$10 billion by 2024. Most of them are located in 4 states: Egypt, Kenya, Nigeria and South Africa¹⁰⁰

In addition to independent efforts of almost half of the states of the African region in the field of using satellite systems to minimize economic backwardness, attempts are being made to integrate such efforts at the regional level. The number of such projects has been actively growing in recent years.

Probably one of the first pan-African initiatives in the field of constructing satellite systems was the creation of the **Regional African Satellite Communication Organisation (RASCOM)**. Like projects such as Intelsat and Eutelsat, it was founded in 1993 as an intergovernmental organisation based on an international convention¹⁰¹. Since 2002, RASCOM has been developing in a commercial form through RascomStar Corporation with the participation of Libyan capital (the share of the Libyan African Investment Fund in the share capital of the corporation as of 2020 was 63%), the own capital of RASCOM (25% in the share capital) and the French-Italian company Thales Alenia Space (12% in the share capital). This company built two communications satellites for RascomStar. RQ1 was

¹⁰⁰ African Space Industry Revenue to Surpass USD 10.24 billion by 2024 Despite COVID-19 Setback [Electronic resource]. – Mode of access: <https://africanews.space/african-space-industry-revenue-to-surpass-usd-10-24-billion-by-2024-despite-covid-19-setback/>. – Date of access: 24.05.2022.

¹⁰¹ Regional African Satellite Communications Organisation (RASCOM) [Electronic resource]. – Mode of access: <http://www.dirco.gov.za/foreign/Multilateral/africa/rascom.htm>. – Date of access: 09.02.2022.

launched into geostationary orbit at the position of 2.9 °E, but decommissioned due to a malfunction in 2010¹⁰². It was replaced by RQ1R with a payload in the C and Ku bands, which together allow services to be provided throughout Africa. Its commercial life should end in 2025¹⁰³. RascomStar does not have a unified satellite control and service provision complex. The satellite flight is controlled from teleports in Gharyan (Libya), information on the actual performance of which after the civil war in this country is not available, and Fucino (Italy). The service and customer management is carried out from the technical centre in Douala (Cameroon)¹⁰⁴.

According to the Senior Executives of RascomStar Corporation, it provides services in approximately 25 countries in Africa.¹⁰⁵ According to LyngSat, about 40 television programs, including two multiplexes, are distributed through RQ1R¹⁰⁶. An analysis of the information from rascomstar.com allows us to state that the company in its commercial development mainly counts on the offer of data transmission services (satellite backhaul for terrestrial fixed and mobile telecommunications networks, VSAT). The main projects with the participation of RascomStar (satellite backhaul for the availability of GSM networks in the Democratic Republic of the Congo, the data transmission network of universities in 4 francophone countries of West Africa as part of the Federal Polytechnic School of Lausanne project, India's Pan-African E-Network project for the development of e-education and e-medicine services) are somehow connected with data transmission, rather than with broadcasting¹⁰⁷.

Opportunities for the further development of RascomStar, as seen by its managing director Mamadou Sarr in 2020, were in attracting a new member to the corporation's share capital, whose capital would allow for the creation of a high-performance satellite¹⁰⁸. Probably, in order to more effectively search for a new strategic partner for the corporation, the actual location of its headquarters was moved from Mauritius to Dubai (United Arab Emirates). At the same time, he admitted that the ambitious goals set at the creation of RASCOM had not been achieved¹⁰⁹.

Since 2013, the **African Union** has been aimed at creating a system of transcontinental cooperation in the field of exploration and use of outer space. In 2017, this organisation approved a document called "African Space Policy: Towards Social, Political and Economic Integration". Its purpose is to provide a general policy framework for planning projects in this area by Member States. The framework tasks of such projects were defined as follows: addressing user needs; optimal use of resources and results; market development for

¹⁰² Our History [Electronic resource]. – Mode of access: <https://rascomstar.com/about-us/our-history/>. – Date of access: 09.02.2022.

¹⁰³ Rascom 1R [Electronic resource]. – Mode of access: <https://www.satbeams.com/satellites?norad=36831>. – Date of access: 09.02.2022.

¹⁰⁴ Ground Stations [Electronic resource]. – Mode of access: <https://rascomstar.com/our-resources/ground-stations/>. – Date of access: 09.02.2022.

¹⁰⁵ 2020 In Review – Regional African Satellite Communication Organization [Electronic resource]. – Mode of access: <https://africanews.space/2020-in-review-regional-african-satellite-communication-organization/>. – Date of access: 09.02.2022.

¹⁰⁶ Rascom QAF 1R at 2.8°E [Electronic resource]. – Mode of access: <https://www.lyngsat.com/Rascom-QAF-1R.html>. – Date of access: 09.02.2022.

¹⁰⁷ Case History [Electronic resource]. – Mode of access: <https://rascomstar.com/our-market/case-study/drc/>. – Date of access: 09.02.2022.

¹⁰⁸ 2020 In Review – Regional African Satellite Communication Organization [Electronic resource]. – Mode of access: <https://africanews.space/2020-in-review-regional-african-satellite-communication-organization/>. – Date of access: 09.02.2022.

¹⁰⁹ Ibid.

the benefit of the entire region; adopting good governance and management; coordination and cooperation in the field of space activities among the countries of the African region¹¹⁰.

In 2019, in addition to the above policy document, the African Union Commission approved the African Space Strategy: Towards Social, Political and Economic Integration. It defines the main areas of activity in the field of exploration and use of outer space (Earth observation; navigation and positioning; communications; space research and astronomy) and the use of results of this activity in the economic and social spheres. The results of the SWOT analysis of implementation of this Strategy were presented. The directions for minimizing the weaknesses and threats, as well as reinforcing the strengths and opportunities identified in this analysis and indicative indicators for evaluating the effectiveness of relevant measures were named. Recommendations were made on the content of actions in the four areas of exploration and use of outer space. A priority among these areas should be considered the creation of an autonomous orbital constellation of Earth observation satellites to obtain high-precision geoinformation using space vehicles designed and built in Africa¹¹¹.

In January 2018, the supreme body of the African Union, the Assembly, adopted the Statute of the African Space Agency. The Agency has been proclaimed as one of the bodies of the African Union dedicated to promoting, advising and coordinating the development and utilisation of space science and technology in Africa. The Statute determined the composition of the supreme bodies and officers of the Agency: the African Space Council, the Advisory Committee, the Secretariat, and the Director General. The location of the Agency was not specified in the Statute¹¹². Only two years later, the Assembly chose Egypt as its seat¹¹³. Not all states of the continent with "space" ambitions agreed with such decision. For example, Nigeria sought to locate Agency bodies in its territory¹¹⁴.

Until 2021 inclusive, the Agency existed only officially. Its structure was not defined, there was no staff, no website. The reasons for this slow "unrolling" the Agency's activities were associated both with the lack of financial resources and disagreements over the methods of work¹¹⁵. In 2021, \$10 million were allocated for organising the work of the Agency; it has started the hosting of its Secretariat at the International Space Centre in Egypt, the official opening of which is tentatively scheduled for September 2022¹¹⁶. The experience of "space" initiatives of the African Union testifies to the existence of an unresolved discrepancy

¹¹⁰ African Space Policy: Towards Social, Political and Economic Integration [Electronic resource]. – Mode of access: <https://au.int/en/documents/20191007/african-space-policy-towards-social-political-and-economic-integration>. – Date of access: 11.02.2022.

¹¹¹ African Space Strategy For Social, Political and Economic Integration [Electronic resource]. – Mode of access: https://au.int/sites/default/files/documents/37434-doc-au_space_strategy_isbn-electronic.pdf. – Date of access: 11.02.2022.

¹¹² Statute of the African Space Agency [Electronic resource]. – Mode of access: <https://au.int/en/treaties/statute-african-space-agency>. – Date of access: 11.02.2022.

¹¹³ Plans for African Space Agency jeopardized by lack of progress [Electronic resource]. – Mode of access: <https://physicsworld.com/a/plans-for-african-space-agency-jeopardized-by-lack-of-progress/>. – Date of access: 11.02.2022.

¹¹⁴ State of the Nigerian Space Program – Interview with Dr Halilu Ahmad Shaba , NASRDA New Director General [Electronic resource]. – Mode of access: <https://africanews.space/state-of-the-nigerian-space-program-interview-with-dr-halilu-ahmad-shaba-nasrda-new-director-general/>. – Date of access: 11.02.2022.

¹¹⁵ Plans for African Space Agency jeopardized by lack of progress [Electronic resource]. – Mode of access: <https://physicsworld.com/a/plans-for-african-space-agency-jeopardized-by-lack-of-progress/>. – Date of access: 11.02.2022.

¹¹⁶ Egyptian Satellite 'Next' to be launched in December, African Space Agency to be established in Egyptian Space City [Electronic resource]. – Mode of access: <https://www.egypttoday.com/Article/1/97032/Egyptian-Satellite-Next-to-be-launched-in-December-African-Space>. – Date of access: 11.02.2022.

between the wide scale of plans, limited material capabilities for their implementation, and the conflict of interests of individual major players in the African "space" market.

In 2019, Egypt initiated the **Africa Development Satellite Initiative (AfDev-Sat)** project by inviting Botswana, Ghana, Kenya, Morocco, Nigeria and Sudan to participate. Its task is to jointly create a satellite system for Earth observation, including a ground segment and scientific base in the signatory states. In 2021, this project was carried out in the form of educational activities – through the holding of a training event with the participation of representatives of Ghana, Kenya, Nigeria, Sudan and Uganda in July and August. This project is considered as an independent initiative of Egypt, rather than an achievement of the African Space Union¹¹⁷.

Back in 2013, the South African National Space Agency launched the **Africa Resource Management Constellation (ARMC)** project. By 2018, when work on its implementation became more active, four states had expressed their readiness to participate in its implementation: in addition to South Africa, they were Algeria, Kenya and Nigeria. Its main objective was declared to be the assessment and protection of natural resources of the signatory states. The main emphasis in this project is on the use of data obtained from Earth observation satellites¹¹⁸. However, the creation of a separate constellation of satellites for the project is not envisaged; it is assumed that individual satellites constructed by signatory states will be used for the purposes of this project. For example, Algeria plans to use the capabilities of the prospective AlSat-3 satellite when participating in the project¹¹⁹.

In 2019, All Nations University in Ghana initiated the **African Constellation Satellite Network (AFCONSAT)** project. Its exact organisational, technical and time frames were not announced. It was expected that interested organisations from African countries would submit their proposals on the relevant aspects, after which a memorandum of understanding would be prepared for signing and the practical implementation would begin. Initially, Burkina Faso, Cape Verde, Côte d'Ivoire and Namibia – i.e. mainly countries of the West Africa subregion – participated in the discussion of the contours of this project. The question of the project funding sources at the time of its announcement also remained open¹²⁰. According to information published in January 2022, this project has a chance to develop as a platform for the training and skill improvement of engineering personnel¹²¹.

Several Earth observation satellite data projects implemented by the Gabonese Studies and Space Observations Agency have united the French-speaking states of Equatorial Africa, becoming essentially sub-regional ones. The beginnings of subregional space activities can also be seen in the National Space Program Management Office of Angola, which can act as a consulting partner in the planning of Mozambique's "space" activities.

¹¹⁷ Mustapha Iderawumi. A Glimpse into the AfDev-Sat Initiative with Dr Ayman, Head of Imaging Department at EgSA [Electronic resource]. – Mode of access: <https://africanews.space/a-glimpse-into-the-afdev-sat-initiative-with-dr-ayman-head-of-imaging-department-at-egsa/>. – Date of access: 13.02.2022.

¹¹⁸ Pan-African satellite constellation in the works [Electronic resource]. – Mode of access: <https://www.sansa.org.za/2019/08/13/pan-african-satellite-constellation-in-the-works/>. – Date of access: 13.02.2022.

¹¹⁹ AlSat-3 Satellite Currently In Definition Phase And Plans For AlComSat-2 Ongoing – ASAL Head [Electronic resource]. – Mode of access: <https://africanews.space/alsat-3-satellite-currently-in-definition-phase-and-plans-for-alcomsat-2-ongoing-asal-head/>. – Date of access: 13.02.2022.

¹²⁰ An African Satellite Constellation Project To Be Launched This Week At The 8th Annual SSSTA Conference In Ghana [Electronic resource]. – Mode of access: <https://africanews.space/an-african-constellation-satellite-project-to-be-launched-this-week-at-the-8th-annual-sssta-conference-in-ghana/>. – Date of access: 13.02.2022.

¹²¹ All Nations University College to spearhead the first African Constellation Satellite Project [Electronic resource]. – Mode of access: <https://anu.edu.gh/all-nations-university-college-to-spearhead-the-first-african-constellation-satellite-project/>. – Date of access: 13.02.2022.

The above pan-African projects for the development of satellite systems show the desire of states that have achieved some success in this area to provide a market for the services and work of their organisations in the "space" industry by promoting international initiatives where they expect to occupy a leadership position, while using scientific and technical potential or their partners. However, as the leaders themselves face the problem of resource availability, most of these initiatives are implemented slowly, with uncertain prospects in the long term.

No matter how dynamic the growth of regional and national space industries is in the African Region, it is clear that their supply in the short and long term will not meet the demand for satellite communications services in this market. In terms of the degree of participation of foreign satellite operators in the projects, there are differences, on the one hand, between relatively developed countries, where foreign operators establish business partnerships with national or regional telecommunication operators or distributors of media products, which take on a significant amount of work for the implementation of projects, and, on the other hand, the least developed countries, where a foreign satellite operator is required to resolve the entire range of problems related to the organisation of service provision, from supply of satellite capacity to the installation and operation of terrestrial equipment and training of local personnel.

Some projects, such as those initiated in Guinea, Malawi, Mali, Rwanda, Sierra Leone, were carried out without the direct participation of satellite operators. This fact confirms that for satellite operators that do not have a commercial presence in this region, the establishment of a commercial partnership with operators integrating technical solutions for the provision of data transmission and broadcasting services can be considered an important tool for promoting their services. Such operators can be companies registered both in African countries and in countries of other regions that have commercial interests in Africa (for example, Intersat (United Arab Emirates), which is one of the leading providers of VSAT services in Africa). And yet, building a commercial presence that brings service providers closer to their users seems to be a significant success factor in promoting satellite services in the African market. Among the facts we have considered for the provision of satellite communications services by foreign companies in Africa in 2019 – 2022, about 66 percent were due to the fact that the former had a representative office or some other form of maintaining regular contacts with potential users. It is also noteworthy that the majority of the above events – 73 percent – were associated with the provision of data services, either for end users or through backhaul services for terrestrial network operators.

Rightfully remaining one of the main sources of income growth for satellite operators, the activity in the African market now requires them to show partnership, rather than a consumer attitude, to service users.