SpaceOps-2023, ID # 111

THE OPENING OF COMMERCIAL SPACE PORT IN DUBAI : THE DESIGN AND THE REQUIREMENTS OF THE LAUNCH SITE.

Jamel Metmati

[a] *Department of Cyber, djamel.metmati@thalesgroup.com*

Abstract

The New Space needs design and requirements with the new commercial routes to Space. With the African Space agencies and the one in the middle East, the Space port shall be built close to this area to support the life cycle of the Space programs. To perform the Space access, the design of a launch site combines several types of launch site : land and maritime base. Moreover, the sites can be specialized for the satellites on Earth orbit and those for the Deep Space to the Moon or the assets in the solar system. The design is completed with the infrastructures close to launch site including the private compagnies for the clearance access. Then, the requirements of equatorial provides the efficiency and the speed for the heavy satellite. The lattitude of Dubaï could be an advantage because its level is less important than the Cap Canaveral, Xichang, Kagoshima, Cornwall sites. And the maritime features of the city shall give the design and the requirements for a platform on the sea for rockets dedicated for the CubeSats. The competitiveness of Dubaï should increase with this design and these requirements because it should be part of its Space program. At last, this hub connection should permit the launching of Space assets from the Space Africa agencies for the satellites turn on the Earth.

Keywords: space Port, commercial launch, Dubaï

1-Introduction

The goal and the objective on this article is to demonstrate how the New Space parameters are going to be in specific requirements in Africa. It means to deal with as well the New Space definition than the potentiality of its use by specific investment in the ground segment.

2-Methods

The methods consists of the analysis the Space way in Africa in regard of the need due to the context from the distances, the potentiallity on the ground for many applications linked with human activities.

3-Discussion

3.1- New Space in Africa

The New Space defines itself as the arrival of private sector in the exploitation of the different Earth orbit [1]. Allowing the use the Space for the ground, this finding provide a new way to manage the human activity. In this context, African countries structure itself in the New Space industry opportunities through the satellite and the commercial ecosystem should be built. With the Challenge one, the Tunisia project made a satellite from design requirements to the achievement. Moreover, the technology to communicate with this satellite use the same parameters than the terrestrial networks. The commercial segment of the satellite industry is the spot about the beginning of the New Space in Africa Except the one doesn't combine yet, the launch site, the launchers, and the complete ecosystem support to design the Space assets.

This beginning aims to get Space Data to improve the ground management for any requirements about a situation. Indeed, the "New Space" is changing also the parameters for launching satellites into Earth orbit allowing a Space access easier thanks to new offer. While many African countries are launching satellites into different orbits, the opening of the space market to commercial players is paving the way for low Earth orbit launches. In fact, the arrival of small satellites with high performance capabilities is a response to a broadening of the types of launchers.

The latter are moving away from traditional rockets to smaller launchers capable of carrying payloads of 150 kilograms to an altitude of 500 kilometers. In the African Space dynamic, the launch of micro and nano satellites to support the consolidation of territory, and the position of a launch pad near the equator, offers African countries a

competitive advantage in orbiting. Not only does the launch offer a slingshot effect limiting fuel consumption, but the position of a satellite at the equator gives it a geographical position of information superior to another.

Moreover, with the satellite component manufacturing in Africa, the investments could orient to the launch capacity with new players in this domain.

The Nigerian National Agency for Space Research and Development (NASRDA) and the French company Prometheus signed on Tuesday 9 November in Abuja, a letter of intent laying the foundations for cooperation covering the field of Earth observation nanosatellite constellation systems. These miniature satellites have a modular structure consisting of one to six units of 10 x 10 x 10 cm that can have a mass of less than 100 kg. These dimensions are sufficient to perform the basic functions of the satellite and to carry a "payload" to enable the satellite to fulfill its scientific mission. The Space industry gets the conditions to produce easier the satellites delivering the services and the functionalities.

The objective would respond to a decrease in transportation costs necessary in the context of the New Space. While assembly can be carried out on local infrastructures, placing the satellite in orbit implies complex management of operations at traditional launch sites.

This constraint applies to each actor wishing to send a spacecraft into orbit. The Ghanasat-I satellite was launched via several platforms: NASA launch site, Space X commercial flight, and placement into orbit by the Japanese KIBO module. Nevertheless, the design have been developed in the agile context. GhanaSat-1 was assembled and tested by three students at All Nations University. The five 1U CubeSats, four built by the guest countries and one by Kyushu Institute of Technology (Japan), were all identical in their design. The two-year period spanning the development, construction, launch and operation of the satellites engaged three university students from each of the five participating countries. The satellite cost about US$500,000 to manufacture and launch.

Insofar as African space agencies have emerged, and or, an African space agency is being structured, the provision of a launch pad on the equator would increase the frequency of launches while providing a favorable ecosystem for the development of an African space environment. Jean Patrice Keka, an congolese engineer, tried to reach this purpose through the rocket named "Troposphere 6". Troposphere 6 is a 15-metre high rocket composed of three 6.4 storeys, named Nyiragongo Engine, Mbabola and Kimbirimbiriet. It weighs nearly 10 tonnes. Its aim is to send the N'jiwa satellite 200 kilometres above sea level to take photos of the Earth, which will be transmitted live to the Menkao control centre, 180 kilometres from Kinshasa. The Mpongo 1 vessel was not selected for Flight 4. It consists of metal drums and salvage materials.

Complemented by a space academy, the technologies developed will help support the economic development of territories and the preservation of ecosystems: geo-engineering through observation, management of the green belt in sub-Saharan Africa, crop optimization in Somalia.

Ghana, advanced country in the Space ecosystem, is integrating this global approach by including a space program in its secondary school curriculum.

Secondly, the development objectives of the African Space Agency lead to economic benefits at the territorial level. As roads and networks allow for a better resonance of supply and demand in a market, space technologies are one of the factors that allow for this goal.

The Maasai tribe uses telephones to anticipate and optimize the arrival of rainfall to guide their herds to specific locations. Telecommunications are the corollary of economic development. And as the African continent uses mobile connections from smartphones, satellites provide support to exchanges by decompartmentalizing territories and facilitating potential exchanges. However, the leasing of non-proprietary satellites takes up part of the available resources. This is changing in the context of the "New Space", since the new generation of satellites allows to embark technology in small formats.

Today, information transmissions are made on the basis of transit systems outside the continent to return to the users' terminals. In addition, as the geographical magnitudes are different from the rest of the continents, the satellite communication systems are a flexible basis for exchanges. If the deployment of the constellation Starlink, by the Space Internet, fills this need for the isolated zones. It will not be able to satisfy a coverage at the height of the potentialities of exchanges within the African continent.

The Africa New Space requirements introduce a design with the specifities. An information transmission to ensure the dissemination of data on the ground require the network architecture with mobile device. This asset shall be combined with applications using Space as web services from the icons on the smartphone screens.

Therefore, the Africa new Space requirements implies a flexible adapted ecosystem whose commercial development requires investments of long distance communication from the new satellite generation potential added to launch capability on small launchers.

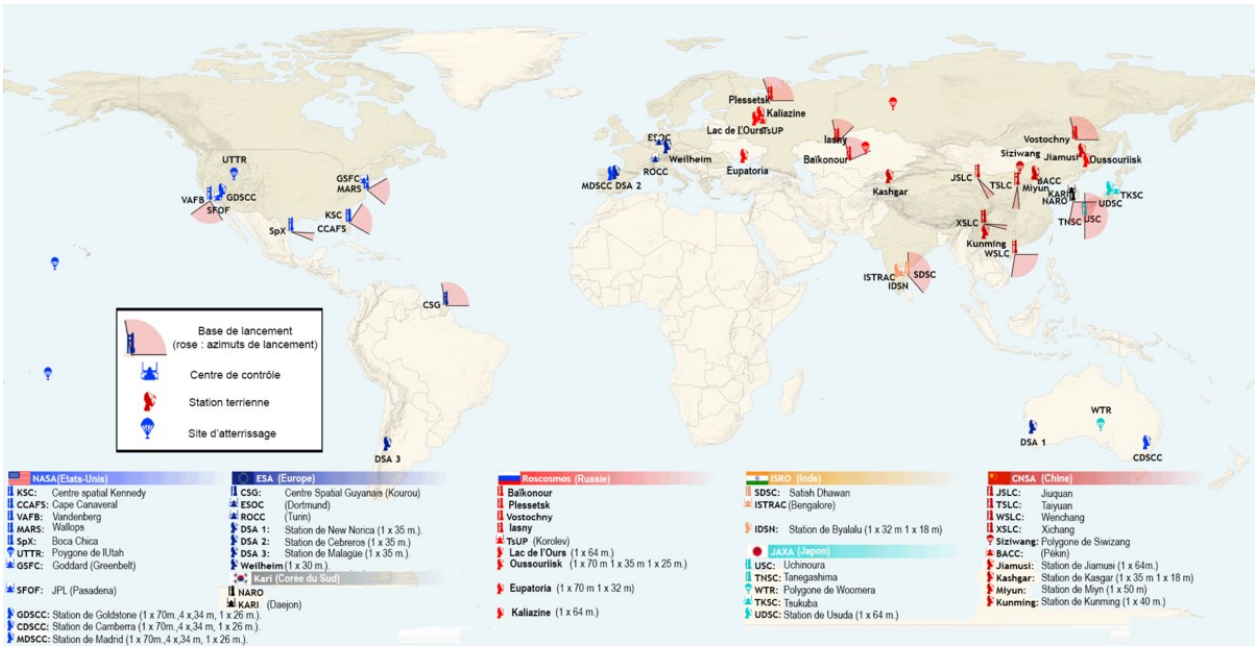

Figure I : Space port in the world

3.2-Design fo Space Port from Dubaï area

The case of Cornwall precise the requirement for commercial launch [2] in place for the Spaceflight laws thanks to the Space Industry Act 2018. In 2022, Cornwall will have the United Kingdom's only horizontal launch spaceport for small satellite payloads into orbit. Cornwall Council and Virgin Orbit are partnering to deliver the horizontal launch Spaceport at Cornwall Airport Newquay. Cornwall Council are looking at a phased implementation of the Spaceport in which capabilities, facilities and services can be offered to the market from launch systems. Using an existing Airport facility, it supports the potential of the Cornish space cluster. Geographically advantageous, the UK's long coastline and island location make it unique in easily hosting different types of launch services. Scotland is the best place in the UK to reach in-demand satellite orbits with vertically launched rockets. Spaceplanes and other space transportation can be launched at a number of aerodromes around the UK, each with their own individual geography and local infrastructure [3]. The UK-US Technology Safeguards Agreement, (TSA), allows US companies to operate from UK spaceports and export space launch technology.

The site offers a 2,744m long runway, direct access over the sea, adjoining military site RAF St Mawgan, ground handling equipment, a new Aviation Centre including Space Systems Integration, Mission Operations Facilities, a Laboratories/R&D workspace, a Rocket test facility [4]. The renowned Goonhilly Earth Station is also offering its services alongside the spaceport. Collaboratively, Cornwall offers broader opportunities than just launch, including : mission control and tracking services, countless downstream application companies, aerospace Cornwall which offers funding for research and development [5].

3.3 Dubaï position

The Cornwall position [6] provides the basis of requirement for Space port in the Arabian Peninsula, particulary for Dubaï. The sea at east, the infrastructures, the innovation Space sector. Four Dubaï ports with complementary roles are spread out from the north to the south of the city. The old ports of Hamriya and the Cove have been deepened and modernized. At the foot of the glass and steel towers, the port of La Crique is home to dhows that handle re-exports to Iran. And two modern commercial ports have been developed: Jebel Ali and Port Rashid. Port Rashid, which opened in 1972, is located just south of the mouth of the Cove, in close proximity to the city and the airport. It offers 7 km of unloading quays and more than 167,000 m² of covered warehouses.

The entire port is open to the sea and it is extended to the south by refit basins and a dry dock for giant tankers. The port of Jebel Ali, dug into the coastal sands 40 km south of the city, was originally designed to compensate for the planned depletion of oil resources. It includes a dry dock for supertankers making Dubai the rival of Bahrain as a service station in the region, with 15 km of quays, 42,500 m³ of cold storage. It has become the major transshipment

port of the Arabian Peninsula and the countries bordering the Gulf. It also serves the Red Sea and the Indian Ocean. The port of Jebel Ali is associated with a huge free zone where many multinational companies (General Motors, Siemens, Schneider, etc.) have opened branches.
Goods from all over the world are stored there, packaged, sometimes transformed, and then reshipped. A system of diversified thematic free zones accompanies these infrastructures. There are currently nine such zones. Jebel Ali, the first free zone to be established in the UAE Federation, is the largest and has the largest number of companies. All these facilities provide the capacity to receive the assets need to be launch in Space and the routes to bring the components missing for the launch site.
As for Cornwall, the airport should provide the area for the Space port [7]. The international airport zone has a storage space concentrated in a cargo Village capable of handling 500,000 t/year and directly connected to neighboring industrial zones, states and ports, thanks to seven combined air-sea freight docks. As a result, it takes only four hours to transfer a package from the container ship to the cargo plane. The connection seems enough to esure the efficiency of its airport hub. It means these features should provide the requirements to initiate the study of commercial Space port within the Federation with the cooperation with the countries around.

3.4 Dubaï requirements

The requirements of for Dubaï Space port include a depopulated area for launch vehicle overflight at liftoff and non-satellite rocket stage reentry because the base is potentially implanted on the seaside [8]. The trajectory of the rocket flies immediately over the maritime zone after the takeoff.
The first criteria is the large area of land because of the large number of buildings to be set up and the need to place them at a sufficient distance from the launch area to protect them from an explosion at a short distance from the ground. The consortium of Dubaï Space port could gather the countries of Arabian Peninsula, particulary the Oman sultanat with the opening to the sea at southeast.
The second is the direction of firing towards the east clear; by firing towards the east the launcher benefits from an additional speed linked to the speed of rotation of the Earth. This condition is less important for the bases specialized in polar orbit launches. In the case of the consortium of Dubaï is going to launch the assets in Space on the polar orbit launches, the lack of the depth on the east clear shall be mitigated. The advantages of polar orbit is the capacity of launch the 90° orbital plan using constantly the light of the sun for the batteries and for the ground.
The third is the easy access to the site by means of high capacity transport. Given the size of launchers and satellites, the large quantity of equipment necessary for the construction and maintenance of a launch base, it is necessary to have good maritime, road or rail links with the sites producing these components. For very large diameter launchers (Ariane 5, Long March 5, Saturn V, etc.) maritime access is essential because the road and rail gauge is not sufficient.
The fourth is the immediate surroundings of the base are not or not very populated. The desert and the maritime overview would be the ideal conditions for the launch. It considers the missions and the types of assets to be launched in Space. It means the Space port shall choose the speciality of the site. Depending on the type of mission, the launch can be done from different angles : the azimuth can be close to 0° and 180° for observation satellites, while it will be close to 90° for geostationary satellites. The azimuths usable from a base depend on their location. For example, the Cape Canaveral Center does not allow the launch of observation satellites, these are fired from the Vandenberg space base.
The fifth is the base close to the equator which improves the performance of the launcher when the payload must be placed in a geostationary orbit, because the speed of rotation of the Earth, which is added to that imparted by the launcher, is maximum at this latitude. With the lattitude and the longitude close the equator, the close area from Dubaï shall give the same advantage as the US Space port at east coast. Moreover, the desert gives the requirements to the facilities building. The US Moraje Space port shows the possibility to link in the desert all the infrastructures needed to launch a rocket. The east of the dubai airport is free with sea and desert for commercial launch, the connection with the port is close to transfer to the airport. And the second airport can be built in the desert. The perspective of big rocket should be suitable with a site in the Palm island.
The sixth is the distance from the borders can play a role if the relations with the neighbouring country are tense. The home close to the site is also a requirement to avoid the consequences of the failure at the momen where the rocket doesn't follow the trajectory expected. This characteristic was taken into account when China created its bases at the distance from Mongolia not in the island of Hainan. The site itself is shareable if it compares the others location in Japan, in Guyana, in Baikonour where the foreign payloads are luanched from the local site. The features of Arabian Peninsula gives the perspectives of cooperation the Space agencies programme and the education installation. The

site will provide the opportunity to launch at first the commercial satellites services. The sand storm shall be taken account for the management of the Space port.

4. Conclusions

The requirement to built a space port on Dubaï area are gathered to ensure the launch in the New Space context. The space installation would increase the space exploration through a complet ecosystem.

References

Reference to a journal publication:
[1] Borowski, S. K., and Sauls, B. G., "Key Technologies, Systems, and Infrastructure Enabling Travel From the Earth to the Moon – a Look Ahead at What's Required", AIAA–2021-4212, November 2021.

Reference to a conference/congress paper:
[2] Luigi D'Amatoa*, Maria L. Battaglieb , Alessandro Colettac, Space systems, services and applications in support of large national infrastructures. 73rd International Astronautical Congress (IAC), Paris, France, 18-22 September 2022. Page 1 of 7

Reference to a book:
[3] D. Edberg, Design of Rockets and Space Launch Vehicles, 2020
McKinsey & Company, The role of space in driving sustainability, security, and development on Earth, 2022
[4] L. Leandro, AQP S.p.A, "Le tecnologie satellitari (e non) per la ricerca e localizzazione delle perdite idriche utilizzate da Acquedotto Pugliese" [Satellite (and non-satellite) technologies for the research and localization of water leaks used by the Apulian Aqueduct], Presentation within the workshop "Systems, Services and Space Applications in support of large national infrastructures" (2021).
[5] E. Fedeli, RFI S.p.A., "Il Monitoraggio Satellitare dell'infrastruttura ferroviaria: i progetti in corso di RFI" [Satellite
[6] monitoring of the railway infrastructure: RFI's ongoing projects], Presentation within the workshop "Systems, 73rd International Astronautical Congress (IAC), Paris, France, 18-22 September 2022.

Reference to a website:
[7] Henry, Caleb, "Companies are flying old satellites longer, study finds", August 10, 2020, https://spacenews.com/companies-are-flying-oldsatellites-longer-study-finds/, (accessed 17.08.22).
[8] Olson, J. et al. "State of the Space Industrial Base 2021: Infrastructure & Services for Economic Growth & National Security," November 2021. URL: https://www.diu.mil/latest/state-of-the-space-industrialbase-2021