FOSSA SYSTEMS

Aerospace Electronics

FOSSA Systems

FOSSA Systems is a startup with base in Madrid, dedicated to the development, launch and operations of PocketQube satellites.

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Personal Statement

First, I wanted to explain why I selected this topic and how I found out about this company. I found out while listening to the radio a couple months back, where they interviewed the founder of the company which is a 20-year-old Aerospace engineer student. I was immediately impressed and researched the website. Reading all the specs and services they offer and understanding the details was very comforting. I see that we have learned a lot with this course, and I wanted to share and test my knowledge by looking if I could truly understand all the specification and details they described in their products. But the two questions that appeared in my head were on the on hand what are the limits of these small satellites and on the other hand is this the new future of satellite industry.

Introduction

FOSSA Systems is a Spanish startup that develops, launches, and handles the operations of PocketQube satellites. The main reasons and starting points of this company were the further development of miniaturization of satellites, the reduction of launching costs and the expansion of IoT connectivity. All these aspects are part of the services they offer as a company.

FOSSA Systems

Types of small satellites

First of all, it is important to understand what PocketQube satellites are all about and what kind of satellite they are. PocketQube satellites are a type of Pico satellites, which are a subtype of small satellites.

The table below shows, the range of small satellites that exist nowadays:

TYPE OF SATELLITE	**WET MASS [KG]**
Mini satellite	201 - 600
Micro satellite	11 - 200
Nano satellite	1.1 – 10
Pico satellite	0.1 - 1
Femto satellite	< 0.1

As we can see, the Pico satellites have a wet mass of 0.1 kg – 1kg. As we know from class, there is the dry mass (mass of the satellite itself), payload mass (mass of the payload), the propellent mass and the wet mass (mass of satellite + mass of propellent). So therefore, we can see that the Pico Satellite has an extremely low mass and that's the main reason why all the costs are very low.

FOSSA Systems services

The main service they offer is their low power IoT Connectivity for asset monitorization through their PocketCube satellites and their nodes. Furthermore, they also offer launch brokerage services for other companies or interested clients and development of dedicated infrastructures of satellites constellations.

FOSSASat-2 Evolved

The satellite designed and manufactured by FOSSA Systems is a 2P Pico satellite of the PocketQube family. This type of satellites has a mass of no more than 250 grams and usually have a size of 5cm cubed.

FOSSA Systems offer three types of payloads, depending on the use the client wants to achieve with the satellite.

First, we have the IoT payload. This payload is used for the monitorization of the assets the client wants to track. So basically, it has dedicated antenna for communication purposes and a LoRa concentrator for sending LoRa messages. LoRa is a Low Power, Wide Area networking protocol. It is designed to have bidirectional communication, end-to-end security, mobility, and localization services. That's why it is perfect for IoT devices and services.

Second, we have the EO payload. This payload is a multi and hyperspectral camera with GSD capabilities which is a very interesting feature. GSD stands for Ground Sampling Distance and is a metric for mapping and aerial surveying. The resolution is 10-20m / px. This means that a 10 x 10 meter or 20 x 20-meter square on the ground represents a pixel in the image. So, the resolution is good for not in detail projects.

And last, we have the IoD payload, which offers the client a flexible and reliable platform to test their own payloads. So, this is a customizable payload, depending on the needs of each client.

Regarding the capabilities of their satellite, we have some aspects that we have seen in class.

First, we can see the specifications for the power subsystem. The satellite uses solar energy as the primary energy source system. The panels can generate up to 9W of solar power and the batteries can store up to 10 Wh.

Next is the communication subsystem. We start with the communication protocols and data buses. The platform offers the Universal Asynchronous Receiver-Transmitter or UART which is one of the most reliable and simplest protocols. Also, they offer the I2C and SPI data buses for the communication between payload and satellite. The options are on point because of the easy use and reliable interface, which is extremely important. Regarding the communication between the satellite and the base nodes or earth stations, they offer a high data rate, approximately 1 Mbps and a backup of 9,6 kbps. This is possible with their dedicated antenna for uplink communications from the low power ground devices on the earth surface.

So, seeing all the stats and specifications of the satellite we have an idea of the projects it's going to work on. It's perfect for earth monitorization like getting information of certain parts or regions of land and oceans. It`s perfect for communication services like IoT or serve as communication between a network of other satellites. This are some of the applications it has.

IoT Connectivity

Once we have seen the satellite, we can describe the main service they offer, which is their IoT Connectivity. They offer the satellites, IoT Nodes that help monitor the assets and the ground stations for the data reception.

The data flow would be the sensors and IoT Nodes send the data to the satellite. The satellite then reroutes the data to the ground station where it can be processed and send to the client.

It is also important to mention that the sensors capabilities are very multifunctional. They have humidity, temperature, salinity, chemical composition, and air quality sensors.

Because this system and the network they can deploy is not the main part of the course, I decided to focus on the satellite itself.

Launch Brokerage System

Finally, FOSSA Systems have designed their own satellite deployer, the PocketPod so that clients that have designed their own satellites, but don't have the tools to put it into orbit can launch their systems. This deployer, which is also the one they use for their own satellites, is designed to send satellites into Low Earth Orbit (LEO).

What are the limits for these satellites?

One of the most important aspects is the possible applications which the services and products they offer can be used for. Regarding this topic they have in their website a section where some examples can be seen, like agriculture, farming, monitor energy and much more. The common aspect is that no matter how far away you are from civilization, you are going to be able to access your data. So back to the first question, after all this research and some thinking, the answer is clear. These satellites have very strict and concise jobs. But the main functionality for these satellites is not going to Mars or taking pictures of deep space. The job they must do is monitor certain parts of earth, get data from oceans, communication services etc. That's why they are truly efficient and the way to go. So, the limits are defined clearly, but that doesn´t mean that their usage is going to be affected negatively. On the contrary, more and more small satellites are going to be launched in the next years.

Is this the new future?

Until the last decade the space industry has been controlled by governments due to the extremely high costs, advanced knowledge, and cutting-edge technology necessary.

But in recent years a sense of democratization and liberalization has grown among the population. This can be seen for example with the rapid growth of decentralized technologies like blockchain. And the space industry is no different. A prime example is the startup FOSSA Systems and the statistics of SpaceWorks, for example, that indicate that in "*2023 between 513 and 745 small satellite launches are going to be make*". Which is big improvement from "*the 253 satellites that were launched in 2018*".

So, the tendency is clear and the reason for that is the accessible information available on the internet and the evolution in technologies like computers and microprocessors for example. The small cost and the fantastic results have shown that small satellites have a bright future and that they will be extremely useful in the years to come. Because of the clear defined functionality they have and the little resources that kind of functionality needs, small satellites are going to be used more and more in the coming years.

Conclusion

In an almost digital world where every sector is either digital or in the process of digitalization, a company that offers and helps with those problems has a very bright future. The overall improvement of a company or anything else from being able to measure data and being able to access it from anywhere in the world is game changing. And that's where the real difference from other technologies appears.

Having a satellite for your business means having communication in the most remote and inaccessible places. But not only that, small satellites like the one from FOSSA Systems are like seen during this report, extremely capable for concrete tasks. So, because of the small size, the low costs, the exponential growth of technological devices like microprocessors and sensor, and the free access to information / knowledge in the internet, the small satellites have a bright future in the years to come.

On a more personal level the best part was being able to read all the specifications and details of the satellite and understand the technologies they are using. Being able to this and see if it is a good satellite or has some improvements to do was exceptional.

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