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David Gascón

Co-Founder & CTO
Libelium

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University Fabrication Lab: High Level Overview

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Libelium is a wireless sensor company based in Zaragoza, Spain. The company's award-winning sensor technology has been implemented in multiple "Smart City" applications across the globe. We spoke with **David Gascón**, the Co-Founder and CTO of **Libelium**, about their contribution to creating the Internet of Things, some surprising applications for their sensors, and Libelium's vision for the "Smart World" of the future.

Could you tell us a little about your background?

I am a computer engineer. I studied at the University of Zaragoza here in Spain, where Libelium is based. Once I finished my degree, I started thinking about my career. Since my final project was related to distributed communications, I thought it would be interesting to get into wireless network and wireless distributed communications. I thought that it was a useful area, but that it could be improved by sending local information in each frame. This is where sensors come in.

When I started Libelium around five years ago, I started to think about how I can connect the real world with the Internet. Normally, when you think about the Internet, it was only related to people actually connected to it through computers or smartphones. Now, we are going one step forward where we are trying to get every object in our life inside of the Internet somehow. People ask me all the time what my work is and I always tell them that I try to expand the limits of the Internet so that not only people are connected, but the real world is connected through smart sensors. Adding sensors to objects in your everyday life enables the technology behind all of these interconnections and creating the Internet of things. The motivation for Libelium stemmed from these wireless distributed communications that I was studied for my degree.

What was the fundraising process like when you started Libelium?

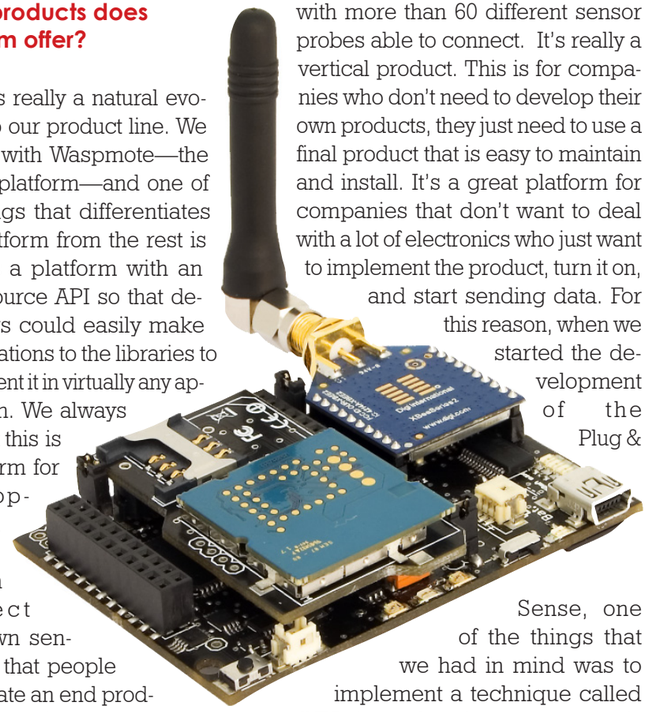
When we started, we had no venture capital or external investments—it was all self-funded with about 3,000 dollars on the table, which was everything we needed to get started. We had a really clear vision to build the technology from the beginning to know how to cope with the development of new products. We started using open source platforms such as Arduino to make our first prototypes.

After that, we moved to manufacturing the products. If you want to make an original product from the beginning, you obviously needed money to invest and manufacture, and to come up with a platform where you can go and buy it for 30 dollars and you can start to connect to it was really healthy for us. I think one of the key points was that we really didn't need much more money to start coming up with technology. Waspmote was the result of three years of research around how to create a low-power sensor device. Waspmote consumes nearly 0.07uA (microamperes) in the sleep mode, which is extremely low and one of our first milestones when we started researching.

What products does Libelium offer?

There is really a natural evolution to our product line. We started with Waspmote—the sensor platform—and one of the things that differentiates this platform from the rest is that it's a platform with an open-source API so that developers could easily make modifications to the libraries to implement it in virtually any application. We always say that this is a platform for developers, and in fact, you can connect your own sensors so that people can create an end product very easily. We say that Waspmote is a platform to help other companies to create end products because Waspmote isn't a vertical platform. The other very important thing about Waspmote is the modularity. Normally, when you are working with a sensor you say, "Okay, I'm going to buy a smart sensor platform and I'm going to use Zigbee or Bluetooth." What we made with Waspmote was a platform you could add the sensors and the radio on top of it, so you have a core base board and after you add the whatever radio model by simply plugging it in. There are three steps to this; you take the Waspmote platform, you select the radio protocol, and finally, you choose the sensors. To be an open-source platform and to be really modular were two of the key decisions we made when we built it.

Another product we offer is the Plug & Sense. The Plug & Sense is essentially Waspmote inside, but with a robust waterproof enclosure and with more than 60 different sensor probes able to connect. It's really a vertical product. This is for companies who don't need to develop their own products, they just need to use a final product that is easy to maintain and install. It's a great platform for companies that don't want to deal with a lot of electronics who just want to implement the product, turn it on, and start sending data. For this reason, when we started the development of the Plug & Sense, one of the things that we had in mind was to implement a technique called OTA (over the air programming),



which allows developers to program the sensor nodes from the Cloud or Internet. There can be a hundred sensor nodes around a city and you can control each one of them individually through the Internet.

The last product in this line is called Meshlium. This is essentially the gateway of the sensor network. Sensor nodes send the information to this gateway by using low consumption protocols such as 802.15.4, ZigBee or Bluetooth; then Meshlium takes this information and sends it to the Cloud by using TCP/IP sockets or through HTTP request via Ethernet, WiFi or 3G. However Meshlium is not only a door to the Internet, it as a complete Linux machine which also integrates internal data bases and allow us to perfom complex sensing capabilities such as smartphone detection by monitoring WiFi and Bluetooth frames sent by iPhone and Android devices.

What are some real-world applications for these products?

One of the most important and most significant projects we are involved with is a smart cities sensor project. We deployed a 1,000-node network in the city of Santander in a project called "Smart Santander", which is in northern Spain. This network measures a variety of parameters. For example, we installed a bunch of nodes underground to measure the automobile activity—not only how many cars are passing, but in terms of cars that are parking. We could say that 400 of the nodes are being used in a smart parking application. They are monitoring the center of the city and they are sending information to the citizens—in real time—how many free parking spots are free in each street just by connecting with your smartphone. The other 600 nodes in the city are used to measure air contamination and pollution—CO2 and NO2 levels—and to measure the noise levels in different streets to create a real-time noise map of the city to see how the noise impacts the citizens. They are also using luminosity sensors to create a smart lighting application where the streetlights turn on when the sunlight dims to a certain level.

A Waspmote unit implemented in a Smart City

Another project we have in northern Spain is a smart agriculture network for vineyards so that you can measure in real-time how much water is absorbing into the crops and how much light is being reflected through our ultraviolet sensors. The farmers can keep track of the water levels using moisture sensors and they can also measure danger to the crops if

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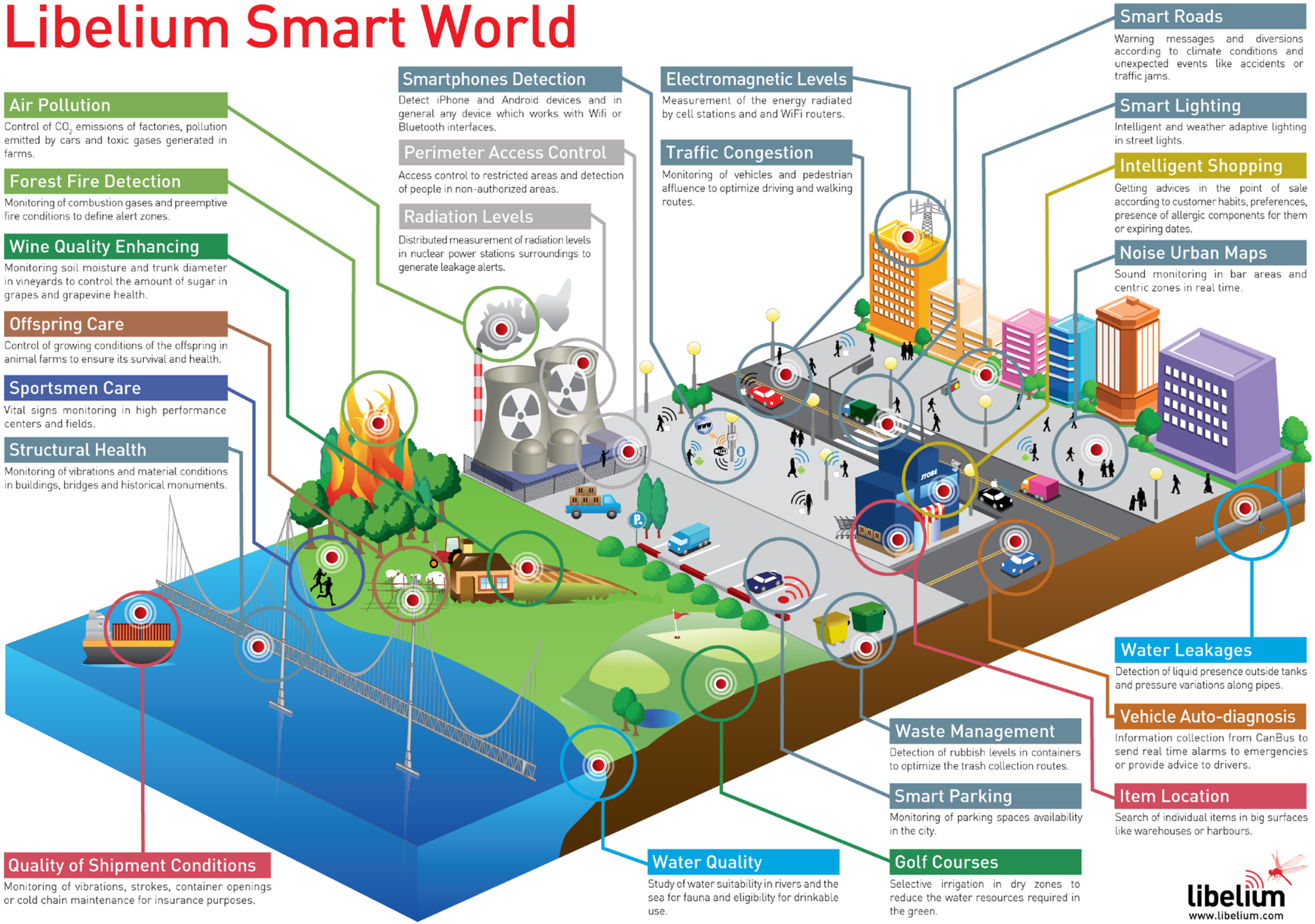
there is damaging frost at night. There is also a similar project concerning forest fire detection. We implemented 200 nodes throughout an entire forest with CO and CO2 sensors that are monitoring whether or not there is fire or smoke.

During the Fukushima plant meltdown in Japan, there was a lot of radiation emitted. We then started thinking of how to measure the amount of radiation through sensors and we created a new model of Waspmote, which introduced our radiation sensors, and sent them over to Fukushima. These can be implemented in the gardens and windows that measure the radiation around you. This was a really beautiful project for us because we gave away these nodes for free and we realized that people can measure the radiation without actually being there, which saves lives in the long run. After that, we created a Plug & Sense radiation model.

Could you tell us a little more about Libelium?

We are based in Zaragoza, Spain and there are around 35 people who work here. Zaragoza is a medium-sized city, which is based in between Madrid and Barcelona, so it's really well connected. All of the people that work here are relatively young. My partner, Alicia Asín—the other co-founder of the company—is just 30 years old. The rest of the employee's ages range from 25 to 35. It's a really young team to be making not only software, but also hardware products. We are learning a lot about how the market works and about how we can improve manufacturing because it's not the same to make just software where you can just correct the programming. We are learning to cope with hardware designs and electronic devices and make them look nice. The last year, we managed to release a new product



for each month of the year, so this gives you an idea of how hard our team is working—there is a lot of strength and movement, and there are a lot of dynamic people that work here. It's a small company, but we move quickly.

What is the future looking like for Libelium?

One of the things that we have to cope with now is multiple integration with the Cloud systems. On the one side, we are the manufacturers or sensor technology and in the middle there is the Cloud system providers, and on the other end, there is the end users. One of the most important things we have to deal with in the coming years is we have make a platform that can be easily integrated with the Cloud system. You can't make these kinds of proprietary protocols because if you can't talk to a web server and you don't do an open implementation of the communication protocols, you can't really grow. Everyday, there a bunch of new Cloud companies created, so you have to be open in terms of compatibility and compliance. Over the next year, we have to really be really compatible with Cloud systems so that when someone wants to create a new project, they think of using the Libelium platform because it can be easily integrated in any database, web server, and in any smart phone technology. We are clearly making this not only open-source API, but also communication frame, so that any web developer can take our sensor frames and integrate in their own sensor and monitor applications.

For more information, visit:

www.libelium.com