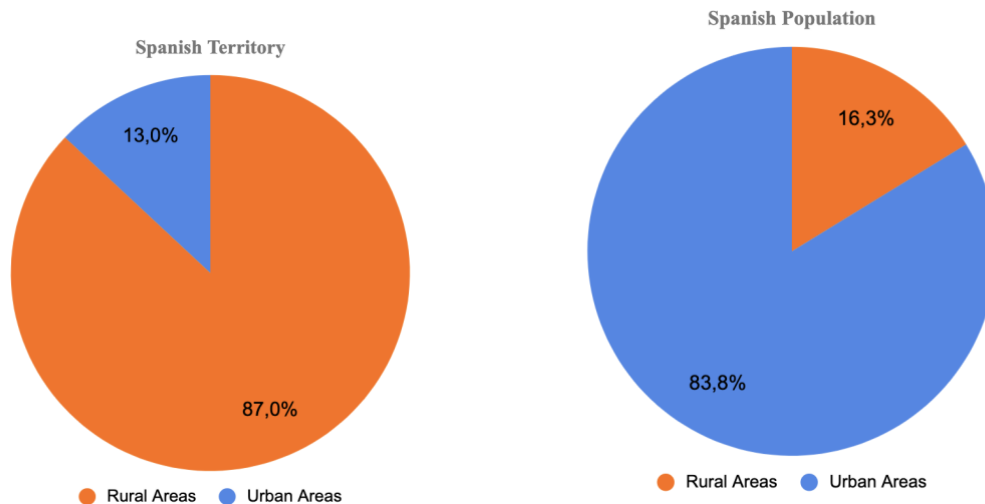


Connecting 'rural Spain' with **OpenRoaming™** enabled Wi-Fi Galgus and Telefónica success case.

Introduction

Rural environments in Spain comprise approximately 87% of the territory, but only 16.25% of the population lives in it, meaning the rest are living in large cities and medium-sized towns.



From 2000 to 2018, the population in rural areas has fallen by 10%. This can mainly be attributed to young people transferring to urban areas in order to have better job opportunities.

This phenomenon is known in our country as "**Rural Spain**".

In most cases, villages do not have modern telecommunications networks. As a result, the digital divide throughout Rural Spain continues to widen.

In this context, the European Commission is developing the **WIFI4EU** (Wi-Fi for Europe) **Program**, which aims to facilitate this sort of connection in this type of environment, providing municipalities with a fixed amount of funds to cover this need.

Despite the aforementioned, the emergence of the **COVID-19** pandemic has caused some people to return to their hometowns as they consider them safer places to live. People who are working remotely

can continue with their daily professional activity from almost everywhere. However, the possibilities of good wireless connectivity decrease the ones that they used to enjoy in large cities.

In this case study, we will explain the Wi-Fi technology, ready for Passpoint® and OpenRoaming™, that Galgus has deployed with its partner, Telefónica. We will also show how we have already reached around thirty towns in Spain with a total of 250,000 inhabitants.

Why We Need Wi-Fi Technology (WIFI4EU) in Rural Areas

Blascosancho, El Barco de Ávila, Herrera del Duque, Lerma, Madrigal de las Altas Torres, Robledillo de la Vera... Those are names of Spanish towns that are a part of the "Empty Spain". These represent places where technology could provide a great opportunity.

Spain and its population distribution

According to the "Annual Report of Indicators: Agriculture, Fisheries, Food and Environment 2018", published in 2019 by the Ministry of Agriculture, Fisheries and Food of the Government of Spain, the country's population is approximately 46.7 million people. Of these, 7.6 million resided in rural municipalities, 16.24%.

This report also highlights that the number of municipalities in Spain is 8,124, with 6,676 of them located in rural areas. A rural area is considered to be the "geographic space formed by the aggregation of municipalities that have a population of fewer than 30,000 inhabitants and a density of fewer than 100 inhabitants per km²" and a small rural municipality is "one with a resident population of fewer than 5,000 inhabitants and that is integrated into the rural environment". Rural municipalities represent 82.2% of total municipalities in Spain and occupy 84.1% of the country's surface.

Non-rural municipalities, hereinafter "urban", occupy 15.9% of the territory and 83.7% of the Spanish population live there, with a density of 488.2 inhabitants per square kilometer, much higher than the density of 17.9 inhabitants per square meter that occurs in rural municipalities.

10% reduction in 20 years: The "Empty Spain"

In the aforementioned report, it is noteworthy to see those **rural areas lost around 850,000 inhabitants between 2000 and 2018** - a depopulation that was more pronounced in the second part of that period (between 2008 and 2018). This population decline can be attributed to the migration of young people to urban centers in search of better job opportunities.

This situation leads these populations to become "deserts" of economic activity. Thus, without employment, there is no good provision of services,



which are the factors that most contribute to people's life quality. Among other services, the importance of having modern telecommunication systems could be mentioned. Without them, the digital divide grows even larger, making these towns less and less attractive to generate jobs and wealth.



life quality. telecommunication divide grows even larger, jobs and wealth.

Europe to the rescue: Wi-Fi for Europe

The situation described is not exclusive to Spain. With normal variations, it is a trend that is observed in many European countries.

In this context, the European Commission launched the Wi-Fi for Europe program (WIFI4EU), which aims to provide residents and visitors with high-quality internet access throughout the EU through free Wi-Fi access points located in public spaces, such as parks, squares, administrative buildings, libraries, and health centers. The bonds financed by the European Commission through this initiative are awarded to **help municipalities to install Wi-Fi access points** in these centers of public life, using the services of Wi-Fi installation companies. Since 2018, the European Commission has carried out four calls for this program, disbursing a figure of 120 million euros.

This initiative of the European Commission, maybe even more important due to the irruption of the COVID-19 pandemic.

COVID-19 is making some people decide to settle in rural areas, considering them safer places to reside in during the pandemic. For those who work remotely, it doesn't matter where they are; if they have high-quality Internet connectivity, they will be able to work from anywhere.

The solution

In November 2019, **Galgus**, a Spanish deep-tech company that focuses on robust, flexible and secure Wi-Fi networks, and the multinational **Telefónica**, reached an agreement to incorporate Galgus's Wi-Fi solution into Telefónica's connectivity proposal for SMEs and **public administrations**, the latter segment in which the WIFI4EU initiative is framed.

The technology developed and patented by Galgus is called CHT (Cognitive Hotspot™ Technology). It is a hardware-agnostic, multi-platform software that can be installed on a large variety of Wi-Fi access points. CHT provides distributed intelligence to the Wi-Fi network where it is installed, optimizes radio resources automatically, and allows the owner of the network to have advanced services such as device location, heatmap generation, hacker detection, or cloud management. CHT comes factory-installed, pre-configured and running on all devices that Galgus sells.

With this partnership agreement, Telefónica strengthened its LAN / Wi-Fi portfolio and consolidated its position as a leader in LAN / Wi-Fi solutions in Spain, with more than 4,000 business clients and more than 120,000 Wi-Fi equipment management.






The solution that Galgus has deployed with Telefónica will be presented in this use case, which already reaches approximately 40 towns with more than 250,000 inhabitants. Together with other large cities that Telefónica has deployed with Galgus, **we serve almost 1 million people.**

Municipalities in which Galvus and Telefónica have deployed WiFi4EU initiatives (November 2020)



In each of these locations, a **Wi-Fi network has been deployed consisting of 10 to 15 Wi-Fi Access Points (AP)** on average.

To achieve this, **3 different AP models have been used (two outdoor and one indoor)**. These APs meet the technical requirements of the WiFi4EU program. Cognitive Hotspot Technology runs inside them, providing intelligence to APs, allowing them to optimize, manage, and analyze any Wi-Fi network from the cloud.

Indoor AP - IC450	Outdoor AP - OC400	Outdoor AP - OC420
 <p>Standards: a/b/g/n/ac Wave 2 2.4 GHz Radio Rate: 300 Mbps 5 GHz Radio Rate: 867 Mbps Maximum Throughput: 1167 Mbps MIMO 2.4 GHz: 2x2:2 MIMO MIMO 5 GHz: 2x2:2 MU-MIMO WAN: 10/100/1000 LAN: 10/100/1000 Maximum Number of clients per AP: 100+ PoE Mode: IEEE 802.3 at standard PoE Typical Power Consumption: <12W Number of Ethernet Ports: 2 Mounting: Wall & Ceiling</p>	 <p>Antenna Type: Omnidirectional Standards: a/b/g/n/ac Wave 2 2.4 GHz Radio Rate: 300 Mbps 5 GHz Radio Rate: 867 Mbps Maximum Throughput: 1167 Mbps MIMO 2.4 GHz: 2x2:2 MIMO MIMO 5 GHz: 2x2:2 MU-MIMO WAN: 10/100/1000 LAN: 10/100/1000 Maximum Number of clients per AP: 100+ PoE Mode: IEEE 802.3 at standard PoE Typical Power Consumption: <20W Number of Ethernet Ports: 2 Mounting: Wall & Mast IP Protection Grade: IP65</p>	 <p>AP Exterior - OC420 Antenna Type: External Standards: a/b/g/n/ac Wave 2 2.4 GHz Radio Rate: 300 Mbps 5 GHz Radio Rate: 867 Mbps Maximum Throughput: 1167 Mbps MIMO 2.4 GHz: 2x2:2 MIMO MIMO 5 GHz: 2x2:2 MU-MIMO WAN: 10/100/1000 Maximum Number of clients per AP: 100+ Typical Power Consumption: <20W Number of Ethernet Ports: 2 Mounting: Mast IP Protection Grade: IP67</p>

In the following pages, two specific cases will be presented: Cuevas de San Marcos (Málaga) and Blascosancho (Ávila)

Cuevas de San Marcos (Málaga)

Cuevas de San Marcos is a Spanish municipality in the province of Málaga (Andalusia) that has 3,648 inhabitants.

It is a town of agricultural activity, with a predominance of olive cultivation and the production of olive oil.



WiFi4EU deployment:



In this case, APs were installed in 4 locations in the municipality. Specifically:

Area	Type	Units
City Council	Indoor	6
Sports Facilities	Outdoor	5
Pablo Picasso Ave.	Outdoor	4
Kinder Playground	Outdoor	4

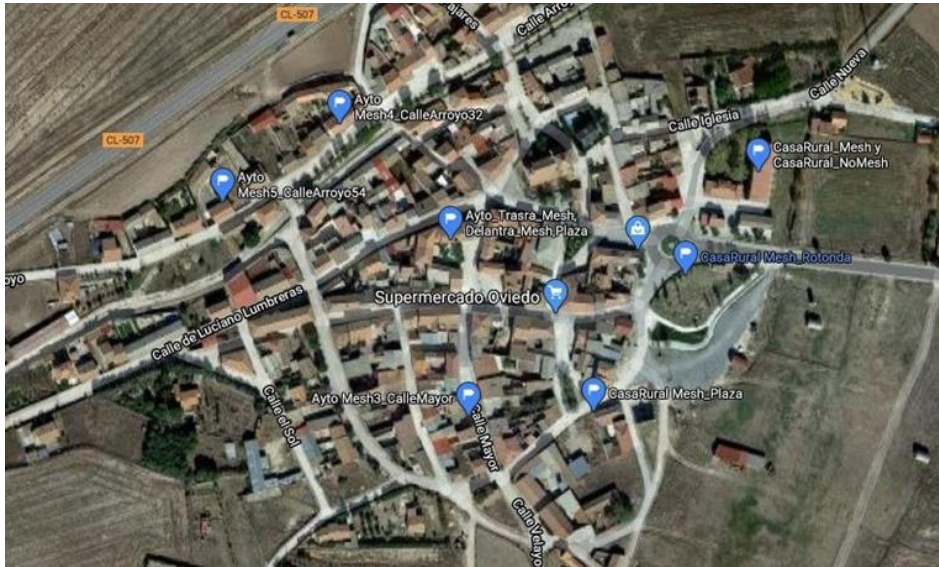
Blascosancho (Ávila)

Blascosancho is a Spanish municipality in the province of Ávila (Castilla y León) that has 105 inhabitants. In recent years it has lost 20% of its inhabitants.

Its population mainly subsists on agriculture and livestock.

A Wi-Fi deployment was made in seven key areas of the town, where 12 access points were installed.



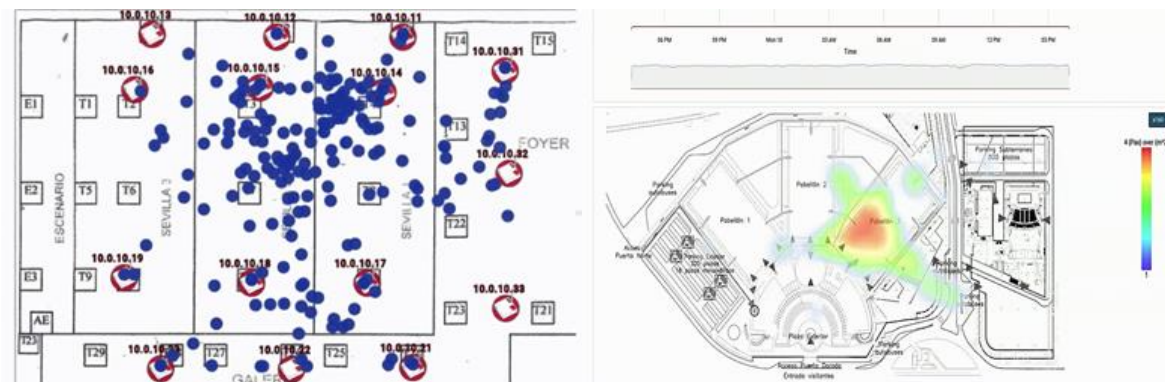


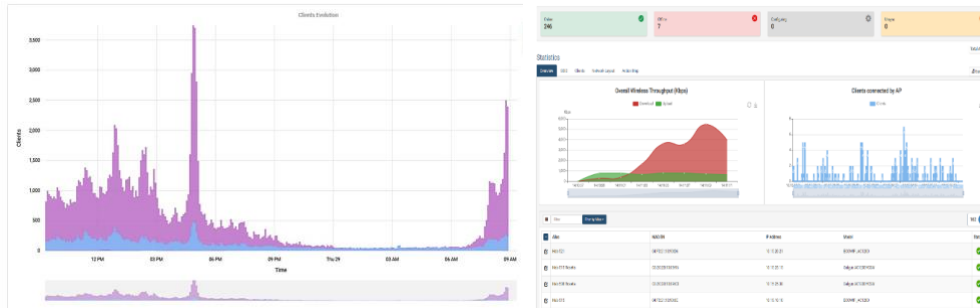
In both towns, Galgus and Telefónica deployed Wi-Fi networks with Hotspot 2.0 (Passpoint), which is the new wireless standard designed to make it easier and more secure to connect to public Wi-Fi hotspots. It allows you to authenticate yourself with your SIM card or other credentials automatically, saving time and ensuring your safety in cities, hotels, airports, convention centers, etc. With this technology, the client device is authenticated with all the certified networks in its path, thanks to its credentials, without asking the user. Ready for Passpoint® and OpenRoaming™.

Passpoint® and OpenRoaming™ means seamless handoff on Wi-Fi networks that may be geographically far away, with strong authentication and security measures – at home, when you arrive at the train station, when you sit in the car, etc. Users can connect Wi-Fi with OpenRoaming™ by using the same identity and seamless, automatic and secure experience which will make the life of users easier. **Galgus will work together on the live deployment of OpenRoaming™ to provide the best Wi-Fi experiences for our partners and customers.**



Galgus shifts the focus of Wi-Fi networks from competition to collaboration, optimizing the use of available resources and attending to the needs of all connected devices in real-time. Additionally, it can provide extremely valuable information to the network owner, as well as advanced management services. All of this is achieved without the need for a central controller or cloud controller, **avoiding bottlenecks, delays, and making the network much more robust and scalable.**





Besides that, Galgus APs locate and track nearby devices, preventing distortion due to MAC address randomization (a common problem of Wi-Fi analytics with modern smartphones). It can also detect and mitigate hacker attacks, including locating the attacker. Moreover, the network administrator can **manage their entire infrastructure from the dashboard in the cloud**, as well as collect valuable data about user behavior, context, and flows of people.

Impact of Galgus Wi-Fi Technology

The deployment of these Wi-Fi networks through the WIFI4EU program provides benefits in both the places where it is installed, as well as for the ISPs and integrators that deploy them.

Thus, for municipalities it can be highlighted:

- **Economic development:** these localities, mostly associated with primary sectors such as agriculture and livestock, are able to turn to new developments in the service sector such as Tourism and Electronic Commerce, either on their initiative or through rural coworking centers.
- **Social development:** the arrival of the Internet to these localities allows better access to information for the inhabitants, reducing the digital divide.
- **Demographic development:** the Internet also makes this type of town more attractive, which can lead to an influx of freelance professionals.
- **Development of digital transformation:** access to online public procedures, etc.

As previously stated, it also provides important benefits for ISPs and installation companies:

- **Higher margin** than with traditional Wi-Fi vendors (CAPEX savings).
- **A higher number of public tenders won** with our solution (Telefónica wins 87% of the projects submitted with Galgus).
- **Savings in OPEX** by enabling cloud management and remote troubleshooting.
- **Minimize errors and user complaints** thanks to automatic network optimization.
- **Improving user experience.**

From a technical point of view, network owners now enjoy benefits such as:

- By disaggregating the software from the hardware, it allows the network owner to choose the APs that best fit their **needs and budget**.
- **Upgrading old networks** through retrofitting, extending the life of already established Wi-Fi networks, and enjoying the latest features at the push of software.

- Avoiding the problems of networks that have centralized controllers or cloud controllers, which can include a lack of adaptability and robustness, the presence of single points of failure, delays in decision making, and/or bottlenecks.
- Reducing **operating costs**, as CHT is responsible for optimizing the network in real-time (allocation of resources radio, power, channels, bandwidth, load balancing, airtime fairness, smart and predictive roaming, traffic congestion management, etc.) automatically, without human intervention.
- Adding enormous **value to the network** through analytics (counting users even if they randomize their MAC address, detecting, mitigating, and even locating hacker attacks, generating heat maps in real time) allowing the owner of the network to mine the data obtained without violating the privacy of the users.
- Simplifying the life of network administrators, thanks to its Zero-Touch Provisioning philosophy for immediate deployment and advanced enterprise-grade management features (Cloud Manager, REST API, captive portal, Passpoint and OpenRoaming™, dynamic VLANs, WPA3 Enterprise, SSH troubleshooting from the cloud, etc).

About Galgus and Telefónica

About Galgus

Galgus is a deep-tech company based in Seville. Its Cognitive Hotspot™ Technology (CHT) creates a fully distributed Wi-Fi network, making each Wi-Fi access point intelligent. Galgus' APs measure key network metrics, exchange that information with nearby access points, and together optimize radio resources in real-time. A Wi-Fi network with Galgus solution is more reliable, offers better performance, is greener, and provides impeccable quality of service for all users and connected devices, all at a very competitive cost for the network owner. Also, it provides advanced services such as device location, heat map generation, hacker detection, or cloud management.

About Telefónica Enterprises (Telefónica Empresas)

LAN / Wi-Fi services that encompass the provision, maintenance, and a comprehensive management model of all customer connectivity and consolidate its position as a leader in these solutions in Spain, with more than 4,000 business customers; and are part of the company's strategy for the business market and its digital transformation under the Telefónica Empresas brand, which includes a unique proposal supported by 6 large business areas: connectivity, cloud, IoT, security, big data and digitization of the job. Telefónica Empresas offers a centralized and comprehensive service offer for each of the projects.

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