MACEDO VITORINO

OCTOBER 2025/ MAKING 5G AVAILABLE TO PORTUGUESE COMPANIES

5G PRIVATE NETWORKS

CONTENTS

MACEDO▪VITORINO

5G AND INDUSTRY 4.0

5G PRIVATE NETWORKS

BACKGROUND

Each new generation of communications systems essentially serves to cancel distances, which happens at a truly dizzying pace.

With the packet transmission speed of 5G networks increasing more than fivefold compared to 4G LTE and settling at ranges close to the speed of thought of its human user[1], the issue of wireless communication speed is, for the moment, largely resolved. The challenge for an optimized network is therefore elsewhere. In other words, once the latency issue has been resolved, it remains to ensure that all the infrastructure it serves may effectively benefit from it.

Essentially, these infrastructures have three elements: computing, transmission and storage, of which the first is the servers that provide applications, services and data to the end user, the second is the circulation of data, and the third is the systems that use specialised equipment and software, designed to store, retrieve, manage and protect data on a large scale.

With 5G having solved, at least for now, the transmission component, the optimization of the system, from the user's perspective, depends on the solutions for accessing databases and, more specifically, on the architecture of their storage, which can be in a centralized system (cloud type) or in a distributed system.

As cloud systems belong to large providers (or hyperscale's such as AWS, Google or Microsoft), by nature accessible only through operators' public networks, it is in the relative flows of distributed data centre's that the issue of private 5G networks arises.

As we will see below, most of the industrial uses that fall under the concept of Industry 4.0 depend on extremely low latencies and computing systems that use distributed and hierarchically organized architectures to allow the creation of flows between peripheral systems closer to the users – a concept known as edge or fog computing.

It is, therefore, in a context in which the capacity for low-latency communication for decentralized operations is critical for the development of various sectors of the economy, that this consultation should be seen and it is in this light that the inconclusive result should be evaluated.

[1] - In the human brain, a synapse (chemistry) has an average transmission interval between 0.5 and 2 milliseconds, in a 5G network, in theoretical terms, the latency is between 1 and 10 milliseconds.

NEXT GENERATION MOBILE NETWORK

5G is a 5th generation wireless mobile network that emerged in 2020 and has since replaced its predecessor, 4G in the daily lives of people and companies.

This new technological standard is the pillar of numerous practical advances such as smart cities, autonomous cars and real-time industrial communication (industry 4.0).

In some European countries, 5G has exceeded expectations, reaching speeds between 200 Mbps and 350 Mbps, and it is expected that at a more advanced stage it could reach 1 Gbps.

Among other advantages, 5G ensures:

- Increased network speed and capacity;

- Reliable and permanent connectivity; and

- More flexible and service-adjusted networks

PRIVATE NETWORKS

Of the advances achieved through 5G technology, private 5G networks stand out, which are independent communication systems, implemented in the infrastructure of the client companies themselves, with or possibly without the support of electronic communications operators.

The impact of the deployment of these networks is equivalent to the installation of a data centre within the facilities themselves, allowing, among others:

- Faster decision-making, particularly when compared to the circulation of information in the cloud;

- Immediate access to connected devices that collect information in real time;

- Full control over network configuration and management; and

- Increased security of company data that remains on the private network.

According to the "Nokia 2024 Industrial Digitalization report", which tracked the progress of 100 companies that installed private 5G networks, 93% of them achieved a return on their investment in 12 months, with 65% of respondents reporting increases in worker safety and reduction in their emissions.

INDUSTRY 4.0

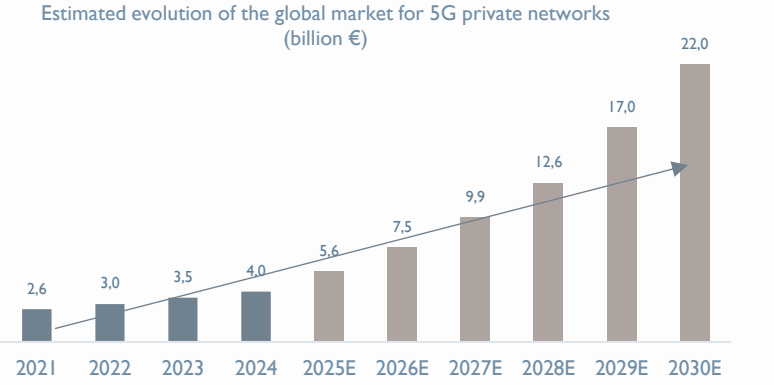
The industrial sector is highly receptive to technological advancements. The concept of Industry 4.0 refers to the digital overhaul of production processes, seamlessly integrated with a factory's routine operations. In 2016, the European Union introduced its "5G Action Plan," outlining a vision to modernize European industry by fostering smarter, more efficient, and safer factories.

Private 5G networks are central to achieving this vision, offering ultra-fast, customizable connectivity tailored to each company's unique needs. By being exclusively managed by the company, these networks provide enhanced flexibility, greater control, and reduced risks compared to shared infrastructure.

According to ANACOM's 5G Portal, a prime example of this transformation is a factory robot equipped with a camera that identifies and processes images of damaged packaging, instantly removing it from the production line to streamline operations.

The rise of these "connected factories" has been rapid. A 2022 Counterpoint research paper estimated the global private 5G network market at €2.5 billion, with projections to grow to €21.8 billion by 2030.

However, companies seeking to implement this connectivity face challenges, particularly their reliance on traditional telecommunications operators, known as Large Operators, to access various spectrum bands.



CAGR = 84,6%

Source: Counterpoint

MACEDO▪VITORINO

THE PORTUGUESE CONTEXT

5G PRIVATE NETWORKS

THE PORTUGUESE CONTEXT

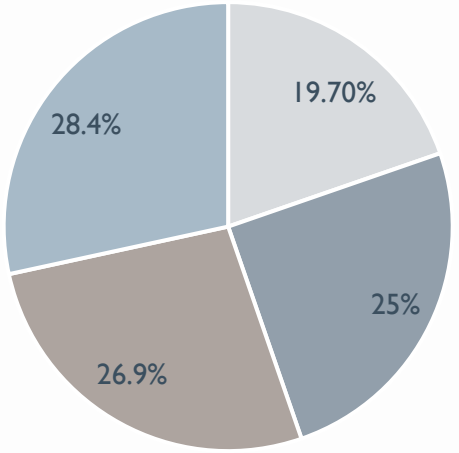
The National Communications Authority (ANACOM) allocates the Terrestrial Electronic Communications Services Spectrum (SCET) to telecommunications operators through auctions, granting Rights of Use of Radio Spectrum (DUER) for specific frequency bands (as shown in the accompanying table).

In Portugal, any company can deploy a private 5G network within its infrastructure, but this relies on traditional telecommunications operators, who currently hold DUER for the 5G spectrum bands: 700 MHz, 900 MHz, 2.1 GHz, and 3.6 GHz.

In the 2021 5G Auction, ANACOM assigned DUER for these bands to telecommunications operators NOS, MEO, Vodafone, NOWO, and DIGI.

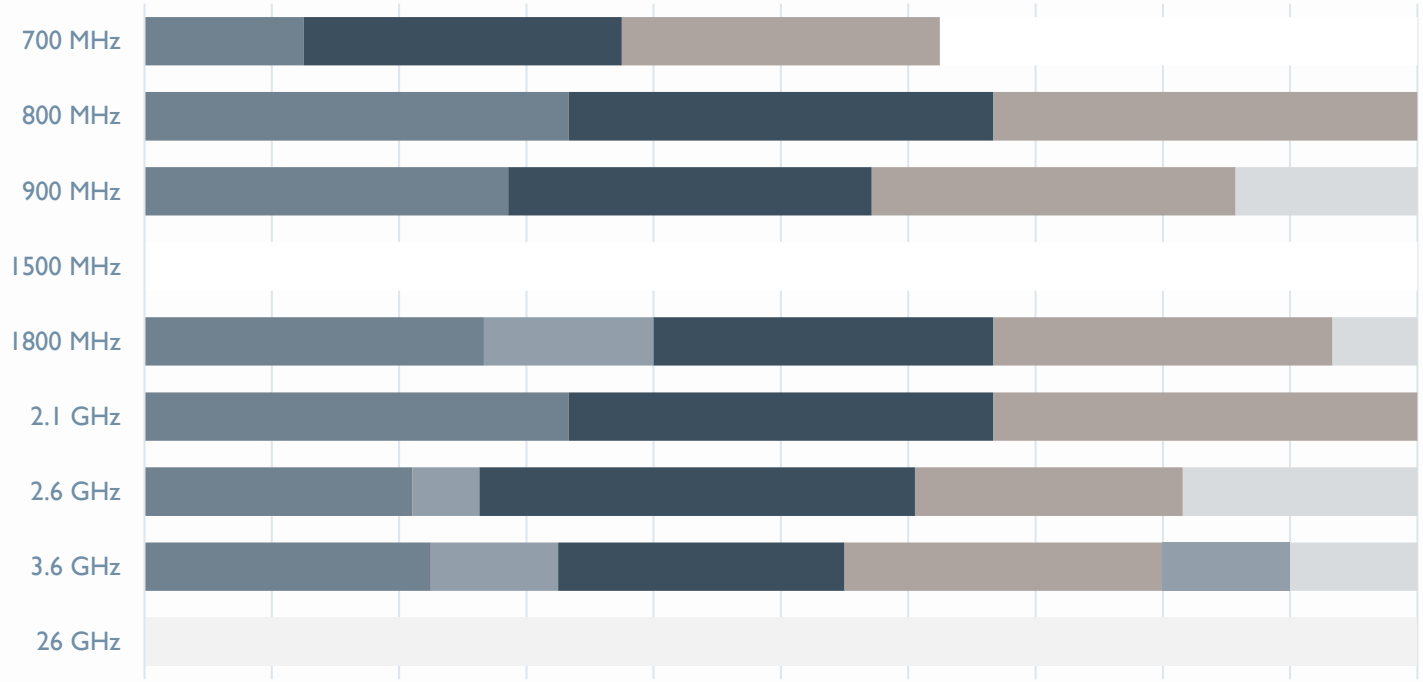
The 26GHz band remains unallocated and is slated for allocation in 2027. Due to its suitability for ultra-fast 5G networks, the National Peacetime Frequency Sharing Agreement (ANPF) was established between ANACOM and the Armed Forces, reserving part of the 26GHz band for military use.

Spectrum distribution for **SCET**



Source: ANACOM

Allocation of Rights of Use of Radio Spectrum for Terrestrial Electronic Communications Services on the date of publication of the Public Consultation (September 2024)



* In February 2025, there were changes to the allocation of DUERS for NOWO and DENSE AIR

Source: ANACOM

MACEDO▪VITORINO

ANACOM'S CONSULTATION ON ALLOCATION PROCEDURES

5G PRIVATE NETWORKS

WHAT IS AT STAKE?

On 26 April 2024, a report by the European Parliament's research service (A Future-Proof Network for the EU: Full Fibre and 5G) drew Member States' attention to the legislative fragmentation in this area.

Reflecting these concerns, ANACOM launched a public consultation in which it questioned the national market about its interest in the possible introduction of a new spectrum allocation model, different from the multi-band auction aimed at public telecommunications network operators and any interested party.

As explained by the Regulator, if there is express interest, an autonomous allocation model, with or without a selection procedure, applied in a logic of local use, with a restricted and delimited geographical scope, may be considered for the 26GHz and 42 GHz bands.

These bands, more specifically the 26GHz band, were chosen because they are the most appropriate for the assignment of part of the spectrum to so-called "vertical" applications, i.e., in which the permission to use the spectrum is directly attributed to the company, industry, or public entity by ANACOM.

The innovation of this new type of model takes place in the distancing of traditional telecommunications operators and in the opening of part of the band to verticals that, instead of depending on operators for the installation and management of private 5G networks, can now install them in their infrastructure autonomously, upon authorization from ANACOM.

In the consultation, the Portuguese authority presents 3 model options, all of them "inspired" by models already adopted by other European countries.

NEW ATTRIBUTION MODELS

Option A- Nationwide rights

Allocation of rights of use for radio frequencies (DUER's) at national level, similar to those allocated in the other frequency bands, for publicly available electronic communication services.

Option B- Local Rights

Similar to the German model, this option provides for consignments of restricted geographical scope, allowing any interested party to apply for rights of use of local scope.

This option allows the direct acquisition of EDUs, without companies relying on traditional operators. However, ANACOM lists, from now on, ONE unavoidable requirement: the submission of a project for the implementation of its network using the 26 GHz band.

This project may eventually include one or more base stations that ensure coverage of the restricted area.

Option C- National or regional rights with local spectrum reservation for "vertical providers"

This was the third and final model presented by the Portuguese telecommunications authority. There is a similarity to the models adopted by Denmark, Spain and Finland, in this case, national or regional SUDs coexist with local rights of restricted geographical scope and self-use, which are guaranteed through the reservation of spectrum for these entities.

In other words, it is a compromise between option A and B that, despite maintaining the possibility of assigning DUER's, for example, circumscribed to a specific region, leaves, from the outset, another part of the band reserved for the creation of private 5G networks.

The purpose of this model is to satisfy all interested parties, however, it will require greater control by ANACOM in order to avoid possible bad faith players.

The United Kingdom, despite having adopted a spectrum allocation model similar to that of option B, plans to modify its allocation model of the 26 GHz band to one similar to this option C.

MACEDO▪VITORINO

PRIVATE 5G NETWORKS IN EUROPE

THE EU
5G ACTION PLAN

Back in 2016, the European Commission launched a strategic initiative, the 5G Action Plan, to deliver 5G connectivity to all citizens and businesses across the European Union. This plan focused on coordinated efforts by Member States to roll out 5G infrastructure, enabling its widespread commercial deployment by the end of 2020.

To support this, the European Electronic Communications Code (ECEC) mandated that, by 31 December 2020, Member States must allocate at least 1GHz of the 26GHz frequency band for 5G use.

The ECEC further specifies in its recitals:

That the 26GHz band will complement existing mobile networks, offering high-capacity connectivity in small-area locations;

The possibility of this band being made available on a non-exclusive basis, i.e., for specific business communications or for use in indoor environments.

EUROPEAN CONTEXT

Powered by Bing
ureau of Statistics, GeoNames, Microsoft, Navinfo, Open Places, OpenStreetMap, Overture Maps Fundation, TomTom, Zenrin

While private 5G networks have yet to reach full-scale deployment, organizations, industries, and public bodies across Europe are increasingly drawn to their high-capacity advantages. In response to growing demand and efforts to reduce dependence on traditional operators, countries like Germany, Sweden, and the United Kingdom have designated the 26 GHz band specifically for vertical sector uses.

Denmark, Spain, and Finland have allocated portions of this spectrum both for verticals and for telecom providers, whereas Austria, Bulgaria, Croatia, Slovenia, Estonia, Greece, and Italy reserve DUER exclusively for established operators. As this landscape evolves, regulatory authorities tasked with allocating DUER are considering reforms: these may streamline procedures and enable independent deployment and management of the technology, sparing users the need for mobile operator services.

PRIVATE 5G NETWORKS IN EUROPE

GERMANY

Since 2019, Germany's Bundesnetzagentur (BNetzA) has pioneered innovative spectrum allocation by reserving the entire 3.7–3.8 GHz and 26 GHz bands exclusively for private networks. Companies can obtain spectrum licenses directly from BNetzA, eliminating the need for traditional telecom intermediaries like Vodafone or Deutsche Telekom.

More than 120 licenses have been issued to industrial firms such as Audi, BASF, and Lufthansa, driven by the opportunity to advance Industry 4.0 initiatives. This approach provides sectors not only with increased flexibility and autonomy but also the strategic advantage of operating independently from telecommunications providers.

A standout case is Deutsche Bahn, which, partnering with Nokia in 2019, deployed a dedicated 5G network for automated rail operations. This example demonstrates how entities leveraging private networks can successfully manage complex tasks without relying on external telecom operators.

FRANCE

In France, the Autorité de Régulation des Communications Électroniques et des Postes (ARCEP) has adopted a cautious strategy for the distribution of spectrum dedicated to private 5G networks. Since 2019, ARCEP has tested the market by issuing test licenses in the 2.6 GHz, 3.8–4.0 GHz, and 26 GHz frequency bands to various industry sectors, aiming to facilitate access to 5G.

In 2022, ARCEP granted 13 experimental licenses to organizations in the industrial, health, and energy sectors for the use of the 2.6–4.0 GHz band. Each authorization allowed up to 100 MHz of spectrum under a local permit for experimental use, originally for a duration of three years.

Although these experimental licenses were set to expire on December 31, 2023, ARCEP extended their validity until December 31, 2024. However, any plans to further continue this measure have not yet been formally announced.

PRIVATE 5G NETWORKS IN EUROPE (CONTINUED)

THE UNITED KINGDOM

The United Kingdom has adopted a more flexible licensing model in relation to private 5G networks, with the Office of Communications (Ofcom) implementing measures that favour micro-operators in access to 5G spectrum.

In 2019, the UK introduced two spectrum allocation models, with the aim of fostering the use of private 5G networks without the need to rely on large communications operators:

Shared Access License (SAL) – This shared spectrum mechanism allows several companies to install private 5G networks, using a wide variety of shared bands such as: 1.8 GHz, 2.39-2.4 GHz, 3.8-4.2 GHz and 26GHz, the latter being only for "indoor" use and having been made available only part of the band. The real impact of this mechanism is that companies obtain this license directly from the regulator (Ofcom). The UK market has received this mechanism positively, with more than 1600 of these permits having been issued since its implementation in 2019.

Local Access License (LAL) – This type of license allows companies in rural or remote locations to rent underutilized spectrum to mobile operators. It is true that in this model, dependence on large operators is maintained, however, it does not fully use their infrastructure, allowing greater flexibility and autonomy in the use of spectrum.

Although Ofcom has opted for a strategy similar to Option B (local rights) proposed by ANACOM, although restricted to indoor applications, the British authority plans to modify the allocation model for the 26GHz band, and the process is already underway.

The change includes a model that is similar to Option C proposed by ANACOM, consisting of the allocation of regional licenses in the upper part of the band with spectrum reservation in the lower part of the band for verticals.

MACEDO▪VITORINO

ANACOM'S CONSULTATION REPORT

5G PRIVATE NETWORKS

THE ANACOM REPORT

On February 12, 2025, ANACOM released its Consultation Report on spectrum provision for electronic communications services, summarizing input from 17 entities and including ANACOM's overall assessment.

No decisions were made on new spectrum allocation models, leaving things unchanged. However, the report outlines ANACOM's views on:

- Spectrum availability and proposed timeline;
- DUER renewal;
- Spectrum utilization rates; and
- Private/"vertical" networks.

The topic of private 5G networks stood out, generating the most contributions during the consultation.

WHY PRIVATE NETWORKS?

According to ANACOM, there is a broad consensus on the benefits that this technology may bring to end users, the same cannot be said about the method of making it available.

Therefore, from the opinions given by the interested parties, it is possible to verify the following duality:

1. Private 5G networks must be provided by SCET operators, with the end user always and necessarily dependent on a traditional operator to be able to take advantage of this technology; and

2. With regard to private 5G networks, the market should be opened to the entry of new players, such as companies from various sectors of industry, innovation and research institutes, start-ups and universities.

This duality arises from the natural interest of each of the interested parties. For example, traditional operators such as MEO, NOS and Vodafone have expressed that spectrum should not be reserved for "verticals", especially with regard to the 26 and 42GHz bands.

These operators consider that any spectrum needs that arise in a local or regional context should be met only by licensed operators, at the expense of devaluing the allocation of a scarce asset in the public domain to the benefit of individual users.

In turn, interested parties such as Nokia Portugal, the Agency for Administrative Modernization ("AMA") and Bosch have positioned themselves in favour of opening the market to vertical applications.

Of the various reasons presented, we highlight the following:

- Digital development in the public and private sectors through greater autonomy in the face of the current dependence on traditional operators;

- Greater flexibility and security for companies, especially those that develop critical activities; and

- The increase in competitiveness and the development of new services for various sectors, especially the industry.

ANACOM'S OPINION

As previously noted, ANACOM's report didn't make any decisions on vertical applications or take a stance on the differing views from stakeholders.

There was significant interest in the 3.8–4.2 GHz bands, alongside the 26 GHz band, according to the contributions. Although the 3.8–4.2 GHz bands weren't part of the public consultation, due to their use for private networks across Europe, ANACOM committed to exploring this option.

ANACOM also pledged to assess ways to address risks tied to any potential decisions, noting that at this time, any choice would be made amid uncertainty about actual spectrum demand from "verticals".

Ultimately, the report only summarized stakeholders' opinions, with ANACOM choosing to delay the much-anticipated decision.

WHAT TO EXPECT?

In its public consultation, ANACOM stated that spectrum allocation under the new model must happen before the 2027 multi-band auction. However, the report was delivered late and, worse, without a decision on vertical allocations.

ANACOM justified its indecision by citing uncertainty about spectrum demand from verticals—a reasoning that's hard to grasp, given the clear interest in this technology across European markets.

The advantages of private 5G networks, bypassing traditional operators, are clear for both private and public sectors. More players offering these services would likely drive competitive pricing and better conditions for end users.

Still, we're left waiting for ANACOM to take a stance, either aligning with SCET's interests or those of other stakeholders.

MACEDO▪VITORINO

SAWAP

5G PRIVATE NETWORKS

SAWAP

In November 2024, the Portuguese Government rolled out measures for Small-Area Wireless Access Points (SAWAP) to align with the Radio Spectrum Policy Program for 5G. SAWAPs are compact, short-range radio devices installed indoors or outdoors to boost mobile connectivity. They enhance cellular networks or shift traffic to WiFi (aka "WiFi offloading") to keep devices seamlessly connected.

The rollout of Small-Area Wireless Access Points (SAWAPs) boosts 5G network coverage without needing major infrastructure upgrades. It reflects Portugal's commitment to expanding and densifying 5G access, in line with the Digital Agenda for Europe.

To set up SAWAPs, operators simply notify ANACOM via a dedicated platform. No fees apply, except for installations in monuments, protected areas, or zones of national interest. Since prior approval isn't required, operators only need the infrastructure owner's consent to install the access points and arrange utilities like power.

Electronic communications operators are central to this process, handling the installation, maintenance, and integration of SAWAPs into the network. This ensures traditional operators remain key players in driving 5G technology forward.

MACEDO▪VITORINO

ABOUT MACEDO VITORINO

WHO WE ARE & WHAT WE DO

WHO WE ARE

MACEDO VITORINO was founded in 1996, focusing its activity on advising national and foreign clients in specific sectors of activity, of which we highlight the financial sector, telecommunications, energy and infrastructure.

Since its inception, MACEDO VITORINO has established close correspondence and partnership relationships with some of the most prestigious international law firms in Europe and the United States, which allows us to provide advice on international transactions effectively.

Our practice is cited by the international directories, Legal 500, IFLR 1000 and Chambers and Partners, namely in the areas of Banking & Finance, Corporate and M&A, Capital Markets, Tax Law, Projects and Litigation.

Our practice is multifaceted. We advise some of the largest national and international companies in various sectors of commercial and industrial activity, with special relevance in banking, industry, telecommunications, venture capital and technology.

MACEDO VITORINO represents:

- NATIONAL AND MULTINATIONAL COMPANIES
- BANKS AND FINANCIAL INSTITUTIONS
- INVESTMENT FUNDS
- INVESTMENT COMPANIES AND PRIVATE EQUITY FUNDS
- BUSINESS, SCIENTIFIC AND ACADEMIC ASSOCIATIONS
- EMBASSIES AND GOVERNMENTS
- SOLE PROPRIETORS
- PRIVATE CLIENTS

GLOSSARY

ANACOM – National Communications Authority

ARCEP – Autorité de Régulation des Communications Électroniques et des Postes (French Telecommunications Authority)

BNetzA – Bundesnetzagentur (German Telecommunications Authority)

EEC - European Electronic Communications Code

DUER – Rights of Use of Radio Spectrum

LAL - Local Access License

Ofcom – Office of Communications

SAL - Shared Access License

SAWAP – Small-Area Wireless Access Points

SCET – Terrestrial Electronic Communications Services

Verticals – Companies, industries and public organizations interested in the direct allocation by telecommunications authorities of the right to use a private 5G network.

MACEDO VITORINO

João Vitorino
Jvitorino@macedovitorino.com

Pedro Ramalho de Almeida
PAlmeida@macedovitorino.com

Diogo Faria Lopes
dlopes@macedovitorino.com