Spain's 5G National Plan 2018-2020

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5G NATIONAL PLAN

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GRAPHS AND TABLES

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1.   INTRODUCTION

Why a 5G National Plan?

5G technology is not only a new paradigm of wireless communications, but the essential tecnological key to the digital transformation of society and the economy in the most advanced countries in the next decade. The main enablers for such digital transformation —i.e., the Internet of Things and Big Data, robotics, virtual reality or ultra-high definition— will be supported over 5G.

For that reason, in order to introduce this new technology successfully, infrastructures and telecommunications networks must evolve and a whole 5G platform, service and content ecosystem must be created through innovation and entrepreneurship.

Although it is foreseen that 5G will reach its technological and commercial maturity, and will therefore become massive, by 2020, a number of regulatory and innovation initiatives should be taken now with the aim of making the most of 5G. During this period, it is necessary to adopt standards, identify practical use cases, experiment with technology and develop the relevant ecosystems. The stakeholders that are called upon to join this process are telco operators, the manufacturers and vendors of cutting-edge technological solutions, entrepreneurs, the scientific and research community, public administrations and users, and particularly companies from different economic sectors that will be faced by the challenge of digital transformation.

Therefore, the aim of the 5G National Plan is to place Spain amongst the most advanced countries in developing this new technology so that, by the time 5G reaches its technological and commercial maturity point, Spain may be ready to harness all the opportunities arising from this technological paradigm. The Ministry of Energy, Tourism and Digital Agenda (MINETAD, in Spanish) has developed this 5G National Plan for the 2018-2020 period, on the basis of the input and conclusions gathered from the public consultation held in July 2017.

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The 5G National Plan thus becomes a key driver to the 4.0 ecosystems to be promoted under the "Digital Strategy for an Intelligent Spain".[1] The 5G National Plan is also intended to drive early experimentation over 5G networks in Spain and contribute to R&D&I and entrepreneurship in this field.

Public Consultation about the 5G National Plan

The public consultation about the 5G National Plan (hereinafter, the Consultation) was held between 6 and 31 July 2017 and **51 answers** were received. The Consultation consisted of 25 questions. Feedback on the development of 5G networks and services in Spain was obtained from public administration agencies, companies from various sectors and different associations.

The graph below shows a breakdown of the number of participants in percentage terms:

Legend:
- Public Administration
- Social stakeholders
- Civil associations
- Sectoral associations
- Academia
- Telco operators
- Manufacturers and suppliers
- Other economic sectors
- Individuals
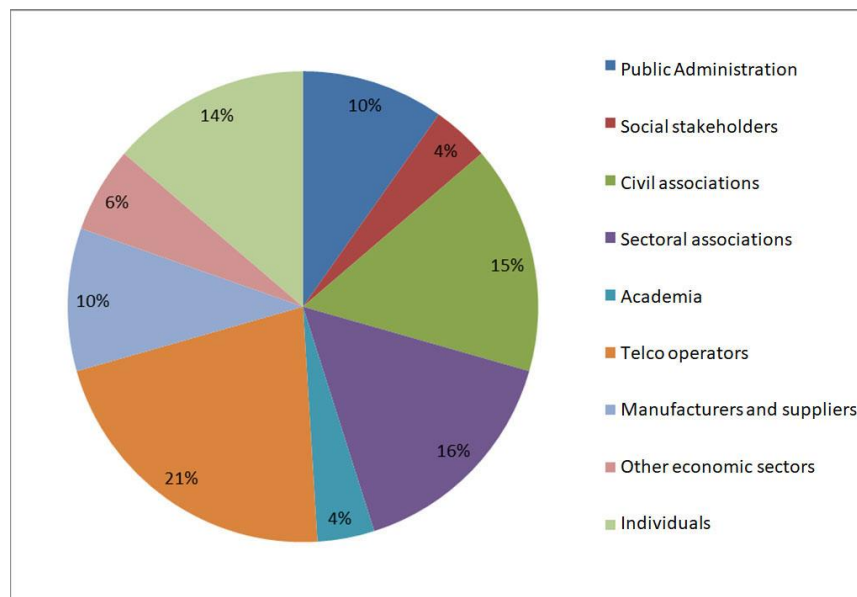
Graph 1. Participation in the Public Consultation on the 5G National Plan

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[1]   http://www.minetad.gob.es/telecomunicaciones/es-ES/Participacion/Paginas/Cerradas/consulta-estrategia-digital.aspx

The text of the Consultation is available on the website[2] of MINETAD together with the input provided by the various participants and a summary report of all the feedback obtained.

Applications to 5G Technology

The expected impact of introducing 5G networks and services is based on the technological innovation that 5G adds to the capacity of the current mobile communications infrastructure. Specifically, 5G networks will enable the following:

- **Mobile broadband of very high speed and capacity**, which will allow mobile speeds over 100 Mbit/s with 1 Gbit/s peaks, making it possible to offer UHD contents or virtual reality experiences.

- **Ultra-reliable low latency communication** at around 1 millisecond (ms) against 20-30 ms over 4G networks. This condition could make them suitable for applications with specific requirements, such as the connected vehicle or the autonomous vehicle, telemedicine services, security and control systems in real time and smart manufacturing, among others.

- **Mass M2M communications.** There will be increased capacity to manage a great number of simultaneous connections that will allow, among others, deploying sensors massively, in addition to IoT and more Big Data services.

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[2]http://www.minetad.gob.es/telecomunicaciones/es-ES/Participacion/Paginas/Cerradas/plan-nacional-5G.aspx
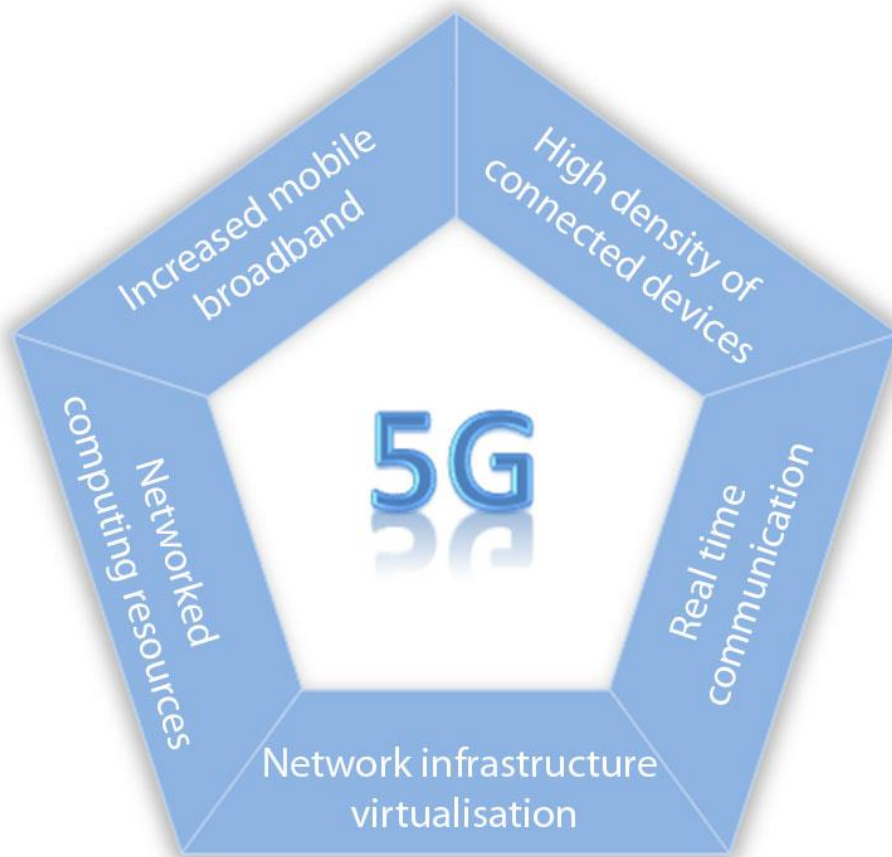
Graph 2. New 5G capabilities

5G will make it possible, for example, to manage the expected increased mobile traffic (estimated to eightfold in the next 5 years). Likewise, 5G will support the estimated massive increase of devices associated to IoT (at world level, there will be a rise from 15,400 million devices in 2015 to 75,400 million in 2025), which will lead to the deployment of the data economy and, particularly, of data analysis technologies or Big Data. It will also allow reducing the download time of different files by 2 orders of magnitude (100 times), paving the way for UHD contents in mobile technology and virtual reality. Thus, it will be possible to download a HD film in 4.8 seconds over 5G networks.[3]

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[3] Factsheet on Spectrum published by the European Commission.
http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=47917

Additionally, as several participants in the Consultation pointed out, 5G networks and infrastructures will provide **network virtualisation functions** (NVF). These capabilities will facilitate the set-up of multi-operator networks at various levels, and will allow decentralising **Cloud computing capabilities**. All of the foregoing will facilitate introducing new services into the market in an agile and flexible way.

5G at the Core of Digital Transformation

There is widespread agreement about the significance of digital transformation in order to improve a country's well-being. Public administrations, in conjunction with the private sector and citizens, must take action to address the challenges posed by digitalisation. Digitalisation can have a positive impact on productivity; on the efficiency and effectiveness of businesses and public administration agencies; on providing a wider range of products and services that may benefit society at large; and on greater competition fostering investment, innovation and the quality of the solutions available on the market.

By contrast with what replacing 3G for 4G implied, 5G will have an impact that goes beyond a technological shift to mobile networks. 5G is expected to have a cross-cutting effect on the overall economy and society. The new mobile communication networks and infrastructure will lay the groundwork for an unprecedented increase in the number of connected devices, data transfer volumes and remote management capabilities in real time, all of which will be the basic underlying technology to carry out the digital transformation.

The cross-cutting impact of 5G is evidenced in several studies published over the past years. In our immediate context, the analyses conducted by the European Commission[4] foresee that, by deploying 5G in four productive sectors (automotive industry, health, transport and utilities), the estimated benefits will gradually rise until reaching 62,500 million euros a year in direct impact within the EU by 2025, which would total 113,000 million euros considering indirect impacts as

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[4] SMART 2014/0008 study: "Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe".

well. The same study states that our country could obtain indirect benefits in four analysed sectors in the amount of 14,600 million euros and that a significant number of new jobs would be created.

Prior to developing this Plan the opinions about how 5G could be applied to multiple sectors were stated in the Consultation. Participants pointed out eight main sectors as the chief beneficiaries of technological innovation, namely: manufacturing, security and defence, automotive industry, health and sanitation, media and entertainment, energy and utilities, transport and financial services. Regarding Spain, the main areas of interest that were mentioned include tourism, IoT within the framework of intelligent territories and, due to the importance of the automotive sector in our economy, the connected vehicle.

Some examples of the possibilities allowed by 5G within the digital transformation framework include:

Digital Transformation of Production: IoT, supported by 5G, will be key to optimise the companies' manufacturing processes by monitoring and acquiring data remotely and through the remote control of robots or production chains or the use of 3D printing. Other factors that will contribute to optimising productive processes are global connectivity among production centres, as well as customers and suppliers, while improving distribution and logistics.

The digital transformation of production will make it possible not only to improve the current production processes, but also offer new opportunities. For example, it will allow recovering activities that are currently outsourced or performed offshore, as well as carrying out "intelligent" activities related to manufacturing (for example, managing and maintaining manufactured products, harnessing the value of the data obtained from the operation or use of a product, development and virtual simulation of new prototypes), all of which will add more value to production. Furthermore, it will provide access to manufacturing by SMEs that, given their smaller production volumes or the need to adapt to their customers' diverse specifications, must currently resort to an external manufacturer.

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Intelligent Transport: The connected vehicle will be one of the main applications where 5G support will be required. It will allow safer driving and automated driving based on controlling the outside environment in real time. However, 5G networks will have a special impact on the transport infrastructure and other applications. On the one hand, they will allow for optimised traffic management, both on roads and in cities, and for better public transport management, thus improving mobility. They also offer outstanding possibilities for improved port and airport management. Regarding applications, they will promote the development of intelligent logistics, enabling to choose the best route in real time for the delivery or reception of products, avoiding bottlenecks and searching alternative routes in case of incidents.

Multimedia Applications: 5G will allow developing optimised mobility applications such as augmented or enhanced reality, virtual reality, 4K/8K 3D high-definition, transmission from drones, etc. These applications will be useful not only in the area of digital entertainment, but also in the areas of health, training and distance education, remote infrastructure monitoring, manufacturing processes, farming or environmental management.

Intelligent Territories: By allowing global connectivity and enhanced features, 5G will enable the development, improvement and coordination of public services included within the concept of "intelligent territories": health, assistance to old people and disadvantaged groups, traffic and citizen infrastructure management, utilities management (water, electricity, gas), tourism, mass events, etc. It will then be possible to extend this concept from cities to the rural context interconnecting both settings through digital corridors.

Intelligent and Precision Agriculture and Livestock Farming: The installation of 5G sensors and processors in farming machinery and in the field will enable intelligent agriculture. The scalability of the great number of connected devices will optimise farming by improving productivity and crop selection: real time control of the soil moisture to optimise irrigation systems, fertilisation adapted to the soil and crop characteristics, precision sowing, intelligent plague detection and control — all of this aimed at a global crop management in an intelligent farm setting. Intelligent systems can also be applied to livestock breeding for the care of animals or smart-milking systems. In addition, an intelligent and connected farm allows access to global markets, for both

the sale and direct purchase of products, and facilitates escalation by creating purchase/sale groups in real time.
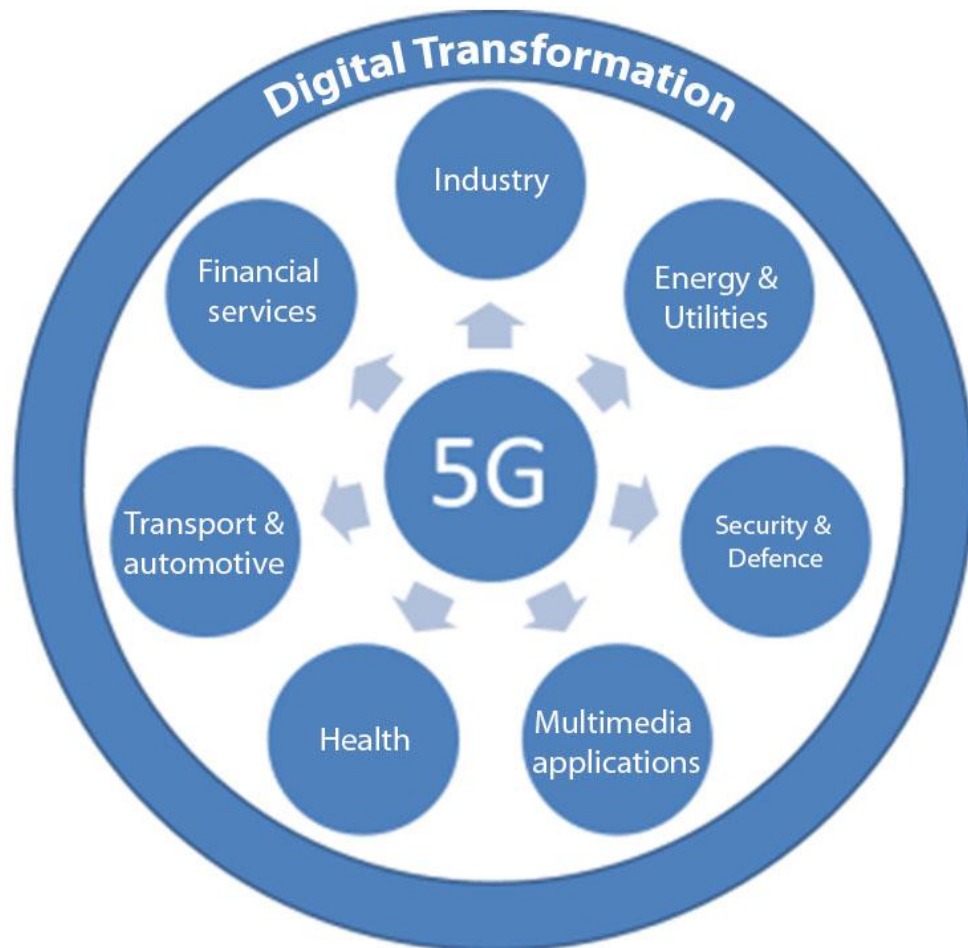
Graph 3. 5G technology and digital transformation

The 5G National Plan and the Goals of the European Union

The European Union adopted the 5G for Europe Action Plan in April 2016.[5] The aim of said Plan is to foster coordination among Member States to improve Europe's competitiveness in developing this emerging technology. The Plan sets out the short-term goals that should be attained before 2020, and a more forward-looking approach with a view to 2025. Specifically, it encourages Member States to develop national work plans by the end of 2017 in order to deploy 5G as part of their national broadband plans. Such plans should include network and application pilot projects.

The 5G National Plan described herein, therefore, contributes to the pursuit of such EU goals. On the one hand, this Plan is developed in line with the deadlines established in the Union's strategy. And, on the other, it foresees that pilot projects be performed in order to develop ecosystems where operators, equipment and service vendors, application developers, companies from the various vertical sectors, public administration agencies and users in general may gain the experience needed to benefit from the use of new networks and services.

The strategic importance of deploying 5G technology in Europe has been ratified several times by the heads of the Member States, especially during the second half of 2017. Specifically, in July 2017, the Ministry of Energy, Tourism and Digital Agenda signed, alongside its European counterparts, the Ministerial Declaration of Tallinn on making 5G a success for Europe.[6] The steps identified therein for a successful 5G deployment are listed below:

- Make more spectrum available in a timely and predictable manner.
- Encourage front-runners and support peer learning and increased transparency.
- Strengthen basic principles of spectrum management.
- Place coverage and connectivity focus in large cities and throughout the main communication pathways first.

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[5] See "5G for Europe: An Action Plan"COM (2016) 588 final.
http://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX:52016DC0588
[6] See "Making 5G a success for Europe"
http://www.digitaleurope.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=2491&language=en-US&PortalId=0&TabId=353

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- Preserve 5G global interoperability.

- Facilitate the deployment of fibre optic.

- Facilitate small cell implementation.

- Set-up a strategic dialogue with all stakeholders.

All of the foregoing has resulted in an agreed roadmap for a homogeneous deployment of 5G across the Union. The political agreement for the deployment of 5G in Europe is fully compatible with the 5G National Plan.

5G National Plan Measures

After analysing the feedback and input received from the Consultation and taking into account the common objectives of the EU Member States, the measures to be developed under the **National Plan are supported by the following pillars**:

- **Radio spectrum management and planning:** Actions aimed at securing the availability of the necessary frequency bands for the delivery of communication services over 5G networks within the relevant timelines.

- **Driving 5G technology —Network and service pilot projects and R&D&I activities:** Pilot projects and use cases promoted by the Administration geared to enable operators, suppliers, equipment manufacturers and industry players to experiment with the new technology with a view to developing 5G ecosystems and ensuring adequate 5G services in the future, and to identifying new business models. It also includes actions to foster entrepreneurship, the research and development of cutting-edge services that may facilitate the set-up of a Spanish ecosystem for the provision of services, contents, applications and 5G platforms.

- **Regulatory issues:** Identifying and developing the legal instruments, in addition to those applied to spectrum management, required to provide an adequate and flexible legal framework to guarantee the legal security that is essential to promote and enable the investments needed for the deployment of 5G infrastructure and technology.

- **5G Plan coordination and international cooperation:** Developing the necessary infrastructure for the governance and coordination of the 5G Plan measures, as well as international cooperation and support actions and follow-up on the 5G standardisation work.
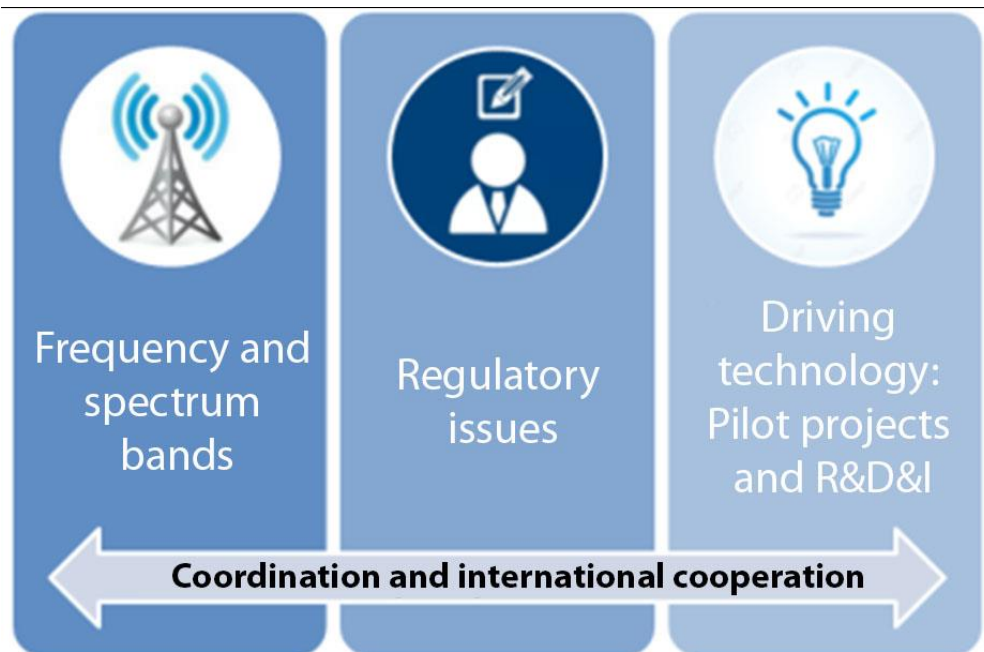
Graph 4. Pillars of the 5G National Plan

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2. RADIO SPECTRUM MANAGEMENT AND PLANNING

The measures included in the 5G National Plan in this sphere, and which will be performed in the upcoming years, are as follows:

- **An immediate call for tender of the 3.6-3.8 GHz band and definition of the scenarios for the global rearrangement of the 3.4-3.8 GHz band.**

- **Call for tender of the 1452-1492 MHz band and adoption of measures for the future release of the extended L-band.**

- **Defining, together with all stakeholders, and before 30 June 2018, the national roadmap for the release of the 700 MHz band (second digital dividend) and calling for tender for this frequency band according to the schedule set out in the national roadmap.**

- **Analysing the possibility of rearranging the 26 GHz band and establishing its use technical conditions prior to tender.**

- **Facilitating the use of the different frequency bands identified for the delivery of 5G services in the pilot projects carried out within the scope of the National Plan.**

- **Participating actively in European and international fora to promote the global and harmonised availability of radio spectrum resources for 5G services and technology.**

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Harmonised Frequency Bands for 5G Services in Europe

The allocation of spectrum bands to 5G services is agreed at the World Radiocommunication Conferences (WRC) of the International Telecommunications Union (ITU). Within the European Union, in November 2016 the Radio Spectrum Policy Group (RSPG) approved the Opinion[7] that identifies the frequency bands to be used in the launching of 5G across the European Union, namely:

- The 3.4-3.8 GHz band (3400-3800 MHz) is considered to be the main band for introducing 5G based services in Europe, even before 2020. This band could place Europe in a leadership position in terms of 5G deployment.

- 5G will have to be deployed over bands that are already harmonised below 1 GHz, including the 700 MHz band specifically.

- The mobile industry supports the 26 GHz band (24.25-27.5 GHz) as a pioneer band for the early implementation of 5G in Europe over frequencies above 24 GHz.

High frequencies > 6GHz	• High data transmission capacity for specific cases • eMBB, ultra-reliable communications
Medium frequencies 3.4 –3.8 GHz	• Better compromise between coverage and capacity • eMBB, ultra-reliable communications, M2M (less coverage)
Low frequencies 700 MHz	• Extended coverage and use inside buildings • eMBB, ultra-reliable communications, mass M2M

Graph 5. Frequency bands identified for 5G in Europe and potential use cases

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[7]http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf

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The situation of harmonised frequency bands in Spain for 5G use is detailed in the table below.

Frequency band		Situation in the national territory
3.4 – 3.8 GHz	3.4 – 3.6 GHz	Awarded. It can be used to deliver 5G services pursuant to the General Telecommunications Law 9/2014, of 9 May.[8] Four licensees have 2x20 MHz. The remaining 2x20 MHz are used for radiolocation and guard bands.[9]
	3.6 – 3.8 GHz	Release process currently underway (in the past it was used for television signal transmission radio links). Currently available as it is still used, though rarely.
700 MHz		Currently used for TDT broadcasting. Availability pending the second digital dividend release, which will enable its use for electronic communications services, as per the schedule timely defined, together with all the stakeholders, in the national roadmap stated in Article 5 under Decision (EU) 2017/899. Potentially restricted use in certain geographical areas for pilot projects.
26 GHz		400 MHz available for immediate use on the band lower portion and 500 MHz plus another 500 MHz with some limitations, on the band higher portion. Remaining band is used by radio links in point-to-point fixed services over mobile trunk networks. Definition of technical usage conditions pending.

Graph 6. Status of the main 5G frequency bands in Spain

Providing access to the spectrum bands specified for 5G services within the relevant timeframes is a critical factor to enable the development of a new mobile telephony generation in Spain. Therefore, it is fundamental that the stated frequency bands are made available. This will require planning and, in some cases, releasing resources from their current use.

The 3.4-3.8 GHz band is deemed a priority to facilitate the early 5G rollouts, particularly for enhanced mobile broadband (eMBB). Actions for the National Plan to facilitate the use of this

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[8] Article 66 and Interim Provision Four under the General Telecommunications Law 9/2014, of 9 May, following the enforcement of technology and service neutrality principles.

[9] See Note 107 of the National Frequency Allocation Chart (CNAF, in Spanish). Radiolocation services on this band are linked to national defence systems.

frequency range will be taken in a differentiated way on the 3.4-3.6 GHz and 3.6-3.8 GHz bands. The work to determine the technical conditions for using this frequency band within the RSPG, and ensure that the spectrum is used more efficiently and according to 5G requirements, suggests that the band should be designed to work in TDD mode, with larger frequency blocks that may allow faster rates. To this end, a tender will be immediately called for the 3.6-3.8 GHz band, which is expected to be released shortly. The global rearrangement of the 3.4-3.8 GHz band will be analysed, assessing the various alternatives that may exist. Actions will be taken regarding this band in order to allow the current and future holders of rights to use these frequencies to benefit from all of the efficiency of 5G technology.

As for **the 700 MHz band, its availability will be specified in the schedule established in the national roadmap** stated in Article 5 under Decision (EU)[10]2017/899 on the use of the 470-790 MHz frequency band in the Union. Pursuant to such Decision, said national roadmap will be established by 30 June 2018 and will be prepared after consulting with all the stakeholders, including a public consultation.[11] The technical conditions for use of this band in Spain will be those set forth in the *"Commission Implementing Decision (EU) 2016/687, of 28 April 2016, on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the Union".* Most answers gathered in the Consultation, prior to this Plan, proposed that the band be tendered out in FDD mode in following other European countries[12], pursuant to the Decision. Participants in the Consultation also pointed out that the 700 MHz band will be necessary to extend 5G to the rural environment and for use inside buildings.

Finally, with regards to the 26 GHz band, the EU Radio Spectrum Committee approved a Commission mandate to the CEPT (European Conference of Postal and Telecommunications Administrations) to study the technical requirements for the harmonisation of this frequency band. Although this band meets the requirements for the delivery of eMBB services, based on

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[10] Article 5 of the DECISION (EU) 2017/899 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, of 17 May 2017, on the use of the 470-790 MHz frequency band in the Union.

[11] During the public consultation, after discussion with the relevant stakeholders, feedback will be asked on the timeframes and technological aspects.

[12] The 703-733 MHz and 758-788 MHz blocks have been tendered out in FDD mode.

the answers from the Consultation, it may be inferred that it does not need to be made available immediately. The initial objective is to **facilitate the use of the 26 GHz band during the pilot projects** in order to analyse its potential use for commercial service purposes. In the medium term, more adequate conditions will be assessed and analysed so that the spectrum can be used more efficiently. For these purposes, its current use will be examined as well as the way in which **the 26 GHz band can be rearranged in order to call a future tender** making more contiguous spectrum available to the sector.

Other Useful Frequency Bands for 5G Services

In addition to the bands specifically identified by the RSPG for 5G in Europe, the 1.5 GHz[13] and 2.3 GHZ bands may also be relevant for the delivery of 5G services.

The 1.5 GHz band or "L-band" may be used to increase the downlink capacity. At present, sub-band 1452-1492 MHz is available in our country, which has also been tendered out in several other European countries[14]. **Actions will be taken for the tender of the 1452-1492 MHz sub-band.**

During the Consultation, different stakeholders proposed that the "extended L-band"[15] be made available for use, rather than calling for a limited tender of the "L-band". On the **"extended L-band" there are spectrum resources already in use; therefore, actions should be taken[16] to release it from** such current use.

On the other hand, the CEPT has harmonised the conditions for the use of the 2.3-2.4 GHz band[17] so that up to 20 TDD blocks of 5 MHz can be used. In Spain, this band is being used for telemetry and television mobile radio links (ENG) services; thus, in the short term it could only be used through Licensed Shared Access (LSA). This modality, which would facilitate the shared use of this band, could capitalise on the 4G/5G advantages through new innovation and business models by working together with other differentiated industrial sectors. For that reason, the possibilities and requirements for the shared use of this band will be analysed under the LSA model. The market's interest in using this band for 5G under such conditions will be examined as well.

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[13] 1452 - 1492 MHz band.

[14] Among others, Germany, Italy and the United Kingdom.

[15] 1427 - 1518 MHz band.

[16] One first step would be to include the relevant forecasts in the CNAF when making reference to the extended L-band in notes UN 46 and UN 88 respectively.

[17] See CNAF, note UN-50. Different respondents to the Consultation have shown their interest in this band.

Relevant Frequency Bands for Long-term 5G Services

Besides frequency bands mentioned in the sections above, there are other bands that can also be relevant in the long term to provide 5G services. For that reason, the necessary steps will be taken to **continue participating actively in European and international fora where the global and harmonised availability of radio spectrum resources for 5G services and technology are being discussed**.

First of all, currently there are bands in use for 2G/3G/4G. The CEPT has been mandated to establish the requirements that may allow for the future coexistence of the current and future services that 5G technologies will use. In applying the technology neutrality principle, Spain will promote that the bands currently used to deliver mobile services may be utilised for 5G.

On the other hand, the RSPG recognises that the 31.8-33.4 GHz band could be enabled relatively easily by several European administrations and, on the other, it believes that the 40.5-43.5 GHz band is a viable option for 5G in the long haul, taking into account the support of the mobile communications sector.[18]

In this context, actions will be taken to facilitate that these bands be available for 5G in the future.

In the long term, the work entrusted to the future World Radiocommunication Conference to be held in 2019 should be considered with the aim of extending 5G services and use cases over to new bands. During the Consultation, suppliers proposed that, as a result of this work and in addition to the bands already identified by the RSPG, the following bands should be considered:

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[18] Both frequency bands will require further studies to guarantee future availability and to meet the industry's demand. Also, they should have the potential to allow global harmonisation and the technical conditions required to protect the current services, including passive services in adjacent bands. The RSPG recommends that the services for which these bands are available are not changed in order to have the choice of making them available for 5G services in the future.

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- 37 GHz to 40.5 GHz, 45.5 GHz to 47 GHz, 47.2 GHz to 50.2 GHz, 50.4 GHz to 52.6 GHz, 66 GHz to 76 GHz and 81 GHz to 86 GHz, which are primarily assigned to mobile services.

- 47 GHz to 47.2 GHz may require primary allocation to mobile services.

Work will be done jointly with the group in charge of preparing the 2019 WRC and, during the conference, to identify new potential frequency bands for 5G services.

3. DRIVING 5G TECHNOLOGY — NETWORK AND SERVICE PILOT PROJECTS AND R&D&I ACTIVITIES

The measures contained in the 5G National Plan, in the area of pilot project development, will include:

- **Facilitating interim frequency range authorisations on the various 5G bands, specifically, on the 3.4-3.8 GHz and 26 GHz bands, as well as on the rest of the frequency bands in specific geographical areas where they may be partially available, to be used in pilot tests.**

- **Calling for one or more pilot projects for the experimental deployment of 5G networks in order to validate the network's new capabilities and develop sector-based real applications and use cases.**

- **Using such infrastructure to test other third-party innovative applications in the area of intelligent territories, farming, tourism, connected vehicle, etc.**

- **Monitoring and disseminating the different pilot projects and their outcomes through the National Plan Technical Office.**

- **Adopting R&D&I measures on 5G technologies within the Strategic Action Economy and Digital Society.**

Pilot Project Call

Before developing this Plan, the following main conclusions have been drawn from the Consultation:

- The cross-cutting and disruptive nature of applying 5G.
- The incorporation of new elements to the network architecture compared to previous mobile generations.

In addition, participants stated that 5G should be expected to have a special impact during the initial phase on sectoral applications and concrete use cases that may require enhanced broadband capabilities or infrastructure virtualisation solutions. In the specific case of Spain, the LGTeand the connected vehicle. Those who participated in the Consultation also stated that the Administration should act as a facilitator of the pilot projects.

The National Plan foresees one or several calls for aid to conduct pilot projects. Such pilot projects will be intended to **collate the infrastructure new technological capabilities as well as their capacity to support innovative sectoral applications**.

In developing such pilot projects, the following stakeholders are expected to participate: **telco operators, equipment and service vendors, universities and research centres, sectoral companies involved in digital transformation projects and other users keen on experiencing 5G benefits and undertaking digital transformation projects related to this technology**.

By driving pilot projects, the Administration seeks to promote early demand to start experimenting with 5G various dimensions, and to promote the development of an ecosystem among operators, technology and solutions providers and users — all of this with the ultimate goal of introducing 5G in our country in a swift and agile manner once 5G and the market are mature enough to allow for mass commercial rollouts.

Pilot projects **will at the same time allow for the mass deployment of 5G networks and services in the future, as well as for their implementation by the different economic sectors and users**. The experimental deployments and sectoral use cases run under the pilot projects are expected to result in the following **benefits for the stakeholders involved**:

- From the telco operators' viewpoint, pilot projects will make it possible to evaluate the deployment of infrastructure allowing easier access to knowledge about 5G in different scenarios (network virtualisation, network expansion, MIMO antennae mass implementation, use of public infrastructure to facilitate rollouts), as well as to obtain practical experience for efficient deployment and learn about service delivery models to accelerate the return on the investment as much as possible.

- From the standpoint of network and service providers, it will enable them to evaluate their needs correctly while acquiring know-how about deployment aspects, and it will consolidate the presence of 5G reference centres in our country.

- As for the developers of solutions, services, contents and applications, it will enable the entrepreneurship and innovation ecosystem to have a platform in place to test their solutions, thus contributing to build a business fabric around 5G.

- From the point of view of users (companies, public administration agencies and citizens), 5G may facilitate the digital transformation processes that are being tackled in different fields. Therefore, they will be able to identify, in a practical way, the advantages provided by 5G services to their respective business areas vis-à-vis prior generations, and thus speed up digital transformation.

- Finally, MINETAD, the Plan's sponsor, will acquire more knowledge about aspects relating to the efficient use of frequencies and other aspects concerning network deployments and 5G services that may serve as a reference for future regulations to allow for 5G deployments both at access points and trunk networks, while addressing other challenges such as cybersecurity, environmental impact and health.

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The State Secretariat for the Information Society and Digital Agenda (SESIAD, in Spanish) will act on certain critical factors[19] identified by participants during the Consultation:

- By ensuring the availability of frequency ranges on the spectrum bands identified for the deployment of 5G services. To this end, **it will temporarily authorise frequency ranges on the various 5G bands and, particularly, on the 3.6-3.8 GHz and 26 GHz bands, as well as on other 5G frequency bands that may be available in specific geographical areas,** for use in the pilot projects, if necessary.[20]

- It will provide **economic aid to the pilot projects** through public calls for aid to be held by the public entity Red.es, in consultation with SESIAD.

- **It will foster the set-up of ecosystems where the various stakeholders may be present** to address the various challenges arising from the calls.

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[19] During the Consultation, stakeholders pointed out specific areas where the Administration could act as a facilitator of the pilot projects.

[20] Mechanisms will be enabled to provide frequency availability, specifically for the pilot projects developed under the 5G National Plan.

Graph 7. Use cases for 5G pilot projects

The first call for pilot projects is planned for the first quarter of 2018. **Planning should be done in order to incorporate the first pre-commercial equipment as soon as it becomes available** according to 5G standards early versions.[21] The duration of these pilot projects is estimated until 2020.

The purpose of the first call for pilot projects would focus on supporting projects that include the validation of **new network capabilities** enabled by 5G and one or several **applications or sector-based use cases**, as well as the possibility of adding the new features that may be subsequently developed under the 5G standard.

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[21] Pilot projects might by started over 4.5G technology.

Likewise, other calls may be held later one, if relevant, in order to include applications that may require tailor-made features technically available under 5G standards, specifically when advanced low latency and mass M2M communications solutions may be needed.

It is expected that use cases for the pilot initiatives cover as many sectors as possible, such as **digital transformation, robotics, intelligent productive processes, farming, energy, tourism or the connected vehicle**.

Additionally, actions will be taken so that the results of the projects aimed at tapping into 5G features and developed under R&D&I calls held by the State General Administration may be validated in the network environments deployed during the pilot initiatives.

Monitoring Pilot Projects

SESIAD will **monitor and disseminate the different pilot projects and their outcomes through the National Plan Technical Office**.

Furthermore, participants will also be encouraged to disseminate the results of the pilot projects, as well as to exchange experiences and best practices.

5G Technology and the Strategy Action Economy and Digital Society

In 2013 SESIAD implemented an aid programme for R&D projects on ICTs and the Information Society under the Scientific, Technical and Innovation Plan within the framework of the Strategic Action Economy and Digital Society. In previous calls for aid, priority was given to applications that could be delivered through the emerging technologies. **SESIAD will promote 5G as one of the priorities within its R&D&I support policies.**

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4. REGULATORY ISSUES

The measures contained in the 5G National Plan concerning regulations will include:

- **Analysing and developing potential regulatory measures on 5G network deployment, security, service quality or users' rights.**

- **Contributing to an EU regulatory framework that takes into account the needs arising from implementing 5G technologies and services.**

- **Continuing fostering the voluntary shared use of infrastructure under the current regulatory framework.**

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Security and Privacy of services and applications 5G

5G will be a key component for the mass rollout of a whole array of services and applications such as those relating to energy, transport, security and IoT, either for business or individual use. It is necessary to guarantee that these services, especially those that are more strategic and critical, meet the relevant security, reliability, privacy and user rights requirements, among others. Such security requirements must also be fulfilled by the "virtualised" applications, services and networks that may use the cutting-edge shared resources capabilities provided by 5G.

Regarding security, Article 44 under the General Telecommunications Law 9/2014 (LGTel, in Spanish), of 9 May, lays down provisions to guarantee the integrity and security of networks and electronic communications services. Additionally, Law 8/2011, of 28 April, whereby measures for the protection of critical infrastructure are set out, considers ICTs within the strategic areas embedded into the Critical Infrastructure Protection System.

LGTel Law specific provisions about data privacy and personal data protection regarding electronic communications networks and services are complemented by the general provisions specified under Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

The reform of the personal data privacy and protection framework in the EU will be completed after the approval, if applicable, of the future Regulation on privacy and electronic communications.[22] Some participants in the Consultation have expressed their concern about the fact that new requirements contained in the proposal may hinder the deployment and development of 5G networks and services, and even affect the current delivery thereof.

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[22] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications)

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User Rights and Service Quality

The rights of telecommunications services users are set out in Chapter V, Title III of the LGTel Law. They have been established pursuant to the Chapter of Electronic Communications User Rights, in force since 2009.[23] Such a Chapter has enabled Spain to position itself as one of the countries that provides the greatest protection to users. Therefore, it is estimated that, in principle, it is sufficient to guarantee the rights of 5G networks and services users. MINETAD periodically publishes reports on user rights and detailed information about the main reasons for complaints filed before the Telecommunications Customer Service Office.[24]

The quality associated to electronic communications networks and services is dealt with in various articles under LGTel Law. Thus, measures are established to determine the quality parameters that must be measured and the conditions required for the quality measurements to be comparable. Likewise, operators and MINETAD itself[25] periodically publish the results of the service quality reports. The Committee for the Follow-up on the Quality of Telecommunications Services[26] provides a forum where operators, associations, users, professional associations, trade unions and administrative bodies are present. This Committee will further actions to follow up on the specificities of the quality of service of networks and 5G.

Regarding Internet access services specifically, Regulation (EU) 2015/2120 of the European Parliament and of the Council, whereby measures are set forth concerning open access to the Internet and Directive 2002/22/EC and Regulation 531/2012 (TSM Regulation) are amended, guarantees a number of rights to end users in connection with the Internet access service. This regulation came into force on 30 April 2016. Article 1 therein states that the purpose of the standard is "to safeguard equal and non-discriminatory treatment of traffic in the provision of internet access services and related end-users' rights".

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[23] Royal Decree 899/2009, of 22 May, whereby the Charter of Electronic Communications Service User Rights is approved.

[24] http://www.usuariosteleco.gob.es/Paginas/Index.aspx

[25] http://www.minetad.gob.es/telecomunicaciones/es-ES/Servicios/CalidadServicio/Paginas/Calidad.aspx

[26] Created pursuant to Article 25 under IET Order /1090/2014, of 16 June, whereby the service quality conditions for the delivery of electronic communications services are regulated.

The rights recognised to users imposed by the TSM Regulation of Internet Service Providers (ISPs) are grouped as follows:

- Those set out under Article 3 on the guaranteed right of end users "to access and distribute information and content, use and provide applications and services, and use terminal equipment of their choice, irrespective of the end-user's or provider's location or the location, origin or destination of the information, content, application or service, via their internet access service".

- The rights concerning transparency under Article 4 reflect, in turn, those stated in the previous article. The TSM Regulation recognises the right of users to access certain information on specific aspects relating to the "Network Neutrality" principle (either published or added to contracts between ISPs and end users).

MINETAD periodically publishes[27] information on the application of the TSM Regulation about network neutrality.

Infrastructure Deployment

The development of 5G services will imply the mass deployment of new network components in the Spanish territory, either in new sites or in those currently used for other technologies and services. Efficient and agile deployment can be achieved only if a reduced number of network components are deployed and administrative and urban planning barriers to the installation of equipment in urban areas are limited. Some participants in the Consultation raised a point about the national legal framework's adequacy for these purposes.

On the one hand, the use of shared infrastructure among operators —whether network sites, back-up equipment (masts and towers), network components (equipment, including antennae)— or even the use of frequencies may reduce deployment costs markedly, chiefly in

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[27] http://www.minetad.gob.es/telecomunicaciones/banda-ancha/Paginas/neutralidad-Red.aspx

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isolated and poorly populated areas or in places where there is already a significant amount of infrastructure in place, such as the centre of big cities.

Article 42 under the LGTel Law enables electronic communications operators to formalise voluntary agreements on the location and shared use of infrastructure, always in compliance with competition protection regulations. Public administration agencies will also foster voluntary agreements among operators for the shared location and use of infrastructure situated in privately or publicly owned property, mainly with a view to deploying rapid and ultra-rapid networks such as 5G.

Participants in the Consultation also made a positive comment on the legal framework as an enabler for the shared use of infrastructure for 5G deployment. The LGTel Law enforcement has allowed operators to share passive infrastructure (masts and sites) in deploying mobile networks in the areas where an individual rollout was not deemed efficient.

Given that 5G makes it possible to share active network resources through virtualisation, there are no legal impediments to extend the shared use of infrastructure to any network component, notwithstanding the provisions set out in the law in force and compliance with competition legislation.

On the other hand, the Regulation on the use of the radioelectric public domain (Spectrum Regulation), approved by virtue of a Royal Decree[28] in February 2017, allows, under certain conditions, to grant authorisation to share the spectrum usage rights. This possibility could be particularly useful in the case of deploying 5G networks.

By way of conclusion, the regulatory framework in force already allows taking advantage of the shared use of infrastructure and frequencies to facilitate the deployment of 5G networks, with no special requirements or changes apparently being needed. **Such shared use should be further fostered to include currently active components, always under voluntary agreements and pursuant to law.**

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[28] Royal Decree 123/2017, of 24 February, whereby the Regulation on the use of the public radioelectric domain is approved.

A significant part of 5G rollouts will take place in city centres and the most populated areas within municipalities. As pointed out by several stakeholders in the Consultation, no significant deployment of small cells is expected in the early years, yet they will be critical in the future. Therefore, local and regional authorities should enable telco operators to access the necessary street furniture (billboards, kiosks, street lamps, signs, traffic lights, etc.) in this regard.

The LGTel Law already contains some important measures[29] to favour a rapid and flexible deployment of state-of-the art electronic communications networks. In fact, Articles 34 through 38 encompass a great number of measures aimed at promoting investments in deploying electronic communications networks by designing mechanisms to coordinate the competences of the various public administration agencies regarding such deployments (telecommunications, urban, land management, and environmental competences, among others).

In this respect, and regarding the deployment of 5G networks specifically, the above-mentioned law sets out a regime whereby base mobile telephony stations are to be installed under an accountability regime, in such a way that, in order to install radioelectric stations in a private domain, the public authorities will not require any special operation or environmental licence or permit, nor any other similar authorisations for such installations to be carried out.[30]

Furthermore, current legislation puts forward measures to plan and allow the installation of infrastructure and deployment of networks in buildings or new urban developments[31]. In addition, it allows access to the infrastructure that can accommodate public electronic communications networks owned by other economic sectors and to the networks owned by official bodies or State transport infrastructure management agencies.[32]

Legal considerations have been rapidly addressed through the enactment of Royal Decree 330/2016, of 9 September, on the measures to reduce the cost of deploying high-speed

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[29]   One relevant amendment to the LGTel Law approved in 2014 has been the introduction of measures aimed at enabling telco operators to deploy their networks and provide their services more easily, avoiding that they become discouraged to keep on investing in deploying top-notched telecommunications networks so that, eventually, citizens can benefit from increased coverage and more innovative and better services that are suited to their needs and at increasingly lower prices.

[30]   See Article 34.6 under the LGTel Law.

[31]   See Articles 36 and 45 under the LGTel Law.

[32]   See Articles 37 and 38 under the LGTel Law.

electronic communications networks. The Regulation pursues to promote the deployment of communications networks by establishing rights to access the current infrastructure, by coordinating civil works and by improving access to information about the existing infrastructure, planned civil works and procedures to obtain permits.

Such measures will allow for an efficient 5G deployment, which will accelerate the process and will gradually increase coverage.
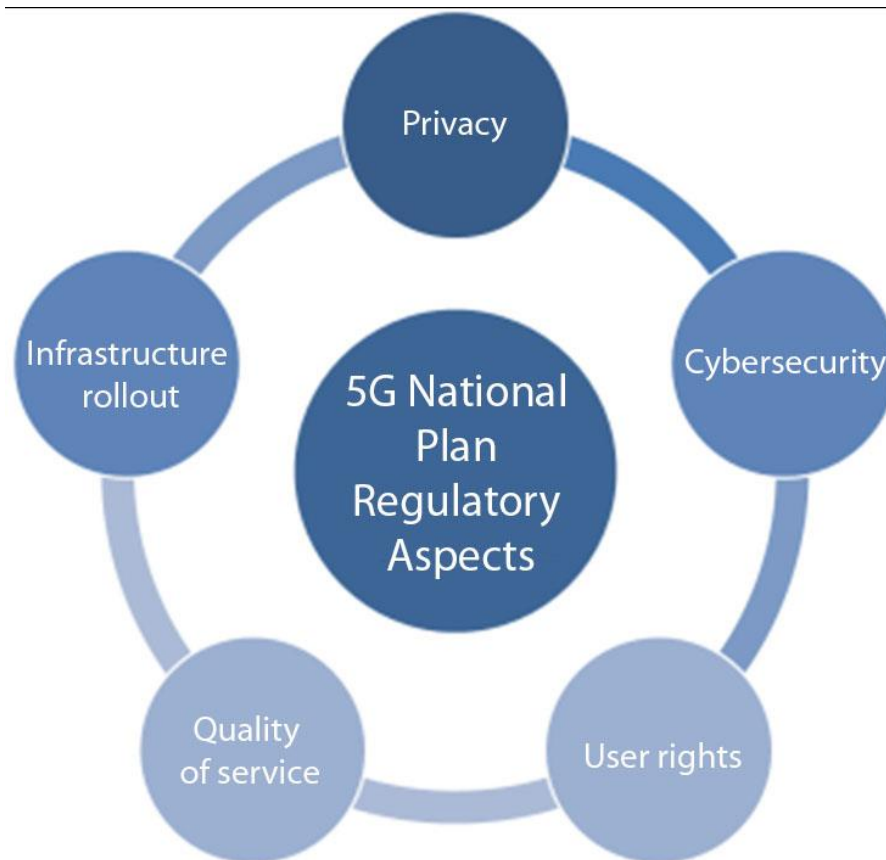
Graph 8. Regulatory issues of the 5G National Plan

5.   INTERNATIONAL COORDINATION AND COOPERATION

The measures foreseen in the 5G National Plan for coordination and cooperation in international fora will include:

- **Creating a Technical Office for coordinating and disseminating the 5G National Plan actions.**
- **Participating in international standardisation bodies to support the outreach and dissemination of 5G standards in the domestic business sector.**
- **Monitoring 5G PPP activities through the national entities that have already been participating.**

Coordinating the Plan Actions — The 5G National Plan Technical Office

5G will have a cross-cutting impact on a significant number of economic sectors and on the personal and social life of citizens. The stakeholders that answered the Consultation claimed that the Administration should play an active role in driving the deployment of networks and services under the new technological paradigm, building synergies between the private and public sectors in the various areas. In order to accomplish this aim, which will result in a faster development of new infrastructure, **a 5G National Plan Technical Office, under the umbrella of the Directorate General for Telecommunications and Information Technologies**, would be created within SESIAD.

This Technical Office will perform the following activities among others:

- Coordinating and monitoring administrative, technical and regulatory measures concerning the Plan, identifying critical pathways and barriers.
- Promoting the participation of the various stakeholders in the calls for pilot initiatives and research, development and innovation programmes.
- Disseminating the actions performed at national and international fora.
- Collaborating in defining a communication strategy.
- Endorsing the call for 5G pilot projects and technical follow-up thereon. Reporting on their evolution and outputs.
- Coordinating the various stakeholders involved in the Plan (operators, manufacturers, vertical agents, application developers, public administration agencies and users).
- Running a medium-term evaluation and taking potential new actions.

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Contributing to Standardisation and Innovation

Standards applicable to ICTs consist in technical agreements that are voluntarily applied, and are reached by the parties interested in developing a given technology to attain its application in a homogeneous and uniform manner. Regarding mobile technologies, standardisation is critical to guarantee interoperability in terms of hardware, software, networks from different manufacturers, vendors and operators, in order to disseminate such technologies as widely and quickly as possible both at European and world level. Standardisation is an activity led by the industry, harnessing the ideas stemming from academic research and business R&D, where the Administration steps in so as to contribute any relevant know-how that may help address the needs of society (e.g. accessibility, security, etc.).

SESIAD represents the State General Administration before the ITU and the European Telecommunications Standards Institute (ETSI), where various aspects concerning 5G standardisation are currently being developed. **Participation in international standardisation bodies** will be increased, **driving the expansion and application of 5G standards in Spain**.
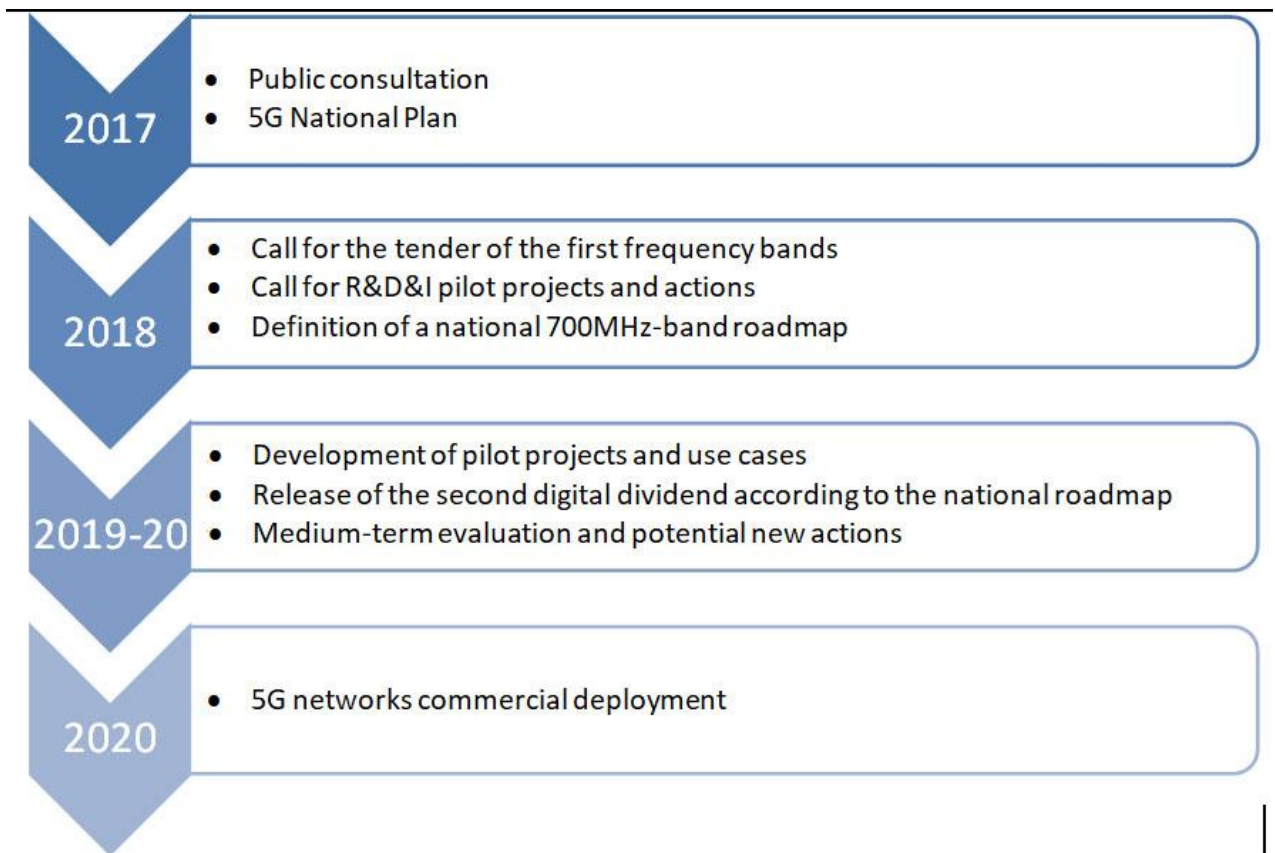
In 2013 the EU implemented the 5G Infrastructure Public Private Partnership (5G PPP), with the aim of fostering Europe's leadership in the new generation of mobile telephony. The EU global financing for the 2014-2020 period amounts to 700 million euros, with a private investment estimated at 3,500 million euros. Companies, research centres and Spanish universities participate actively in the 5G PPP projects. In order to build synergies between such projects and other actions under the Plan, and acquire know-how on the state-of-art of 5G, **5G PPP activities will be followed up through the national entities involved** in the partnership's activities.

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6.   5G NATIONAL PLAN ROADMAP AND KEY ACTIONS

The key purpose of this Plan is to enable Spain to be ready to take advantage of all the benefits inherent to the new technology paradigm.

The measures described above will be evaluated during the Plan valid term to verify their adequacy to the goal pursued. The graph below shows the key actions in each relevant area arranged in chronological order.

2017
- Public consultation
- 5G National Plan

2018
- Call for the tender of the first frequency bands
- Call for R&D&I pilot projects and actions
- Definition of a national 700MHz-band roadmap

2019-20
- Development of pilot projects and use cases
- Release of the second digital dividend according to the national roadmap
- Medium-term evaluation and potential new actions

2020
- 5G networks commercial deployment

Graph 9. 5G National Plan roadmap and key actions