5G

An ambitious roadmap for **FRANCE**

16 July 2018

Liberté · Égalité · Fraternité
RÉPUBLIQUE FRANÇAISE
Le Gouvernement

arcep
autorité de régulation
des communications électroniques
et des postes

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Let's make 5G a priority for France!

Our digital strategy contains two key words: inclusion and innovation.

Inclusion is the watchword being implemented with Julien Denormandie, the Secretary of State to the Minister of Territorial Cohesion, for the deployment of France's Superfast Broadband Scheme (*Plan France Très Haut Débit*). In 2022, every person in France will be covered for superfast broadband. And every person will have access to high quality 4G mobile coverage, thanks to the agreement reached at the start of the year with telecoms operators – promoting growth and job creation in every enterprise, in every part of the country.

Meanwhile, innovation is being spurred by the new digital revolution, whose driving forces are data and connectivity. This administration committed very early on to placing France at the forefront of artificial intelligence, which has the ability to turn raw data into an instrument of competitiveness. Today, we are calling on industry stakeholders to innovate, to experiement, to take hold of 5G technology. It will tranform connectivity in the workplace: data exchanges will become faster, more secure, more fluid and more energy efficient.

Making 5G a priority means getting France ready for tomorrow's innovations. It will enable us to develop applications in every industry sector: health by performing surgery remotely, services by connecting hundreds of objects using low-power solutions, and transportation.

We are setting ambitious goals with this roadmap: by 2020, frequencies will be allocated and a commercial rollout will be complete in at least one major city. By 2025, the main transport routs will be covered by 5G. We want France to be home to the world's first rollout plans, to innovation platforms that allow start-ups to test their projects, working in partnership with digital industry leaders based in France.

Making 5G a success is strategically vital to ensuring that French industry remains an industry of innovation on the global stage. Our industrial fabric is a force for developing trials in every sector of activity. It is only by galvanising every private and public sector stakeholder, to deploy a growing number of pilot projects nationwide, that we will achieve our goals.

You can count on the Government, working closely with Arcep, to support you in your innovations, so that France will be at the vanguard of 5G.

Delphine Gény-Stephann
Secretary of State to the Ministry of Economic Affairs and Finance

Mounir Mahjoubi
Secretary of State for Digital Affairs, attached to the Prime Minister

The telecoms sector is in good shape, ready to meet the 5G challenge

5G promises to be a disruptive generation. Disruptive in its technical properties, but especially in the way it is likely to transform vertical industries. And it is because it is such a vital ingredient to the competitiveness of our industry, our infrastructures and our regions that our country needs to make it a priority.

Falling behind on 5G is not an option. The telecoms sector is ready for action, stimulated by Arcep's pro-investment regulation. The sector can and must pull out all the stops to achieve an ambitious 5G rollout and catch up on 4G. And let us not forget that the latter enjoys Government support, whose New Deal for mobile created a paradigm shift in frequency allocations. So we can at last prepare for the future, and not simply make up for time lost in the past.

Arcep will fully play its role of policy initiator for the crucial upcoming milestone of 5G frequency allocations. By the end of 2020, every country in the European Union must have allocated enough frequency blocks in the 3.5 GHz band and at least 1 GHz in the 26 GHz band. Arcep welcomes the fact that the European Code, which reforms the telecoms regulatory framework for our Continent, now recognises that every independent authority has a role to play in this procedure – which opens the way for collective work within BEREC, the Body of European Regulators for Electronic Communications.

In addition to frequencies, one of the challenges of 5G lies in its appropriation by economic stakeholders. The "5G pilot" window that Arcep created is designed to do just that: to facilitate the emergence of future business models, Arcep created a window at the start of the year for assigning frequencies to players that request them, to conduct trials on use cases under real life conditions (ports, hospitals, enterprises, roadways, smart cities, etc.). The first use cases are already taking shape, notably those involving connected vehicles.

So everything is in place for the sector to turn trials into reality!

Sébastien Soriano

Chair of the Electronic Communications and Postal Regulatory Authority
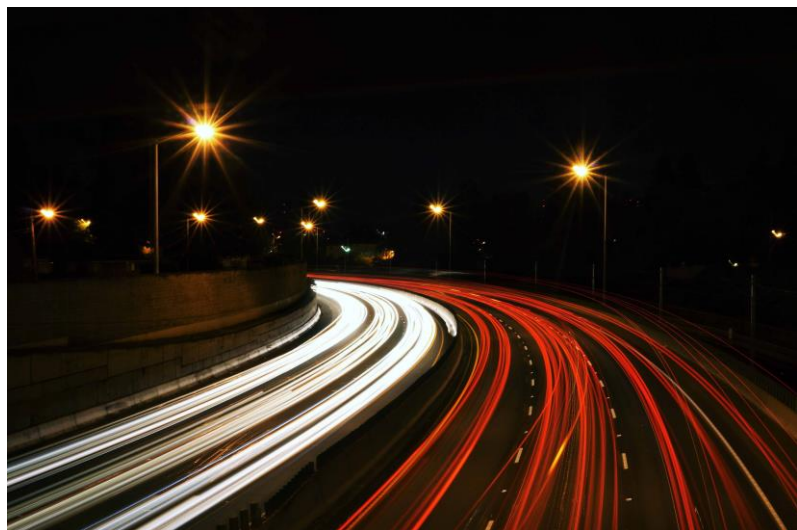
France's objectives

Launch several 5G pilot projects immediately in a variety of regions

Be home to the world's first 5G applications in industrial sectors

In 2020: 5G frequencies allocated and a commercial rollout in at least one major city

In 2025: 5G coverage of all the main transport routes

5G, by the numbers

5G, a new generation of mobile network, will deliver:
- speeds experienced as being **10 times faster than 4G,** for much more rapid data exchange,
- **latency** (response time) **divided by 10**, for ultra-fluid communications,
- **connection density** (number of objects that can communicate simultaneously on the network) **multiplied by 10**, for the development of connected objects.
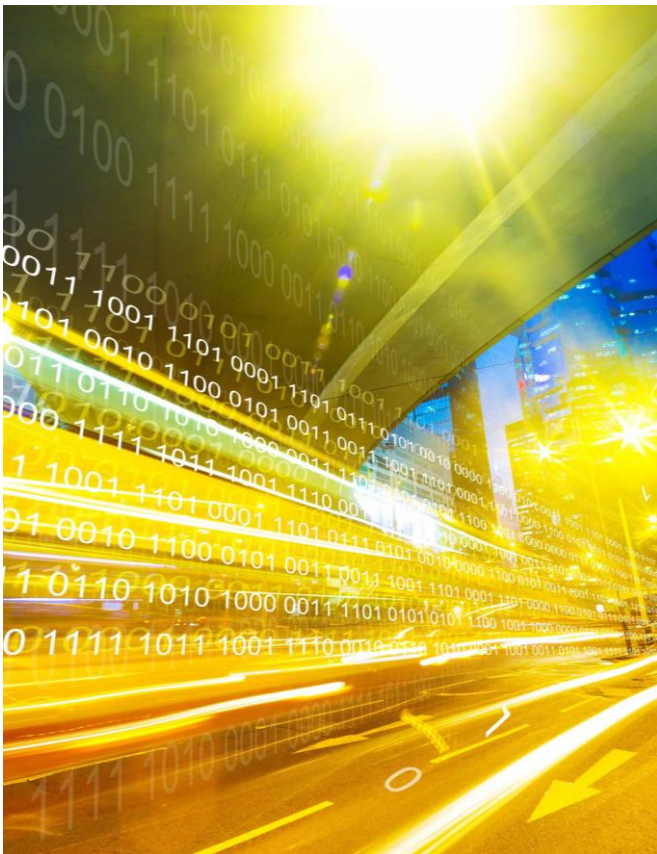
A driving force for the entire economy's digitisation

A wide array of sectors will be able to use 5G: energy, health, media, transport, manufacturing. For instance:
- the potential uses of 5G in smart and connected cities could include monitoring traffic and optimising energy consumption;
- autonomous and connected cars could also be an important application, with increased opportunities for remote driving and data transmission;
- lastly, 5G could pave the way for new applications capable of strengthening industrial sectors' competitiveness: remote tool operation, increased machine connectivity, better control over the supply chain...

5G: innovation in service to the digital transformation

French industry and France's operators are already preparing for 5G, the new generation of mobile networks. This new generation is based on a set of technologies, which will outperform current infrastructures.

A new generation, several technological disruptions

5G employs new frequencies, starting with those below 6 GHz, and particularly frequencies between 3.4 and 3.8 GHz ("3.5 GHz" band or "C band") which will help achieve widespread 5G coverage, but also millimetre-wave frequencies (below 24 GHz) to meet growing demand for capacity and low latency.

5G will rely on the use of active antennae that help optimise the bandwidth and resources available in high traffic areas. The new features of 5G will allow networks to be optimised in real time according to users' needs.

INSTANTANEOUSNESS
5G promises to deliver speeds experienced by users that are up to 10 times faster than 4G. The width of the spectrum used will be another new feature, with frequency bands with a width ranging from 80-100MHz to 1GHz will be used during rollouts. Even more than speed, for which user requirements are increasing steadily, where 5G will really make a difference will no doubt lie in its ability to guarantee performance levels on other communication parameters. By dividing latency (i.e. transmission delay time) by 10, new prospects will be opened up in the area of remote controlled high-precision objects (robots, surgical instruments, etc.), and of interactivity, which will revolutionise applications.

RELIABILITY
5G will provide ultra-reliable communications for critical and new applications, notably thanks to better management of interferences, which are a major cause of data loss.

ENERGY EFFICIENCY
5G will create the ability to manage a host of connected objects, and in an energy efficient way. Among other things, 5G will make it possible to transmit only at the right time and place, by tailoring transmission power to usage. This in turn will prolong battery life considerably, and so make it possible to connect a large number of objects which can thus the monitored for several years.

INTELLIGENCE
5G will rely on an intelligent network that will deliver disparate performance levels, according to the targeted application (network slicing), and will be able to reconfigure itself dynamically.
So, for applications that require ultrafast connections, such as 4K, 8K or 3D video, or virtual reality, the network will supply its maximum speed and large capacities. To manage connected objects, the network will concentrate its resources on managing a large number of simultaneous connections. Lastly,

when ultra-reliable, very low latency communications are required, optimal performance will be achieved by reducing the number of simultaneous communications and speed.

VIRTUALISATION

The virtualisation of a large number of network functions (NFV) and software-defined networking (SDN) will ensure the flexibility, or the ability to adapt, of intelligent 5G networks. These technologies are designed to achieve more agile infrastructure deployment and operation.

The properties of 5G make it a disruptive technology. They will open they way for a host of possible applications in a variety of, notably industrial, sectors. 5G is not merely synonymous with an increase in speed, as was the case with previous generations, but rather a **driving force in the digital transformation of every sector of the economy.**

> **Network security**
>
> *It is vital to master network security to protect people's and businesses' data, and ensure the nation's sovereignty. This is a core issue in network virtualisation, where the network's functions are now performed by software layers, and where a growing number of computing and storage functions will move to the cloud. The National Cybersecurity Agency of France (ANSSI) is ready to help operators, to ensure a high level of cybersecurity for 5G. The Government also supports research and development in this area.*

A variety of new uses, from consumer to industry

5G will create new consumer applications, building on those enabled by 4G. It could thus make 360° 3D video streaming a commonplace, give users access to a vast quantity of higher quality, ultra high definition (4K, 8K…) video content, and enable the development of virtual and augmented reality applications.

Particularly after 2020, the jump in technological performance that will come from 5G is expected to affect a great many industry sectors: automotive, transportation, energy, future manufacturing, smart cities, telemedicine, farming, public safety, homeland security and virtual reality.

Industrial issues

France has a rich and innovative industrial fabric in the telecommunications sector. In 2016, it represented 75 billion euros in revenue, 166,000 direct jobs and investments of 10 billion euros (operators, equipment suppliers, devices, content and internet companies). The Government supports several 5G R&D projects, working to foster the development of technologies and services – examples include the SENDATE flagship project for securing virtualised 5G networks, and the SooGreen project for decreasing mobile networks' energy consumption.

Outside the telecommunications sector, 5G promises to be a driving force in the industry's digital transformation. This issue will be an especially central area of focus in the work that the Government and private sector players are doing within the National Council for Industry/ Conseil national de l'industrie (CNI). Its various branches will be involved in the dissemination of 5G, the new uses it enables and the prospects it opens up for a more competitive economy.

Frequencies are already available for 5G

The European Union identified two pioneer frequency bands for 5G in 2017, and the terms and conditions for their use have been harmonised for the entire European continent. **International bodies are in the process of standardising 5G technology**, and the timetable plans for the completion of international standardisation work and the coordinated availability of the 3.5 GHz and 26 GHz bands in Europe by 2020. Trial initiatives are already underway, and their numbers are expected to increase over the next two years.

Two important milestones have already been reached at 3GPP (3rd Generation Partnership Project, for cooperation between telecommunications standardisation body): in December 2017 with the validation of the first version of release 15 (5G NR NSA, non standalone) and in June 2018 with the validation of version 5G NR SA (standalone).

In January 2018 Arcep opened a "5G pilot" window, with a view to allocating frequencies to players wanting to conduct full-scale 5G trials (ports, hospitals, connected roadways…) and develop future business models.

More than simply a framework for obtaining the technical validation of network equipment, **these trials will make it possible to test the first concrete 5G use cases.**

Arcep also identified several cities and agglomerations that have the available frequencies (3.5 GHz band) and capable of hosting pioneer trials: Lyon, Bordeaux, Nantes, Lille, Le Havre, Saint-Étienne, Douai, Montpellier and Grenoble. Arcep has not confined itself to this list, and examines all requests for 3.5 GHz band and 26 GHz band spectrum.

France's first forays into 5G

Authorisations have been granted for Belfort, Bordeaux, Douai, Grenoble, Lannion, Lille, Lyon, Marseille, Nantes, Sophia-Antipolis and Toulouse. In addition to the projects already announced by operators, today the Government and Arcep are announcing the launch of eleven new trials in the Ile-de-France region – a vital international showcase – including three connected or autonomous vehicle use cases:

- *Trials will be conducted at the Linas/Montlhery speedway, in partnership with UTAC-CERAM: these trials seek to explore connected car-related applications opened up by 5G – mobile data transfer, delivering information, entertainment, platooning, expanded sensors, etc.). Two operators plan on taking part in these trials: Orange and Bouygues Telecom.*
- *The "Saclay 5G Autonomous Vehicles" project involving Nokia, Vedecom and their partners aims to provide wireless coverage to autonomous vehicles, to cover travel outside the city centre, and compare the advantages of different ITS G5, LTE and 5G technologies.*
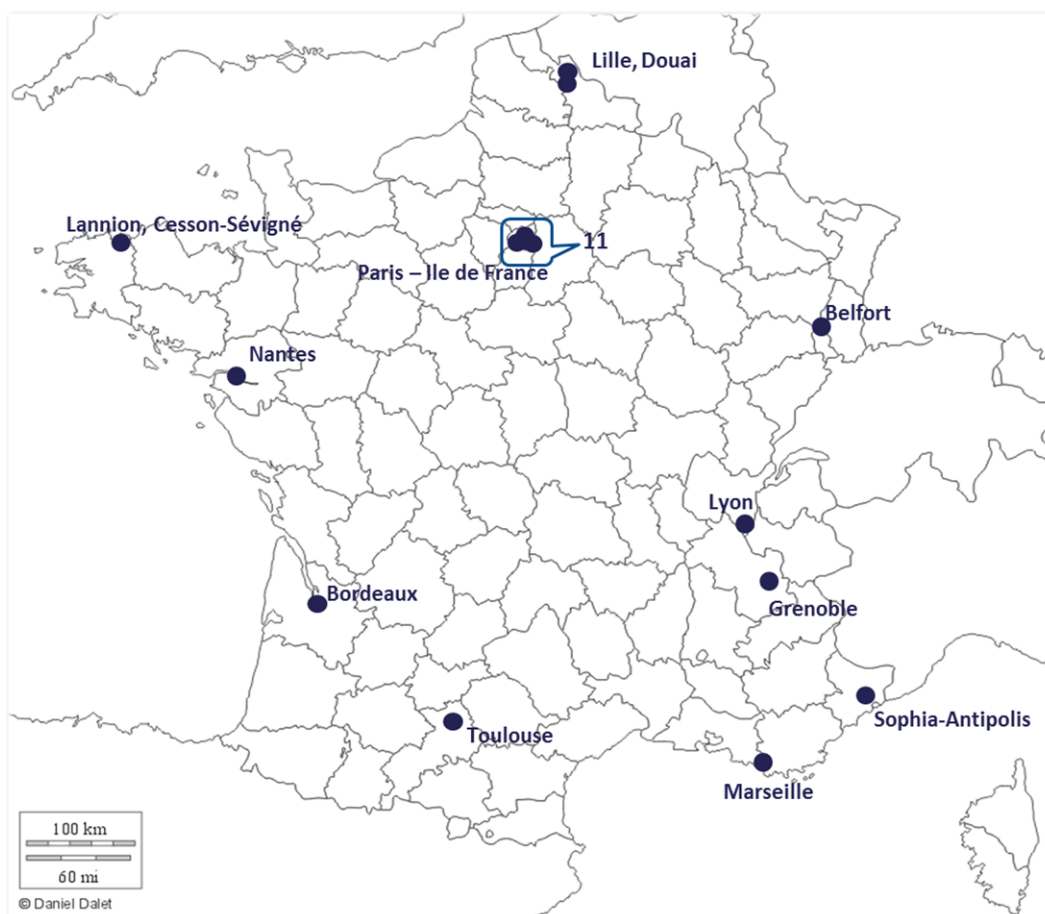
22 trials already authorised

The first 5G-compatible equipment is expected to be on the market by 2019. The vast majority of players appear to agree that the first commercial launches will be in 2020.

Optical fibre and 5G

5G rollouts require an extremely vast optical fibre network for connecting 5G antennae and ensuring ultrafast connections. Launched in 2013 to provide very high speed fixed connections to every person and business by 2022, France's Superfast Broadband Scheme (Plan France Très Haut Débit) relies in large part on the ongoing deployment of optical fibre networks. This fibre network will cover most of France, and so paving the way for 5G.

France at the heart of a coordinated European approach

France's digital strategy, and particularly its roadmap for 5G, is part of a coordinated European approach. In September 2016, the European Commission announced a first 5G action plan. In addition to issues surrounding frequency harmonisation and allocation, the Commission is encouraging stakeholders to experiment with the new applications enabled by 5G.

In July 2017, at the informal meeting of the EU Council in Tallinn, Member States committed to making Europe a 5G leader. Policies in support of its development were put into place: drafting a detailed roadmap for making spectrum available, transparent procedures, sharing best practices between Member States.

Europe's future Electronic Communications Code, which reforms the rules governing electronic communications networks and services, is also an opportunity to institute regulatory conditions to undergird the deployment of these new very high capacity networks. The European Council, Parliament and Commission thus reached an agreement on new spectrum management rules, notably the minimum duration of licences, in addition to establishing a common date for awarding 5G licences for the 3.5 GHz and 26 GHz bands (31 December 2020). The draft version of the Code thus also includes measures for streamlining 5G networks, particularly by focusing on the deployment of small cells.

Stakeholders feedback

This national roadmap for 5G draws on feedback from the consultations held in early 2018 with all of the stakeholders: operators, industry players, equipment suppliers, users and local authorities. They were queried on several issues: frequency allocations, streamlining rollouts, dialogue with members of the public on exposure, testing new applications, and supporting a French and European industry solution. The projects that have been launched seek to address these issues and take the necessary actions.

Public authorities galvanised for the advent of 5G

Because 5G is a key technology for stimulating innovation and propelling the economy's digital transformation, the Government and Arcep are working to lay the groundwork for the development and deployment of 5G technologies – the main issues being to foster industry business models and support investment. Working in tandem with Arcep, the Secretary of State to the Minister of Economic Affairs and Finance, and the Secretary of State for Digital Affairs will head up the steering committee for work initiated by the Government, to ensure the success of 5G.

DIRECTORATE-GENERATE FOR ENTERPRISE (DGE)

The Directorate-General for Enterprise, which operates under the aegis of the Ministry for Economic Affairs and Finance, is tasked with helping France's manufacturing and service companies to be more competitive, and to grow. This goes by way of the development of new sectors, supporting and disseminating innovation, anticipating and keeping pace with economic change, to achieve sustainable growth and create jobs.

In particular, DGE prepares and implements European and national regulations that apply to the telecommunications sector, and contributes to the deployment of fixed and mobile networks, by enacting supporting public policies. It also represents France within competent international bodies. And, lastly, it is involved in securing financial support for R&D projects and trials.

DGE coordinates the actions behind the 5G roadmap, and works to mobilise industry stakeholders. It provides the link with all of the government agencies involved, such as the General Secretariat for Investment/*Secrétariat général for l'investissement* (SGPI), the Department of Housing, Urban planning and Landscape architecture/*Direction de l'habitat, de l'urbanisme et des paysages* (DHUP), the Directorate-General for Risk Prevention/*Direction générale de la prévention des risques* (DGPR), the Directorate-General for Health/*Direction générale de la santé* (DGS), and the National Cybersecurity Agency of France/*Agence nationale de sécurité des systèmes d'information* (ANSSI).

THE ELECTRONIC COMMUNICATIONS AND POSTAL REGULATORY AUTHORITY (ARCEP)

Arcep allocates spectrum for future 5G networks: it participates in freeing up the identified frequencies and defines the technical terms and conditions for their use. It proposes the conditions governing their allocation to the Government, and particularly selection policies and associated obligations. It is responsible for enforcing these obligations, and has the power to impose sanctions.

It helps create a framework that is propitious to the deployment of 5G networks and small cells, by working on the conditions for sharing resources and fostering an exchange of best practices with local authorities.

Lastly, Arcep encourages experimentation: a "5G pilot" window was opened to allow players along the 5G value chain (businesses, manufacturers and infrastructure providers) to take hold of the technology and design innovative business models. It is also working alongside the Government to bring together the most deeply concerned sectors, to discuss technology and requirements.

NATIONAL FREQUENCY AGENCY (ANFR)

Before rollouts take place, ANFR prepares France's positions and conducts negotiations with international spectrum organisations, notably to identify 5G frequency bands, to define then harmonise the technical conditions governing their use. Based on these elements, and working in concert with spec-

trum-using ministries, Arcep and Broadcasting authority, CSA, it submits a frequency distribution scheme to the Prime Minister.

It may harness support funds for rearranging frequencies to accelerate the process of freeing up the bands. It coordinates the installation of radio stations across the country, can perform tests and enforce compliance with threshold values set for the public's exposure to radio waves. The ANFR National dialogue committee will provide a dedicated discussion forum for the different stakeholders, to share information and promote public trust.

ANFR monitors the compliance of equipment and devices being sold in the marketplace. Through its work in the field, it also ensures that all frequency users coexist smoothly, and intervenes in the event of interference.

NATIONAL AGENCY FOR FOOD, ENVIRONMENTAL AND OCCUPATIONAL HEALTH AND SAFETY (ANSES)

ANSES carries out its mandates to monitor, provide expertise, research and benchmark over a large number of areas, including human health and safety. Its work incorporates a cross-cutting exploration of health issues by assessing health hazards and, when relevant, by including a humanities and social sciences perspective.

ANSES will be working on evaluating the health impact of and risks linked to 5G rollouts, according to data on the exposure induced by this technology.

Four priority projects to make 5G a success

Because France must be at the vanguard of 5G, the Government, working jointly with Arcep, is launching several large-scale projects. They will be led by the concerned public authorities, in concert with stakeholders.

PROJECT NO.1 – FREE UP AND ALLOCATE RADIO FREQUENCIES

In addition to the frequency bands that have already been allocated to mobile operators, which could be used for 5G rollouts (e.g. the 700 MHz and 1800 MHz bands), two new frequency bands have been identified at the European level: the 3.5 GHz and the 26 GHz bands. Ensuring the availability of these frequencies is key to the development of 5G, first for trials and later for commercial launches. There are two parts to this project.

The first part consists of ensuring availability of these new frequency bands which are currently assigned to other uses. In particular, it will involve defining the policies for sharing and rearranging these targeted bands, as well as the technical conditions for using the bands, to avoid interference with existing applications (superfast wireless, radar, etc.).

The second part consists of allocating the newly available frequencies, with the first allocations scheduled to take place before the end of 2020. This includes defining the allocation mechanisms, the size of the blocks, the maximum amount of spectrum any one player can be allocated, and possible obligations attached to the licences. This part of the process requires a dialogue with stakeholders, i.e. mobile operators and other economic actors with a stake in the technology's deployment. From a broader perspective, dialogue with all of the stakeholders (consumer associations, businesses, local elected officials, etc.) will also be a vital part of the process.

Arcep will be holding a public consultation on these topics in October 2018. The allocation procedure will ultimately be launched by the Government, acting on a proposal from Arcep, which will conduct it and allocate the frequencies.

PROJECT NO.2 – FOSTER THE DEVELOPMENT OF NEW USES

5G is being heralded as a disruptive technological generation. It does not represent a mere increase in connection speeds, but promises to buttress the economy's digitisation. 5G will open the way for new applications, notably thanks to decreased latency (medicine, autonomous vehicles) and massive connections (Internet of Things). Its implementation will pave the way for applications in a wide array of sectors: energy, health, media, transport, manufacturing.

The national strategy aims to support the development of these new applications in sectors that have been identified as priorities. Particularly close attention will be given to encouraging pilot projects that will test the new potential uses of 5G: monitoring traffic, optimising energy efficiency. The purpose of these trials is to bring together interested parties: local authorities, operators, equipment suppliers, vertical industry players, beta testers, innovative start-ups.

To facilitate the creation of consortia for conducting pilot projects, the Government plans to rely on the National Council for Industry. The Government and Arcep will chair the meetings of play-

ers belonging to the same value chain, in sectors that are priorities in terms of applications to facilitate the emergence of collaborative projects.

In January 2018, Arcep a launched a "5G pilot" window to allow players along the value chain to request frequencies, and so take hold of the technology and design and test use cases and business models.

The first list of test cities is by no means exhaustive. Arcep examines all applications for 3.5 and 26 GHz band spectrum. Thanks to an agreement with the Ministry of the Armed Forces, this now includes GHz in the upper portion of the 26 GHz band.

The "5G pilot" window is open
*As of January **2018,** applications can be sent to: 5G@arcep.fr*

The process of implementing these trials could be accompanied by calls for proposals conducted as part of the "Investing in the future" programme.

This would also include a campaign for informing the public and local authorities, notably regarding exposure to electromagnetic fields.

PROJECT NO.3 – SUPPORT 5G INFRASTRUCTURE ROLLOUTS

The goal of this project is to lay the groundwork for a rapid deployment of 5G.

5G's deployment will make use of macro sites, much as operators' existing networks do, but will also need to be structured around the deployment of small cells. There are overlapping issues to these two components: first, the need to reinforce existing infrastructure, and possibly deploy new infrastructures and, second, the large number of small cells to deploy and the complexities involved in deploying them.

To rise to these new challenges, in addition to the streamlining measures already identified in the Housing, Planning and Digital Development bill (loi ELAN) put forward by the Ministry of Territorial Cohesion, and the European Electronic Communications Code, the Government and Arcep plan on establishing a best practices guide to facilitate and accelerate the deployment of these future networks (e.g. regarding the terms governing operators' access to street furniture). Arcep will also assess the feasibility and opportunity to share small cell networks, notably according to rollout restrictions.

Lastly, the technological changes brought by 5G, combined with growing cybersecurity threats, will mean that very high levels of security will need to be established. An examination will be made of the impact of these new technologies and how to adapt the regulation that governs them, working in concert with ANSSI.

PROJECT NO.4 – ENSURE TRANSPARENCY AND DIALOGUE ON ROLLOUTS AND THE PUBLIC'S EXPOSURE

5G rollouts will involve the deployment of new base stations, and create a need to inform the public about the consequences of these deployments in terms of exposure to electromagnetic fields.

The threshold values for exposure to electromagnetic fields are set by the regulatory framework, and apply regardless of the technology (2G, 3G, 4G or 5G). The 5G networks that will be deployed by operators must therefore comply with these threshold values as fully as existing technologies do.

The Government is working with the National Agency for Food, Environmental, and Occupational Health and Safety (ANSES) and the National Frequency Agency (ANFR) to examine exposure to electromagnetic fields and the potential impact of these new technological developments, starting in the trial phase. All of this work will be discussed with stakeholders within the dialogue committees set up by ANFR and ANSES.

NATIONAL AGENCY FOR FOOD, ENVIRONMENTAL AND OCCUPATIONAL HEALTH AND SAFETY

KEY DATES FOR 5G IN FRANCE

2018: *Trials and pilots: identifying use cases, and collecting data on exposure*

2019: *Progressive freeing up of frequency bands*

First compatible devices available for sale

2020: *Frequency allocation and definition of obligations attached to licences*

Commercial deployment of 5G in at least one major city

2025: *Coverage of main transport routes*

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