

5G strategy for luxembourg

Roadmap for the 5th generation of
mobile communication in Luxembourg

Version française
en-ligne :



THE GOVERNMENT
OF THE GRAND DUCHY OF LUXEMBOURG
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Department of Media, Telecommunications and Digital Policy



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innovative initiatives.

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5G



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a national strategy for the successful introduction of 5G

01.1 background

In September 2016, the European Commission published its 5G for Europe Action Plan, to boost the rollout of 5th generation telecommunications networks (5G) across the EU. The Commission stressed the need for a coordinated approach to ensure prompt deployment of the 5G technology throughout the Union. European telecom ministers responded in December 2017 by endorsing an ambitious roadmap for making Europe the world leader in 5G technology. The roadmap sets out the need to make the spectrum available more swiftly and in a more predictable manner so that 5G networks can be rapidly deployed, with the aim of:

- making 5G available in at least one city per Member State by 2020;
- promoting the rollout of 5G between 2018 and 2025;
- creating a “gigabit society” by 2025 by introducing 5G in major towns and cities, and along key transport routes.

At the start of 2017, Digital Luxembourg’s Infrastructure group consulted with the key players in the Grand Duchy who are affected by 5G, including the regulator, mobile network operators, academics, technology companies and stakeholders in the field of machine-to-machine communication (M2M) and/or the internet of things. A 5G sub-group held its first meeting in July 2017 to exchange ideas on the various aspects of the future 5G ecosystem in Luxembourg, based on the bilateral consultations held earlier in the year.

The group also considered the roadmap needed to reach the objective, including what spectrum to use, business models required, the role of satellites, and the role played by 5G in autonomous networked vehicles. The consultation undertaken by the Infrastructure group showed that operators don’t expect to immediately deploy 5G across the board, but instead intend to develop trials with industry partners.

The Department for Media, Telecommunications and Digital Policy followed up on this first consultation by asking the Luxembourg based inCITES Consulting group to carry out an in-depth study on the opportunities and challenges linked to introducing 5G in the Grand Duchy. The study was based on discussions with a wide range of national stakeholders in the Luxembourgish ecosystem. It looked at various aspects involved in introducing 5G, such as business models, market demand, regulatory issues and potential funding schemes. It moreover identified five potential pioneer areas for the initial introduction of 5G in Luxembourg.

This strategic document is based on the conclusions and recommendations of the inCITES expert report.

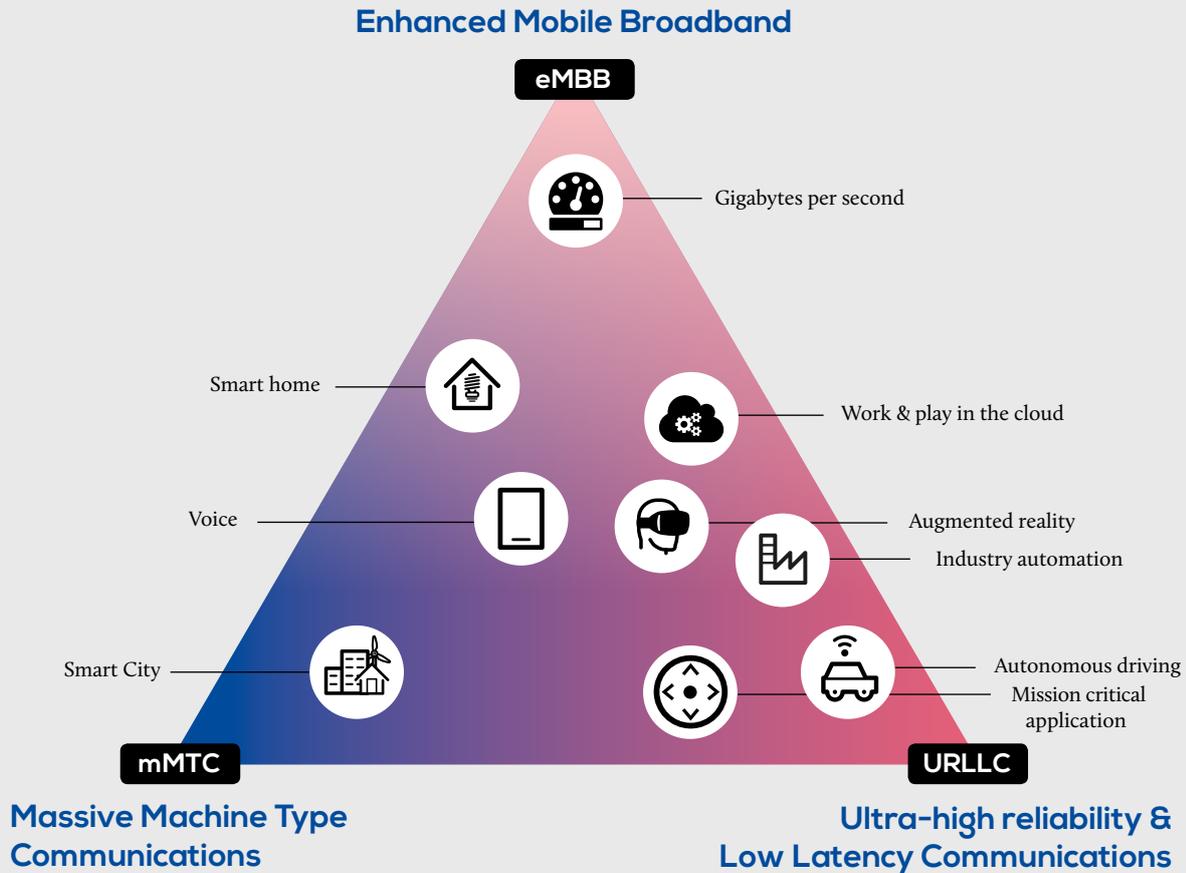
01.2 the strategic importance of 5G

The Government believes that 5G networks are essential to the next wave of productivity and innovation throughout the various sectors of Luxembourg's economy. 5G will come to represent a crucial part of our national infrastructure. The rollout and adoption of 5G have the potential to create **long-term socio-economic benefits** for the whole of the country and its economy. 5G is not merely an extension of existing telecommunications networks, but rather a fully integrated network that caters for increasing data requirements and that allows for new user experiences based on more reliable and ubiquitous connectivity.

5G is not merely about increasing bandwidth and internet speed, it also offers low latency and greatly improved reliability. 5G is a network that will allow users to connect more devices per cell than ever before, while further cutting energy consumption compared to existing technologies.

The International Telecommunication Union has set out a number of requirements for 5G in terms of throughput, reliability and latency. 5G also allows for “**network slicing**”, making it possible for a range of services with differing characteristics to operate together on the same network. This will create new network management opportunities, including the possibility of a single physical 5G network supporting a large number of virtual networks with different performance levels. Network slicing means that for the very first time mobile data services can be adapted to the specific features of users and verticals. Applications such as video streaming services, virtual or augmented reality apps, self-driving or remote services in vehicles, drone and robot control or even remote surgery, do not all need the same features. There will be very few applications that need all of these features at once. The ability to use network slicing rather than creating separate physical networks opens up the option of developing and offering new services targeted towards specific economic and industrial sectors. A 5G network will need to meet the differing needs of a range of applications in the future, across areas such as transport, smart cities, the internet of things, manufacturing, security and emergency services.

Thus, 5G also has real potential **to improve the lives of citizens**. As an example, 5G use in self-driving vehicles will improve road safety and streamline traffic management, leading to fewer road accidents and faster journeys, which in turn will result in a cleaner environment. 5G use cases in the health and medical sector, such as remote treatment and personalised care, will help create more reactive and less congested health systems, and a greater sense of safety for people living in remote areas. The technology will also assist smart home applications, improving users' quality of life by enhancing comfort and safety in the home. While the first four generations of wireless networks have primarily served communications and digital content needs, 5G networks will in addition support the various vertical sectors in their transition towards the digital world.



Graphic based on an ITU (itu.int) and ARCEP (arcep.fr) diagram.

The International Telecommunication Union (ITU) divides 5G applications according to three technical characteristics:

Massive Machine Type Communications (mMTC):

communications between a large number of objects with varying service quality requirements. The aim of this category is to respond to the exponentially increasing density of networked devices;

Enhanced Mobile Broadband (eMBB):

ultra-high-speed outdoor and indoor connection with uniform service quality, even at the edges of the cell;

Ultra-reliable and Low Latency Communications (URLLC):

ultra-reliable communications for critical applications with very low latency, for increased responsiveness.

01.3 the role of public authorities

The Government intends to work with all 5G stakeholders in order to coordinate the development of 5G services and applications in Luxembourg, overcome obstacles that may arise, and **create conditions that favour** the rapid deployment of networks and stimulate larger-scale innovation and investments in the 5G ecosystem.

A number of questions remain to be definitively answered, and 5G standards are not yet fully defined. As a result, this strategy should not be seen as final yet. The Government will need to maintain an ongoing dialogue with the various stakeholders with a view to developing 5G in Luxembourg.

The strategy for introducing 5G in Luxembourg includes a number of aspects:

- It is crucial to set out a timetable and a roadmap to allow the stakeholders to include 5G implementation in their own strategic planning.
- The first task of the public authorities will be making the 5G frequencies available.
- The next step should be to identify potential regulatory or administrative requirements and find ways to overcome obstacles that may prevent 5G implementation, whether these relate to the rollout of the networks or the implementation of the applications made possible by 5G technology.
- In this respect, it is vital to understand the various business models and innovations that 5G will create or foster.
- This may lead to public authorities having a range of responsibilities, as they will be called upon to adapt sector-wide regulations, issue permits, integrate the opportunities offered by 5G into sectoral policies, and occasionally act as 5G users themselves.
- While there is no guarantee for profitability of investments that are needed from operators, at least in the short term, the State may stimulate investments in this key infrastructure by financially supporting initial deployments in the context of pilot projects.



making frequencies available

In order to enable service providers and users to develop innovative 5G business models, increasing demands in terms of capacity, bandwidth, availability and latency of digital infrastructure must be met. Making the required spectrum available in due time and in accordance with a precise timetable is a key factor for the roll out of 5G.

The EU recently identified **the pioneer 5G frequency bands**, which are:

— The 700 MHz band (694–790 MHz):

These frequencies were primarily assigned to European terrestrial digital television. As a second digital dividend, this band will need to be relinquished by broadcasting services in order to be allocated to mobile services. Although this band offers limited bandwidth –allowing for guard bands, it will provide 2 x 30 MHz in duplex, which could be split, for example, into blocks of 2x10 MHz, where there are three competing operators. These relatively low frequencies provide, however, wide reach, and could thus be used in the 5G context to ensure adequate coverage of the territory.

Technical conditions for using this band have been harmonised at the European level through Commission Implementing Decision (EU) 2016/687.

Luxembourg has the advantage in that this band is not used by its broadcasters for television. However, it will only be possible to launch mobile services using this band if neighbouring countries also stop broadcasting within the band to prevent interference between the two systems. According to 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, the 700 MHz band must be allocated by Member States to wireless mobile communications by 30 June 2020 unless the Commission grants an exception/derogation. Regulators have also signed bilateral and multilateral agreements. It is therefore likely that this band will be available from 30 June 2020, but it may not be cleared before then.

A public consultation for allocating licenses in respect of this band is planned for the first quarter of 2019. **Allocation of licenses should be completed in Luxembourg by the second half of 2019.**

— The 3.6 GHz band (3.4–3.8 GHz)

This band will be the first 5G pioneer frequency band to offer increased bandwidth and data throughput for a large number of mobile devices. As much as possible, the aim is to operate far larger contiguous frequency blocks than those used in the 700 MHz band. These blocks will not be part of a duplexing system. Rather than having two separate frequency blocks for transmission in each direction between the terminals and the base station, the same frequencies could be used in either direction.

The Government plans to allocate licenses for the 3.6 GHz band on the same schedule as the 700 MHz band, with the goal of completing **allocation in the second half of 2019**.

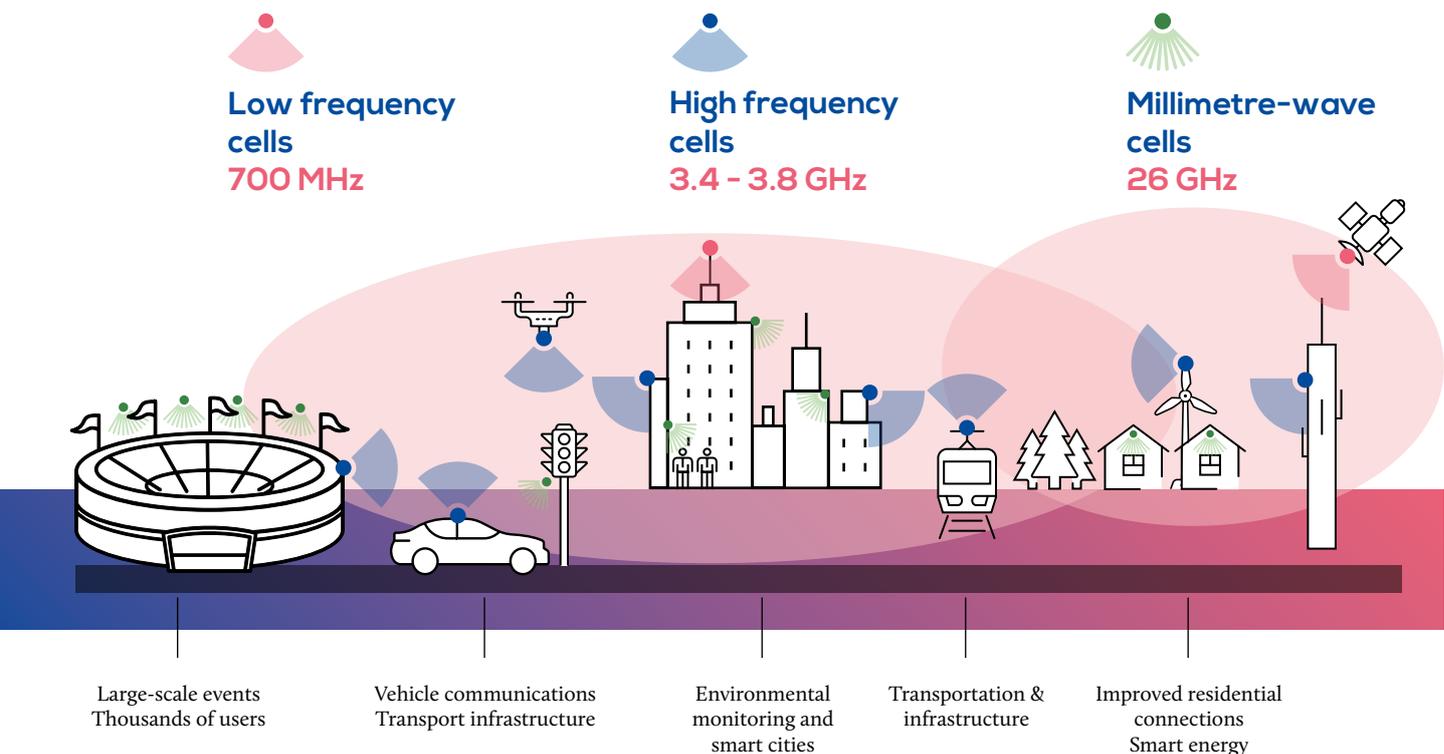
It is worth noting that this band is shared with other services. In Luxembourg, it is primarily used by satellite ground stations, which receive signals on these frequencies, in particular for television programmes, which are then transmitted to other satellites. Mobile network base stations and their corresponding terminals can cause interferences, preventing signals from satellites being received effectively. As the case may be, a protection zone will need to be set aside around these ground stations, at least in part of the band. The Luxembourg Regulatory Institute has commissioned studies and taken measures to look at this issue and will suggest solutions in partnership with the stakeholders concerned. As the standards have not been finalised and equipment for base stations and terminals are not yet on the market, initial results will remain provisional.

— The 26 GHz band (24.25–27.5 GHz)

This band is another key band for 5G in so far as it offers ultra-high capacity for innovative services to support new business models. These frequencies offering reduced coverage will primarily be used for small cells in areas of high-density use. The band is currently being harmonised for 5G at the European level.

Frequencies in this band will be allocated during a second phase to take place in **the second half of 2020**.

This band is also shared with other services, but it should be possible for a total of 1000 MHz in the band to be made available in Luxembourg.

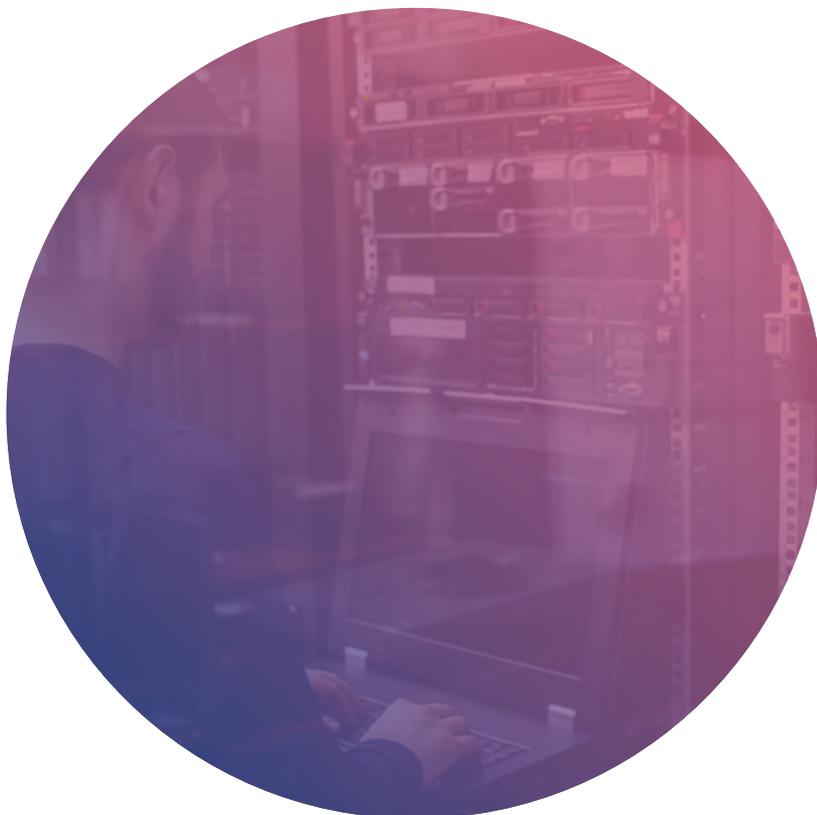


The upcoming **European Electronic Communications Code** will alter the rules that apply to electronic communications networks and services and will provide a suitable legal framework for introducing new high-capacity networks. The draft Code sets out new rules for spectrum management, such as minimum terms for licenses (15 years + optional 5-year extension), and sets 31 December 2020 as the common deadline for issuing 5G licences in the 3.6 GHz and 26GHz bands. It also creates provisions to facilitate the deployment of small cells.

In Luxembourg, the planned term of new 5G licenses will be 20 years or 15 years with a tacit 5-year extension available to the same beneficiary, in line with the future European Electronic Communications Code.

Fees for the use of frequencies will be set by adapting the amended Grand-Ducal Regulation of 21 February 2013. These fees shouldn't be too high in order not to discourage or delay investments.

The regulation already provides for the possibility to make frequencies available for testing, which should facilitate the deployments of the pilots.



other regulatory aspects

Mobile networks are traditionally designed as a collection of macrocells that provide radio coverage over a large area. In order to respond to increasing demand for capacity, coverage and quality of service in 5G, operators will need to create denser networks by installing more base stations. As such, there will be a greater number of small cells in the 3.6 GHz and 26 GHz band in dense areas.

Operators will need a number of authorisations or permits from public authorities in order to roll out these networks. These may include rights-of-way, road permits, construction permits and environmental authorisations, and, in some cases, they may need to use street furniture, such as streetlights, which are often in the remit of the local or national authorities. Shared infrastructure and shared spectrum could be other ways of cutting investment expenses.

— Rights of way:

The law of 27 February 2011 on electronic communication networks and services has put provisions in place for rights of passage for network deployment in public property held by the State or local authorities.

— Road permits:

The same law, in addition to the law of 22 March 2017 on measures to reduce the cost of deploying high-speed electronic communications networks, includes provisions relating to issuing road permits and transparency of permit requests.

— Building permits:

In some countries, the installation of selected equipment is exempted from the need to obtain building permits. In addition, the upcoming European Electronic Communications Code states that the European Commission may issue regulations to set thresholds, below which individual authorisations will not be required. Luxembourg would then also implement these European thresholds.

— Limitation of electromagnetic fields:

The 5G network carries strategic importance not only for the economy, but also in terms of the benefits provided by potential health, safety and environmental uses. Nonetheless, a cautious approach is still required when it comes to protecting people from excessive electromagnetic fields and to pursuing a policy of transparency in this area. 5G is also an innovative technology the features of which could change the circumstances for regulations:

- 5G networks use smart antennas and beams that can move and focus on areas where use is most intense;
- This will make electromagnetic fields more variable; small cells will be closer to end users but will have less power;
- The spectrum will be used more efficiently, with more data being transferred without increasing electromagnetic emissions;
- New technologies are being developed, such as LiFi, which uses light rays from LEDs to carry signals.

— **Environmental authorisations:**

Given the likelihood that the number of sites will multiply with 5G, it is worthwhile studying the options for simplifying procedures and reducing the costs thereof for applicants, but without reducing the rights of citizens. One example would be focussing more on digital and automated procedures.

— **Access to infrastructure and network sharing:**

The law of 27 February 2011 on electronic communication networks and services and the law of 22 March 2017 on measures to reduce the cost of deploying high-speed electronic communications networks include provisions to make it easier for telecommunications operators and other network operators to share infrastructures. The new European Electronic Communications Code further reinforces this, by streamlining sharing of the radio access network and the spectrum of frequencies. Depending on the circumstances, a neutral host may also operate a network segment shared by multiple operators. By sharing infrastructure and networks, operators may, in some cases, be able to reduce the cost of rolling out networks. As such, it is advisable to encourage various types of sharing, so long as this doesn't affect competition between operators.

— **Access to fibre:**

Luxembourg has a fairly dense fibre optic network; as a matter of fact, the national strategy for ultra-high-speed internet called for four fibres per household in the local loop. This network could represent an undeniable advantage in connecting base stations as part of 5G rollout. It will be important to ensure that operators have access to the available fibres at a reasonable cost in order to ensure that 5G networks can be deployed quickly.

— **Access to buildings and street furniture:**

Operators will need easily accessible sites within dense-usage areas that are connected or easy to connect and supplied with electricity in order to install small cells. The façades or roofs of buildings and street furniture (such as bus shelters and street lighting) could be appropriated for installing small base stations. It is therefore crucial for public stakeholders that control well-located buildings and street furniture to be open to having these cells installed under reasonable terms.



luxembourg – a 5G pioneer

04.1 initial deployments through pilot projects

While there is scarcely any doubt that 5G networks will be a key infrastructure in the digital society over the coming years, it is less certain that electronic communications operators will have sufficient assurances in respect of short-term profitability of their investments in these new networks.

Therefore, it is not enough for authorities to simply take measures to make frequencies available promptly and create a regulatory framework conducive to 5G. Although the most likely scenario is that mobile operators will deploy one or several networks, **the State should not rule out co-financing initial investments** to ensure that Luxembourg can launch 5G at the same time as other pioneer countries.

Aside from the cross-border project in autonomous driving (5G CroCo) submitted to the European Commission with the involvement of stakeholders from Luxembourg, the inCITES Consulting study identifies five example **pioneer zones** where initial deployment could be of particular interest. These areas could be used to test various applications of 5G. The five areas were selected based on discussions with a variety of stakeholders. However, the list of areas is not final, and it is moreover not planned to implement projects in all of these areas at the same time.

While the criteria for selecting the final pilot projects will be defined during the second development stage of the strategy, and while it will depend on the funds available, the goal is to select projects that provide the greatest socio-economic benefits for the country.

The pilot projects must contribute to **innovation** and the unlocking of the potential of the 5G ecosystem as well as to **better understanding of the environment needed** to facilitate the rolling out of networks and innovative applications.

Luxembourg has managed to put in place a cross-sector environment to smooth the path for digitalisation (infrastructure, start-up ecosystem, etc.) Rapid rollout of 5G would make Luxembourg fertile ground for creating and luring a new generation of businesses related to 5G and the internet of things. These businesses could develop their innovative services from Luxembourg and offer them internationally. The Grand Duchy could thus position itself as a 5G/IoT digital leader.

The idea is also to subsequently integrate network equipment deployed in pilot areas into a nationwide 5G network to make the most of initial investments. Co-financing will need to comply with European state aid rules.

The areas being considered for the pilot phase are:

- Part of the Kirchberg plateau with cultural and leisure infrastructures;
- The "CFL Multimodal" site in Dudelange;
- The Automotive Campus in Bissen;
- The Belval site with the university;
- A stretch of a major transport route.

The pros and cons of each site are examined in more detail in the inCITES Consulting report. The State could cofinance two or three pilot projects, with part of the investment being covered by the operators who could then further use these network segments, as well as by other interested stakeholders.

04.2 areas of particular relevance for Luxembourg

The work of standardising 5G technology has not yet been finalised. There are a number of matters related to the 5G ecosystem that still need clarifying. Luxembourg could contribute productively to research into technical and regulatory solutions in certain sectors where it can boast specific assets that can be taken advantage of:

— **Cross-border issues:**

No other EU country has to deal as much with close borders as Luxembourg. As such, the country stands to benefit from assisting in research into solutions to obstacles thrown up by the EU's internal borders.

- **Cross-border handover:** People crossing borders have to go from one national network to another, and their connection gets cut out in the process. This usually is not because network coverage is weak, but because there is no allowance for a smooth transition from one network to the next.
 - Looking at 5G, Luxembourg should encourage research into solving this issue. The 5G-CroCo European research project on self-driving cars proposed to the European Commission could represent an opportunity to make technical progress.
 - There may also be regulatory obstacles. Efforts will need to be made to push the European Commission to deal with this issue.
 - In addition, the BENELUX Union could provide a useful framework in which we could look at the problem together with our Belgian and Dutch partners.
- **Network synchronisation:** 5G will see the same frequencies used by operators on each side of a border. As such, there is a risk of interference in areas close to the border. This could be avoided if the operators' networks are properly synchronised. Luxembourg has a lot to gain from bringing this issue to the international stage and encouraging research into technical or regulatory solutions, possibly through consultations with regulators and/or operators in neighbouring countries.

— Satellites:

- **The role of satellites in the 5G ecosystem:** 5G is primarily a terrestrial network. Nevertheless, satellite technology could play a very useful role in the 5G ecosystem. Satellite technology wins hands down when it comes to providing the same content to a large number of people, and in particular when the content needs to be sent to lots of users at the same time. Satellite technology could thus help take the load off the 5G backbone networks by delivering content, such as sports events that are broadcast live, to a node located close to the recipients of the content. As a country with a strong satellite industry, Luxembourg could drive development of satellite-based solutions to make 5G work as smoothly as possible.
- **Spectrum sharing between 5G and satellites:** The frequency spectrum is a scarce resource, with a range of users fighting for their share. Satellites and 5G are supposed to be able to coexist in certain bands, including the 3,6 GHz and 26 GHz bands (not to mention the 28 GHz band set aside for 5G in the United States). However, coexistence seldom works out for satellites as their downlink signal is weaker. Luxembourg has always sought to safeguard the frequencies set aside for satellite technology. It is important to consider how to organise a sharing system within these bands that would provide good 5G coverage in areas around a satellite operator's terrestrial stations without jeopardising the ability of the satellites themselves to operate effectively. The Luxembourg Institute of Regulation is currently analysing how these two services can best coexist.

— LiFi technology:

- A company has been set up in Luxembourg that is pioneering Lifi technology, in which signals are sent by light rays from LEDs. This technology shows great promise for reducing energy consumption. Luxembourg could promote the use of this technology.

5G as part of the “Digital Luxembourg” initiative

Implementing the “5G Strategy for Luxembourg” is part of the Digital Luxembourg initiative. The added value that 5G could bring to citizens and companies will be a central consideration. With the changes involved in introducing 5G, it becomes important **for the public to be involved** in understanding the challenges and benefits of a digital society. In addition to the technological and regulatory considerations, it is crucial to consider the human and social aspects as well. Introducing 5G will involve changes to the working and private life for all citizens. It will be important to continue explaining the opportunities that 5G brings to the whole population. Citizens, especially the younger generation, will only be able to benefit from the digital jobs of the future if they are able to develop suitable skills and behaviours for future means of communications.

Efforts made in the area of eSkills as part of the Digital Luxembourg initiative could be further developed and complemented by awareness projects focused on 5G technologies. The challenge involved in transferring digital skills is in determining the right basic skills that will allow people to adapt to technological and social developments during their educational and professional career.

Since 2017 there have been multiple meetings with 5G stakeholders. **Transparency and dialogue** on rolling out the technology are a key part of implementing the strategy. Exchanges of opinions with all stakeholders will be carried out with the goal of allowing all companies and administrations in Luxembourg to benefit as much as possible from 5G.

While some details of the 5G standard are yet to be finalised, **the strategy will be implemented in a flexible and scalable way** that takes into account the opportunities and requirements that arise over the coming years, in line with the Digital Luxembourg spirit.

The “5G Strategy for Luxembourg” will be another driver of the Rifkin strategy, launched in 2016 in Luxembourg. The convergence of ICT, renewable energy and new means of transport all within a smart network is a key element of the third industrial revolution. Rapid 5G rollout in Luxembourg will make it possible to achieve this convergence while at the same time fostering a smarter use of resources.

The Luxembourg strategy for ultra-high-speed networks was focused on fixed networks, with 4G being an incidental consideration. The country now has a high-performance fixed network, with over 60% of the country covered by fibre to the home, and an equally dense backbone.

With the advent of 5G and an increasing need for wireless connectivity, the country's strategy should now be giving more priority to the mobile network. 5G is the electronic communications infrastructure of the future, and there is no doubt that the country's high-performance fixed network will be an asset in installing it.

Luxembourg plans to match the ambitious 5G roadmap adopted by the European telecommunications ministers. The strategy described herein should allow Luxembourg to overcome obstacles, and make rapid progress in order to take its place among the leading pack for installing **5th generation** mobile networks (5G).

This document does not set the national 5G strategy in stone. There is still a need to discuss matters with stakeholders, and specific aspects will be fine-tuned through workshops on specific topics and working groups. This national strategy is designed to be adaptive so that it can take into account future developments in technology.

The issue of financing pilot projects and the money set aside for them will need to be determined during the budgeting process. The criteria for selecting pilot projects will be specified in more detail during the **fourth quarter** of 2018.

The technical measures needed to prepare and roll out 5G were set out in the preceding chapters. The measures can be summarised as follows:

— **Frequencies:**

- Make licenses available for testing purposes;
- Allocate 700 MHz and 3.6 GHz licences by the end of 2019;
- Allocate 26 GHz licences in line with the European roadmap.

— **Infrastructure:**

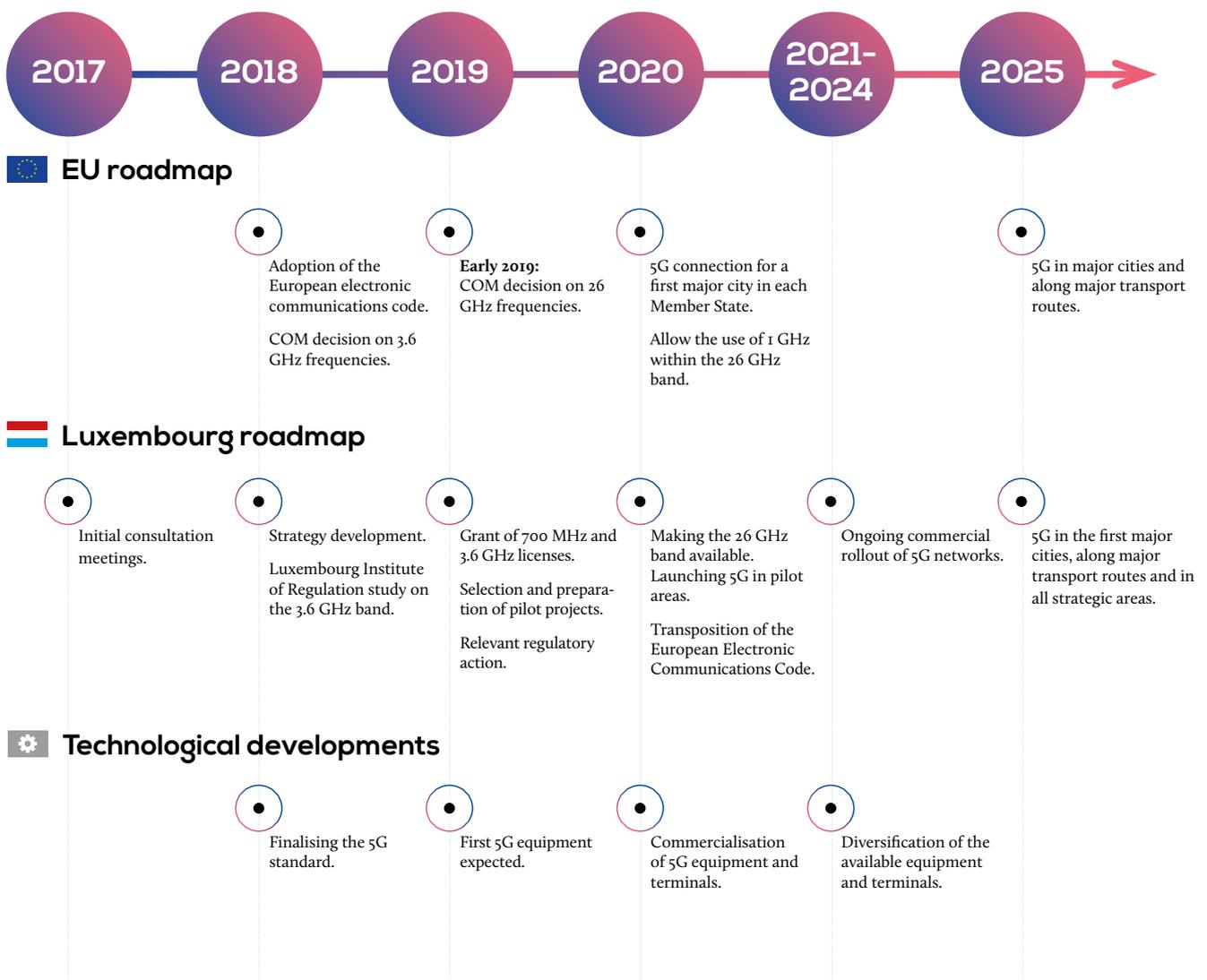
- Foster a flexible and adaptable regulatory framework for rolling out the mobile network;
- Facilitate access to street furniture for installing small cells in high-use areas;
- Facilitate access to passive infrastructure, such as tubes and masts;
- Provide easy access to fibre optic infrastructure in line with the country's ultra-high speed network strategy.

— Population:

- Ensure transparency on issues related to health and the environment;
- Make the population aware of the challenges and benefits of a digital society;
- Prepare citizens for the digital jobs of the future, in particular the younger generation.

— Administrations and companies:

- Focus initial efforts on a limited number of promising pilot areas;
- Make particular efforts in matters of strategic relevance to Luxembourg, such as cross-border issues or the role of satellites in the 5G ecosystem;
- Continue and expand dialogue with stakeholders within the framework of the Digital Luxembourg Infrastructure group.





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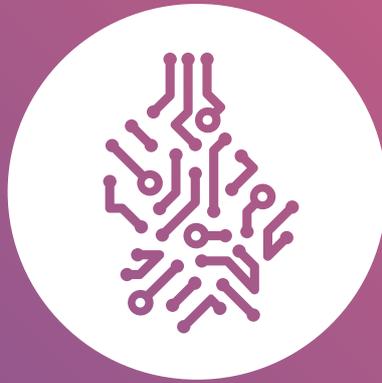


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