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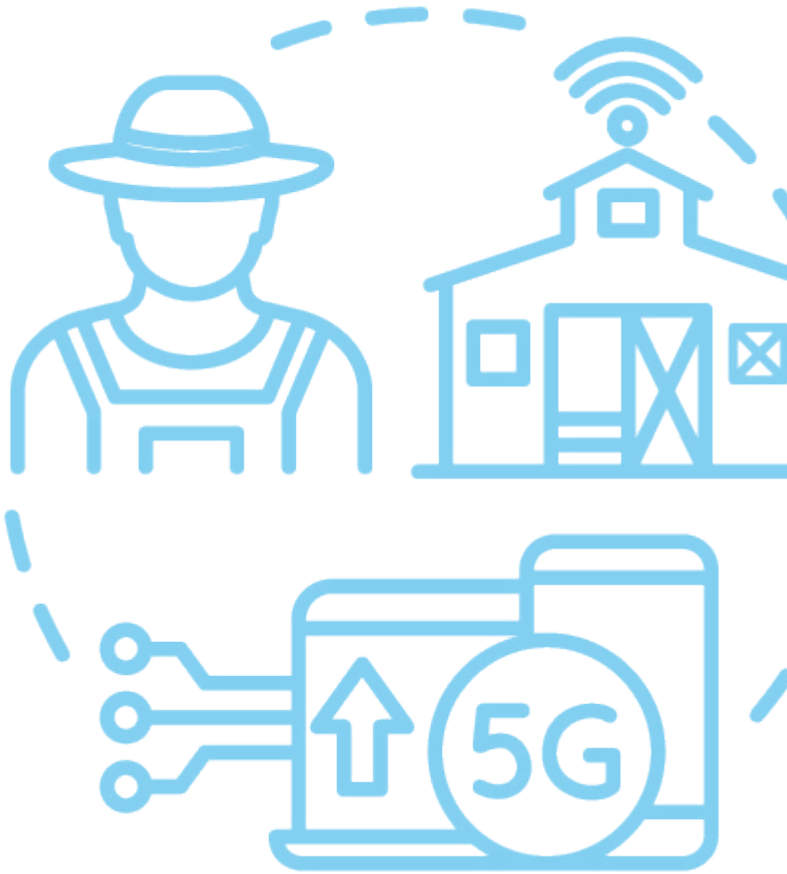
DIPLOCAT AGORA 14

Challenges and opportunities of 5G in rural areas

From the European Commission's strategy to regional implementation models

DIPLOCAT DIGITAL TALK - 2 July 2021



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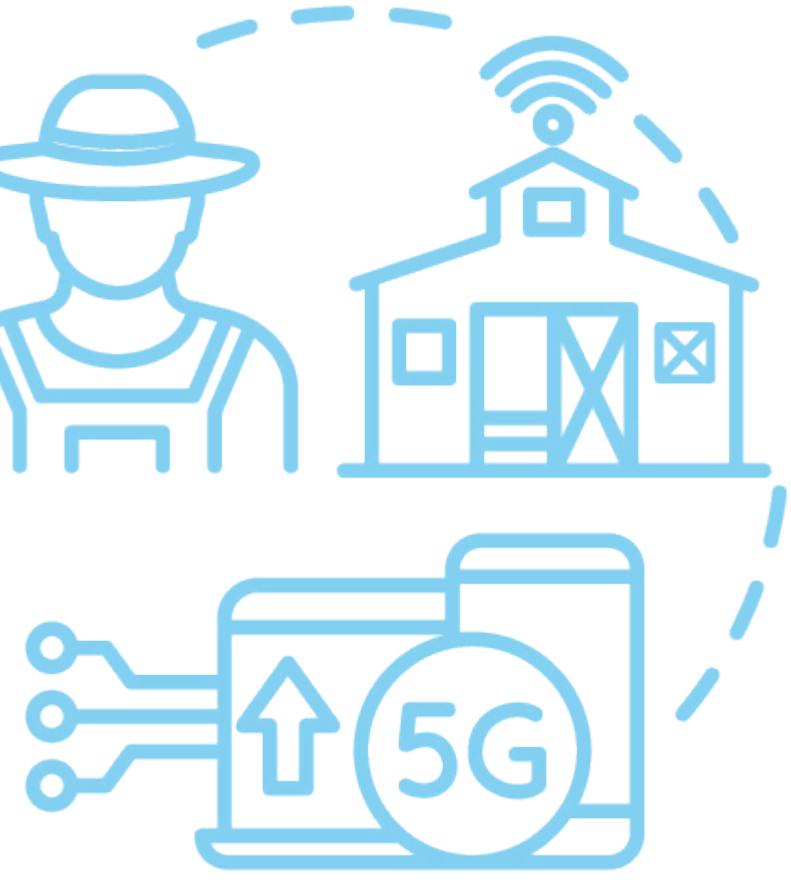
5G

1. Background

The deployment of 5G has started and will change everyone's life. This type of new technology, known as "next generation wireless", undoubtedly represents a major leap towards the Fourth Industrial Revolution (5G for the fourth industrial revolution). Its speed and low latency will make it possible to connect many devices at the same time. Thus, even if there are many people in the same geographical area, there will be no network download congestions and it will be possible to connect devices that are just now being developed, such as driverless cars. All of this will transform communication, innovation and economic development, generating many new jobs, but it will also pose major challenges.

The range of advantages of 5G goes far beyond the great speed and capacity it has. It is developing in terms of the competitiveness it will offer, while also helping to combat depopulation, allowing more people to settle in rural areas and addressing global challenges such as sustainability. It should be noted that the current Covid-19 pandemic has made it clear that remote working, if accompanied by good telecommunications infrastructures, has a positive impact on people's lives.

The impact of 5G in rural areas is clear and not fully explored. Several views were exposed and properly discussed during the digital talk "Challenges and opportunities of 5G in rural areas" organized by DIPLOCAT. It was the seventh event of the Digital Talks series that was launched in 2020 to analyze the world after the pandemic. The talk put together different experts that provided their view, insight on this topic and exchange of good practices while maintaining a lively discussion among them. The talk covered the rural 5G topic from the point of view of representatives from three European regions (Switzerland, Catalonia and Finland), together with the direct participation of the European Commission.

Switzerland is a key leadership case that has given importance to 5G obtaining remarkable benefits and developments. The digital Switzerland strategy focuses on implementing the various issues and objectives it has as a country, and specifically 5G (5G Country profile: Switzerland). Being the most mountainous country in Europe, it is also one of the European regions with the largest deployment of commercial 5G.

In Catalonia, the Ministry for Digital Policies of the Government, i2CAT and the Mobile World Capital Foundation are carrying out large pilot tests in the field of 5G and depopulation. Within the framework of the 5G strategy of February 2019, the government is committed to establish policies to promote its development, so as not to create technological gaps in areas with low population density. It is in this context that the government has carried out several initiatives such as the deployment of 5G rural labs and the Catalonia Rural Hub in the Garrotxa county, which aims to encourage the relocation of digital professionals in sparsely populated rural areas. The government has also created different 5G areas as innovation laboratories on the field, being the first one in Terres de l'Ebre, in southern Catalonia.

In Finland, the northern city of Oulu has been experimenting with 5G since 2017, becoming an innovation pole in both Finland and Europe. The University of Oulu's Centre for Wireless Communications has been carrying out research on the possibilities of 5G in remote sparsely populated areas of Brazil and the Arctic.

The European Union, for its part, has had the 5G Action Plan since 2016, which is part of the European Commission's digital strategy. The plan was created with the initial objective of ensuring 5G coverage of urban centres and transport hubs by the end of 2025 to boost the competitiveness of industry in the Digital Single Market. In 2021, the EU goal was set to cover all inhabited areas in Europe by 2030. In order to monitor progress, the EU created the European 5G Observatory, which monitors market developments in the field of 5G as well as the development strategies of EU member states..

2. Presentation

Laura Foraster, Secretary General of DIPLOCAT, opened the event by pointing out that the Covid-19 pandemic has generated opportunities for sparsely populated areas, especially thanks to technology. Foraster told the audience that without all the improvements and innovations that tech has brought to our daily lives in the last few years, it would be impossible to debate about the opportunities of remote working and companies opening away from big metropolitan areas. 5G is the next big thing in technology, starting from today, and it will certainly have an impact on the way we work and live.

Foraster claimed that the range of advantages of this technology goes far beyond its great speed and capacity. It is developing because of the competitiveness it offers, but most of the tests all over the world are taking place in urban areas, due to the requirements for 5G cell towers to be close to one another, while sending to the speakers an open question: does this leave room for rural areas to take advantage of what 5G offers?

As already exposed, the 5G topic is complex and ambitious. With the aim to focus the talk, some questions where exposed in advance:

1. How can the development of 5G affect the economic promotion of rural areas?

2. To what extent does 5G require the deployment of optical fibre to be effective in the fight against depopulation?

3. To what extent does the need to have nodes installed on telecommunication towers spread throughout the territory hinder the development of 5G in rural and mountainous areas?

4. Are the alleged health risks justified?

5. Does this leave room for rural areas to take advantage of what 5G offers?

Globally, the main objective of this digital talk was to share best practices and explain the need to reconcile concepts such as the need to deploy 5G with its possible positive effects on the economy.

3. Debate

3.1. Moderator insight

The talk was moderated by Sergi Figuerola, an expert in the 5G field ecosystem, who introduced the speakers and gave an overview of the current state of the art of the topic under discussion. It is a moment of change, he summarized. Referring to Foraster's words, he said that the range of advantages that 5G technology brings goes far beyond its current ability and capacity, while the biggest challenge will be to ensure that the deployment of 5G is not creating a larger digital divide. From the service providers point of view, rural areas don't have the same level of importance as urban areas. This means that there are still many social, economic and technical challenges to face.

The digital talk took place during the week of the Mobile World Congress 2021, which also considered the 5G rural topic as part of the congress discussion. The participants in the MWC stated that costs are a key issue despite the fact that 45% of the population is still in rural areas, so the gap is huge, and

it is a paradigm called the coverage gap versus the user's gap. It refers to the challenge on how users migrate from 2G phone technologies to the 5G generation. This is a three generations' jump, so it is not only a question of technology but of society evolution. It is a must to let those people know what are the possibilities and the chances that this new technology offers, and it is a challenge that belongs to governments, industries, organisations and citizens.

3.2. Keynote speech: "The connectivity policy of the EU for rural areas"

Robert Henkel, responsible for the Broadband Policy in the Directorate-General for Communications Networks, Content and Technology (DG CONNECT) of the European Commission, gave a keynote speech to provide an overview about connectivity policy, especially concerning 5G in rural areas. To do so he presented the general frame of the DG CONNECT policy for the post-Covid era, based on the new strategy for the Digital Decade. It consists of several points:

- Bring one gigabit to all households in Europe and 5G to all populated areas until 2030.
- Connecting the "small": IoT systems to develop the zero-distance society concerning the internet connection.
- Connecting the "large": Pan-European cross borders backbones and 5G corridors.
- Geographical continuum: from the main corridors to the cities, to the local communities and villages and rural areas.
- Technological continuum: vertical integration across the EU's digital ecosystem.
- Strategic autonomy: foster the digital supply chain.

Henkel said that the current situation, for very high-capacity network, means the addition of fibre to the premise and DOCSIS 3.1 cable connections. Rural coverage in 2020 was 28% in comparison with the 59% total. Talking about gigabit connection, there is a clear gap between the average coverage and the coverage in rural areas. The best situation was on the NGA (Next Generation Access) coverage in 2020, which meant a minimum of 30 Mb download, with 60% coverage in rural areas out of a total 87% average in Europe.

From Henkel's point of view, Europe is not so far developed if you look at 5G coverage. This is normal since it is a new technology, which is just being deployed, but nevertheless it is important that Europe speeds up. The figures in Europe in 2020 indicate that there was an average coverage of 14%, while we still have to finish the auctions for the spectrum frequencies and a 5G readiness of 40%. There is no surprise situation for 4G, since the coverage is very high: 99.7% in average in Europe, and the take up is 71%. Thus, there is a problem gap between rural and not rural areas. The reasons for this gap are very clear:

1. Unaffordable deployment costs for private sector.
2. Mismatch coverage/take up (i.e. lack of demand and skills, among others), so rural areas will lag significantly behind, especially for standalone 5G. An example is the current situation of 4G (99,7% coverage versus 71% take up), based on the lack of demand mostly based on missing skills and education.

The EC is very much concerned with the fact that rural areas are not so much developed concerning 5G, which is mostly deployed in large or medium cities with large population. The main targets for the EC are uninterrupted 5G coverage in all urban areas, major touristic and transport paths by 2025, and one of the new Digital Decade targets, which is 5G coverage in all populated areas by 2030. Thus, and to overcome these risks, the EC aims at putting in place two important instruments: a publicly supported infrastructure investment and sharing of knowledge to implement these investments.

Instruments are key. First, there is the funding instruments for digital connectivity. This is based on a new instrument called CEF-Digital (Fig. 1). The EC will invest two billion in state aid (public money for connectivity) in combination with InvestEU, as a public bank with loans, together with the European Structural and Investment Funds (ESIF), which could be combined with the state aid money to build up connectivity in rural areas.

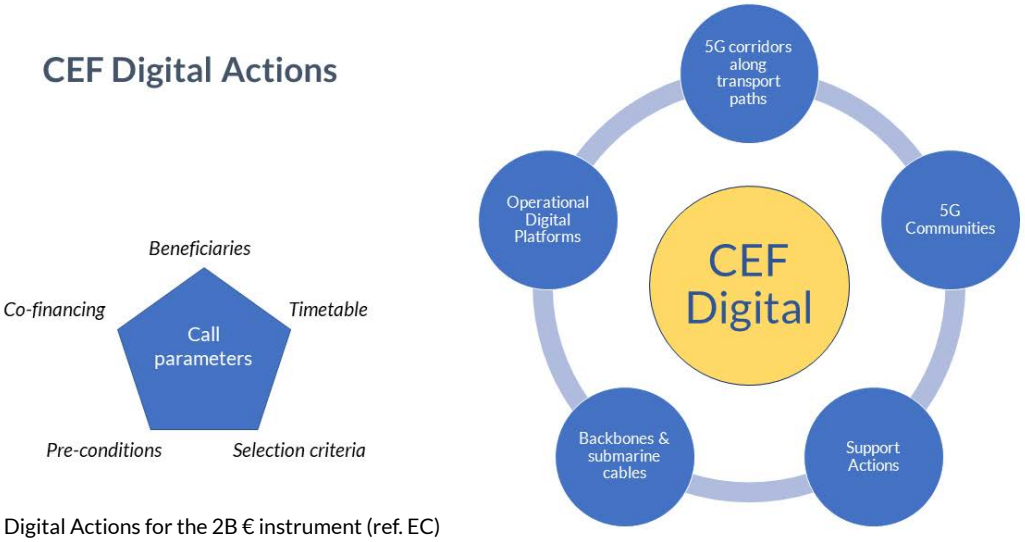

Fig.1 CEF Digital Actions for the 2B € instrument (ref. EC)

All this is included in the general budget for the transition to a greener Europe, since a good broadband connection could also help to save energy and make the industry production more energy effective. It also serves the challenge to have an inclusive Europe, which means people should be covered by all the connectivity targets mentioned (100 megabits to all homes and a minimum update up to 1 Gbps to all main social economic drivers, schools, government, hospitals, etc. by 2025).

Additionally, there is the well-known Next Generation EU Recovery and Resilience Facility program, with 20% of 750 billion EUR is reserved for the digital area. So, an estimated figure of 50 billion could already be used for digital targets such as deployment of broadband, especially in rural areas.

The 5G community is demand-driven, which means that the different services of interest, social economic drivers, government, schools and/or healthcare should ask for this support. The EC will support the 5G antenna and connections with it, assuming that there is already a backbone in place. Thus, the EC will support the connection between backbone and the 5G antenna and the 5G active elements in addition. This is very interesting since the funding could reach up to 75% of the whole costs for the deployment of 5G in rural areas. A very important way to distribute this knowledge is through the regional representatives. Henkel made a point and acknowledged the competent officers existing in Catalonia. There are nearly 120 regional representatives across Europe.

Henkel said that the 5G pooling of resources can combine national digital resources with recovery funds money, since there are already 5G use cases which prove that this is a general interest service for social economic drivers. The whole distribution of knowledge should stimulate:

1. The digital supply chain and standards.

2. The industry impact in rural areas through the usage of smart agriculture and precision farming.

3. The manufacturing for 5G use and logistics in rural areas.

4. The indirect or direct push to industry in these areas.

5. The services of general interest (e.g. healthcare, patient monitoring and assistance at home by hospitals).

Henkel's tasks in Brussels include to sponsor the combination for this kind of financing, define best practices and helping with technical aspects and references the architectures concerning business and investment models and partnership agreements, covering both financing and knowledge distribution. An example is the support provided within the programme WiFi4EU (prior to 5G), where Catalonia has been particularly active. It has a target of 8.900 communities (50% reached already), with supports of vouchers worth 15.000€ each to build up masts and antennas to build up masts and antennas. Henkel concluded that the same success story that has happened with WiF4EU is expected with 5G.

3.3. Perspectives

The debate continued with the participation of three guest speakers that presented the strategy of different regions towards 5G in rural areas while also answering some open questions by the moderator.

3.3.1. Catalonia

Xavier Flores pointed out that prior to explaining the Catalonia 5G strategy that he coordinates, it was important to tell why the government decided to put in place such a strategy in first place. He exposed that 5G brings three main features (much wider bandwidth, much lower latency and a capacity to manage up to 1 million devices per square kilometre) which make it a technology with a clear disruptive character, compared to previous generations of mobile telephony. These three features will have an impact on all social and economic activities, with regards to mobility, as citizens cannot imagine nowadays. This is the reason why the Catalan government decided that 5G should be a priority. Thus, the Catalan government created the Catalan 5G strategy, which was approved in 2019 and was presented at the Mobile World Congress 2019.

The Catalan strategy includes a set of actions around 5 axes: promotion, infrastructure, innovation, ecosystem and talent. The innovation axis includes a very important action for the government, which is the creation of 5G areas throughout Catalonia. Six 5G areas have already been created and by the end of 2021 there will be two more to complete the entire deployment. All areas have a geographical extension between 2.000 and 4.000km^2. The goals of each 5G area are to establish contacts with public entities, business associations, research centres, etc. in order to identify which are the priority business verticals (processed food sector, health, energetic sector, mobility, etc.) where 5G could add value according to its social and economic interests.

Different workshops linked to the verticals are being organized, so that the area ecosystem can find new 5G solutions and services that could solve their specific challenges. Pilots and/or use cases are deployed to validate these challenges. A very important aspect for each 5G area is that a certain specific location gets 5G NSA coverage, together with the support of a service provider, to create the so-called 5G laboratories, where real proof of concepts and solutions are tested and validated. Different types of entities participate in the strategy definition of the 5G areas that represent the whole 5G domain: research groups, the public administration, business sectors representing different verticals and ICT companies, together with citizen representatives.

In the end, the main goal is that the whole area ecosystem starts thinking with a 5G mind-set, in order to better understand and identify how 5G can solve the challenges and needs they have. This strategy allows the territory to be in a better competitive advantage, since 5G pilots and services are tested and validated before 5G operational services are offered. Flores explained that there are sessions and dissemination activities about the impact of 5G technologies during the whole year, to ensure the knowledge of 5G technology reaches the whole territory.

3.3.2. Finland

Marja Matinmikko-Blue, 6G Flagship Research Coordinator and Senior Research Fellow at the University of Oulu, exposed the fact that one of the biggest challenges for 5G deployment in sparsely populated areas is the need of a dense network of 5G cell towers. Based on her experience in rural areas in Brazil, where the mobile network is weak or there is no network at all, and there is a global discussion on the usage of the spectrum, the moderator asked her the following questions: What do you think are the solutions that can be provided for these areas to have proper network connectivity? Could you tell us about your approach focused on local micro-operators? What are the main challenges for these solutions?

Matinmikko-Blue stated that these were huge topics but she would give some answers based on her experience during the last 20 years. She has been deeply involved in the wireless communications domain, working in the academia and research sector, but closely collaborating with the industry and the public sector, including the regulators in Finland, Europe and globally.

According to Matinmikko-Blue, we are in a moment of big change, as the mobile communication ecosystem is transforming rapidly. Until 4G, the market saw the Mobile Network Operators (MNOs) deploying the networks, getting licensed spectrum for nationwide networks from regulators and buying the equipment and the networks from the vendors, while having also a direct relation with the end customer. So, MNOs had a big role. However, and for the past 5 years, 5G has started to become a reality, and all these new generations of wireless technologies, wireless networks and their deployment fully depend on spectrum availability. 5G uses the radio airwaves and the spectrum is fully regulated at different levels: international, European and national. Different regimes exist, so what you can do, and what you cannot do, is strictly regulated.

Lately we have seen 5G spectrum awarding decisions taken by different national regulators. In Europe,

in particular, there are three pioneering bands for 5G: 700 megahertz, 3.5 gigahertz and 26 gigahertz. These bands are very different. From the engineering side, their propagation characteristics differ greatly, while the available capacity in these three bands is also completely different. All in all, the bands are different resources and those who have access to these resources define who can deploy any 5G network. These decisions are being currently made in different countries. Some have already given all three bands, like Finland, while others are in the process of making them available through auctions. Based on her research, Matinmikko-Blue said that these global spectrum decisions for 5G are very different form each other, even inside the EU. The same bands are awarded through different national mechanisms. Auctions are often used, but even the auctions have different purposes. The national governments decide the goals for these market mechanism auctions and the amount of money they want to get from them.

The goal is to maximise the efficiency of spectrum usage and its benefits to society, although it is planned in different ways by different countries. Looking at the rural area and the lower bands, like 700, 800 and 900 megahertz, they provide great coverage and cover big areas. Those who have access to these bands can build very broad networks, with very good coverage. In Finland, for example, there is great 4G coverage operating in those lower bands and MNOs also have shared networks. There are only two networks in the rural and remote areas with good connectivity. But what happens with 5G? Matinmikko-Blue said that through her own research with regulators and industry, they had large discussions about these local operator models. So, they made a big claim four or five years ago, saying that when it comes to 5G, different stakeholders should be allowed to deploy their own 5G networks. It should not be left only in the hands of big mobile network operators in every country. Indeed, there were many objections to this idea.

In order to move in that direction, Matinmikko-Blue's team is developing a national Finnish project to work on that topic, bringing together academia, regulators and industry. They presented these ideas back in 2017 and since then there were many objections. However, the tide gradually changed and now 5G spectrum is also made available locally, although mainstream is still given through auctions. There are local spectrum licenses, especially in the higher bands, although the coverage is very much limited in these bands.

This too is a big change. Every deployment of wireless networks depends on the spectrum available in that specific spot. Concerning these local networks, nowadays there is a huge demand for industrial private networks in factories, harbour areas and various geographical constrained areas. The spectrum availability defines what kind of wireless connectivity can be provided. The same happens in rural and remote areas. Those who have the rights to use the spectrum in those areas, and only those, are those who can deploy the networks. Therefore, the big decision is who gets access to these resources.

In that sense, Matinmikko-Blue said that her research team has focused for a long time already on understanding the possible spectrum sharing models. The shared access model to this precious natural resource is key. So, if rights have been given to some companies, and if they do not use them and they do not build a network in every area, why should they still hold on to that spectrum? This is the problem. When rights are given and the owner of the rights holds on to that with no specific obligations to build a network as an investor, no one else can use that right. This situation is what is currently limiting progress, as no one else can come and build a network. The regulators are aware of it and are starting to take action in some countries.

In the UK, for example, Ofcom is very advanced in making these bands available. If bands are not used, they should be made available to third parties. However, there is still a lot of divergence in this approach and the mainstream is still not to share. That's the really big change Matinmikko-Blue hopes to see in the future. It is part of a big technical, regulation and business triangle, with a strong accent on the business part. Even today, regulators could solve the connectivity problems in rural and remote areas, since there is spectrum available in lower bands. Operators could deploy networks if they were economically feasible. However, this is what is stopping those stakeholders, so other stakeholders cannot enter. It is a real a complex situation.

The situation is different across Europe and different parts of the world, not to mention in Brazil. Matinmikko-Blue said that she has been running a joint EU-Brazil project. Brazil is a huge country and there are many challenges, even related to illegal transmitters, which we do not have in Europe. In the end, there is no unique solution for everyone and 5G is not the only answer either. The whole ICT system is complex. It is complex because you cannot see the airwaves. You cannot even see cables because they go underground. It is a huge and complex network, a system of systems.

At this point, the moderator told Matinmikko-Blue that she was opening a pandora box with these statements. Different countries have different procedures and there is not a unique European vision towards defining a standard way to proceed across the whole continent. As in any complex situation, there is the need to take a holistic view to it. Who is the responsible to establish a unique vision and strategy in Europe? The answer was clear. It is a very complex setup and it is an interplay between the stakeholders, the global regulators with the European Commission in a key role, and the national regulators.

Robert Henkel told Matinmikko-Blue that for that specific purpose there is a new regulation and the new EU code supporting spectrum sharing. He mentioned that the European legal framework is very flexible and very conservative in the sense of using the limited spectrum. The EC tries to push the governments to put some coverage obligations in the auctions, i.e. to forbid to not use the spectrum. Henkel added that there are some good examples, not only in Germany, where coverage obligation has a very strong effect. When a service provider gets a spectrum, it must cover 80% to 90% of the rural areas. This is putting high-pressure on them, of course, and the EC considers it a "good practice".

Henkel also agreed that there is truth on what Matinmikko-Blue described. While national regulators should implement these possibilities, the European code is a framework, a legal framework that national and regional governments are supposed to implement to use its possibilities. Henkel clearly supported the ideas that Matinmikko-Blue expressed, based on sharing the spectrum and putting pressure on those big players who own the spectrum but are not using it. Nevertheless, he also expressed that there is a national and regional responsibility, especially concerning this kind of misuse of spectrum.

3.3.3. Switzerland

Thomas Stemmler, responsible for networks, infrastructure and IT strategy at Swisscom, talked about the private sector in Switzerland. Switzerland being both the most mountainous European country

and the one with the largest deployment of commercial 5G, the first questions were obvious: What is Swisscom's approach to provide 5G to the less populated rural and mountain areas of Switzerland? What is the role of Swisscom in the country's digital strategy?

Stemmler started by saying that the framework conditions in Switzerland have fostered a situation of very good network quality without any public subsidies. The state has not invested a single Euro or Swiss franc neither in the fixed network fibre deployment nor in the mobile deployment. It is all private rivalry and MNOs have a very fierce infrastructure competition to achieve the best network quality possible. For a long time, Swisscom was the only operator offering a good network quality. Now other private competitors have realized that you can only gain substantial market share with a very good network quality, so that investment levels in the networks are high. This is happening not only in urban areas, where they can earn most of the money, but also in the rural areas, where especially for the mobile networks, many customers are moving around. Citizens do not just stay in the cities; they move into the mountains for leisure activities, and they also expect to have very good network coverage there.

According to Stemmler, the regulation should foster investments in terms of access regulation. If you have to share the benefits of your investments with many others through wholesale agreements, it is dampening the investment level, of course. He also said that a liveable regulation regime on network access helps them to monetise their investments. Nevertheless, he stated that there are some specific problems with the regulation in Switzerland, as the country has a very strict electromagnetic field protection regime. This is something not to imitate. It is making very difficult to upgrade to 5G on existing sites or build new sites with 5G technology, since there is a lot of fear in the population about health effects of 5G. Thus, the regulation does not help and Swisscom cannot easily upgrade their sides.

Nevertheless, the level of network coverage is already very high due to the competition pressure. In Switzerland, roughly half of the population is already covered with 5G on the high band, 3.5 gigahertz, which is, in his opinion, the real 5G with gigabit speed, while around 96% of the population is covered with 5G on the other bands, mainly the 2100 and the 700 band. On the other side, the 4G coverage is excellent, since almost the whole population is covered with 4G coverage in 97% of the area.

Switzerland had a very good starting point situation with good mobile networks. Why? Why did Swisscom invest in rural areas as well? The answers are usually related to private investment returns and this also applies to 5G. Swisscom started in the cities. Currently, 50% coverage in Switzerland means all the big cities are covered, let's say the top 20 cities. However, Swisscom also started with 5G coverage in rural areas, railroads and motorways. This is related to tourism and ski resorts, and transportation ways to these resorts. Besides, Swisscom is still owned by the state, as 50.1% is owned by the Swiss Federation, so it must also follow strategic targets given by the state.

According to Stemmler, Swisscom plays a big role in the digital story of Switzerland and contributes to avoid the digital divide between rural and urban areas, basically because politics has certain word into the action plans. There is no direct state intervention, but there is a strategic government goal to avoid digital divide. In terms of regulation in rural areas, it is important to understand that around 7%-10% of the Swiss population lives there. But rural is not always equal to mountains. From the point of view of the infrastructure, coverage is actually more difficult in the hilly terrains between cities than in the mountains. This is due to line-of-sight and wave propagation. In the mountains, it is easy to create good coverage because you can build a rather high antenna, whereas in the hilly terrains of rural areas and in the flatter areas it is much more difficult because of forests and trees.

Swisscom has a universal service obligation for broadband, although that is mainly for fixed broadband. They must provide 10 megabit per second to all end points, which has been achieved already. Only around 4.000 or 5.000 customers have used that regulated product for the universal obligation. However, nowadays there is a political debate in Switzerland, as the 10 megabits per second will probably be lifted to 80 megabits per second. Swisscom would then be obliged to deliver 80 megabits to everywhere where a household or a business is located, independently where it is in the Alps at 4.000 meters or somewhere in a cave.

Swisscom will have 90% coverage with 80 megabit per second on fixed networks already by the end of this year. These are hybrid fibre networks composed of fibre to the home, fibre to the building networks and fibre to the street, where typically they get up to 300 to 500 megabits per second. There is a residual 7% of households where the goal is still not reached.

To close the gap, Swisscom uses three elements. First, there is a technology called bonding that combines 5G and 4G network with the existing copper line network, so that the modem gets two streams from fixed and mobile networks. At least 80 megabits per second are delivered that way, normally much more. If this is not possible due to missing coverage of the wireless network, Swisscom uses satellite connectivity as second option. Thus, the satellite connectivity is bought under a wholesale agreement and then it is offered to the users in distant mountain places where there might even not be power connection. The third one is pure fixed wireless. When copper lines are very long and old, Swisscom replaces them with fixed wireless, also based on 5G. Thus, this is the Swisscom's toolbox to create coverage in the mountain areas.

To sum up, Stemmler did a last technical remark. One may wonder why Swisscom is doing this bonding. When you provide good service quality, you need capacity, and in wireless the capacity is shared in a cell, so that your quality depends on how many users are in the cell. If you have only 10 or 20 megabits per second on your fixed network, for example, you should not throw that away. You can use a combination of both, for instance, you can use TV over the fixed net and then to achieve the higher speeds you can use the wireless part. From Swisscom's point of view, it is reasonable to reuse what already exists in terms of fixed net capacity.

3.4. Debate with the speakers

The moderator started the debate with some questions for Xavier Flores about the CoEbreLab 5G rural project. You are deploying 150km far from Barcelona, what do you pretend to achieve? Which are the opportunities that you foresee for local residents and which are the obstacles that you see? Flores answered that the CoEbreLab is the laboratory of the Terres de l'Ebre 5G area, which was the first 5G area presented on July 2020. It is a 5G area with four verticals identified: rural territory, agriculture, energy sector and health.

Besides the fact that the Catalan government has already been working for years on how 5G rural

deployments should look like to ensure its feasibility and fast deployment, there is still the big dependence of spectrum ownership. Nowadays it depends on five operators, those who bought the spectrum to the state and acquired commitments on the percentage of population to be reached. Like previous generations of mobile telephony, the deployment of mobile operators begins in large cities, continues in the most populated areas, and rural areas always come last.

Due to the disruptive nature of 5G, which has already been mentioned at the beginning of the session, the Catalan government's priority is to reach the whole territory as soon as possible and analyse the main aspects that delay, or even impede, the arrival of mobile telephony services to rural areas. The main reason is, of course, the investment that MNOs must make to reach rural areas. Thus, from the government side, they are interested in reducing the hurdles by ensuring that the investment that telecom operators need in a rural location is much lower. In this sense, the government is working together with the i2CAT Foundation (a European 5G Reference Research Centre located in Barcelona) to analyse how this shared model of 5G deployment in rural areas could be introduced, based on a model that should be good, inexpensive and very efficient.

From the Catalan government side, they are interested in reducing the hurdles by ensuring that the investment that telecom operators need in a rural location is much lower. In this sense, the government is working together with the i2CAT Foundation (a European 5G Reference Research Centre located in Barcelona) to analyse how this shared model of 5G deployment in rural areas could be introduced, based on a model that should be good, inexpensive and very efficient .

The government also needed a rural place to work on this 5G rural deployment model and they chose the Terres de l'Ebre 5G area (CoEbreLab), in southern Catalonia. This 5G rural deployment model will be executed jointly with different mobile operators. The CoEbre 5G lab will be the reference laboratory to analyse and implement shared 5G deployment models in rural areas. It will also be the reference point for high-capacity fixed and wireless connectivity testing in order to bring broadband connectivity via radio to those towers where, due to its orographic difficulty, it is not feasible to do it with fibre. In addition, and thanks to the fact that the CoEbreLab will have 5G coverage, the most important drone company in this area will set its headquarters there to test 5G technologies. The TIC Salut Foundation, from the Ministry of Health, will also create its 5G homecare laboratory there. Flores thanked the involvement of the local leader of the Terres de l'Ebre 5G area and the Ribera d'Ebre Council, who have been involved since day one in the creation of the CoEbre 5G lab.

The main obstacle, especially related to the 5G shared deployment model, has been to reach a close collaboration between the MNOs. The shared model under study must have their technical approval to ensure they can easily connect to and deliver a service. In that sense, the government has already established an agreement to work with them under this model.

Another important aspect, of course, is the budget needed for the 5G rural deployment, and here is where Next Generation EU funds will play a key role. The government is currently analysing how these funds will be distributed to deploy 5G in rural areas. The bet is that regional governments, such as the Catalan government, directly manage these funds, because of their knowledge of the territory and all the alliances they already have with the main entities representing these territories. In fact, there is the plan to take part on the bid for the contract to build the towers and the associated fibre, so the government can invest on the hardware that needs to be installed in those towers to offer 5G service. The Spanish government aims at allocating 2 billion euros from Next Generation EU funds to aid the deployment of 5G and reach 75% of the population by 2025.

To sum up, Flores said that the 5G CoEbreLab is the example and the reference model of what the government wants to happen in all 5G areas around Catalonia: to create 5G laboratories in the territory, where different organisations can test new services and products based on 5G technology before the 5G technology arrives to the territory.

The moderator asked then Marja Matinmikko-Blue about the work she did in Brazil. Could it be implemented in Europe? What PPP model should be applied? Considering all we know so far about 6G, will we have a similar debate when 6G arrives? Starting with the last question, Matinmikko-Blue pointed out that 6G research has already started. The 6G Flagship, fostered by the University of Oulu, was the world's first 6G research programme. It started three years ago already. Globally, similar initiatives have started, and we are all looking at the future, 10 years ahead. 6G is aiming at starting the deployments in 2030, the same target year for the achievement of the United Nations Sustainable Development Goals. A common agreement within the 6G domain, including researchers and industry, is that sustainability is the key driver for the development of the next generation of systems. Technology, but also deployment models and business models, should be economically and environmentally sustainable.

To meet the 17 SDGs, there are 169 individual targets addressing all sectors of society. The sustainability requirements will be very stringent and they cannot be met without widespread adoption of ICT technologies, especially wireless technologies. Equality becomes a big thing then. If you only have solutions available for major cities and big cities, it is not enough. You have to ensure that those solutions are available in remote and rural areas too. Matinmikko-Blue said that she sees a big movement towards realizing what sustainability really means in the development of future wireless, more than in previous generations of mobile communications networks.

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This global challenge calls for new deployment models, new public-private partnership models, new business models on who deploys the networks, who operates them and who uses them. Even technical solutions are different. What is the backhaul? Or the fronthaul solution? It will be a mix of resources brought together by different sets of stakeholders in different places. Whether it is in Brazil, Finland, Spain or anywhere else. Technologies, stakeholders and business models will recombine. Thus, we all need to provide those examples, those best practices, to guide the development.

Robert Henkel said that the EC tries to distribute different models of financing and cooperation between private and public institutions through their BCO (Broadband Competence Office) network workshops. All regional and national BCOs of European countries are invited to participate. The EC's new guide is going to be published by September-October 2021. In the old guide, many models were already presented, but updated cooperation models concerning the deployment of 5G will now be included. This new guide will provide models for the financing of broadband deployment, with all the experiences and the best practices known by the EC. He remarked that this is very important, as it is not only money what the community needs, but the knowledge to use the money, to implement the money. We need to share knowledge and education. Spreading knowledge to the local and regional administrations, who have the ultimate responsibility to build up networks in rural areas, is key. This is a very important task that BCOs and researchers should do.

The moderator asked then Thomas Stemmler about the key performance indicators (KPI) that help him to assure that there is a good 5G development in rural areas. He also asked him about the challenges

he has faced when deploying 5G rural networks and the learnings he has gained. Stemmler responded that the main KPIs are coverage and Support Vector Regression (SVR), and having combined fixed and mobile operators as an incumbent. He said that Swisscom is trying to cover their active fixed net customers also with 5G to allow this bonding technology. So, they just follow the density of the distribution of those customers and this is guiding them where to deploy 5G first in rural areas. That is straightforward. He added that they also look at competitors. In fact, a very active private company has achieved a 5G coverage similar to Swisscom.

Swisscom's plan is to have nationwide 5G coverage on the 3.5 band by 2025 .

Swisscom's plan is to have nationwide 5G coverage on the 3.5 band by 2025. All the population and all the households and businesses would be covered. The biggest challenges during the rollout period are the fears people have, especially in rural areas. The population has fears about adverse health effects of 5G. In fact, he said there was a huge misinformation campaign on social media, starting in 2018/19, at the time when the spectrum was awarded. At Swisscom they thought: "It's again the same thing as with 4G or 3G and we underestimated again its power!" The 5G term has a negative connotation among Swiss people as surveys clearly show. People just do not want 5G in their community. They do not want antennas being upgraded and they do not want to have new sites either. Swisscom has initiated information campaigns, while supporting neutral entities. Until now, people do not believe that 5G is within the limits and harmless. Stemmler said he did not know if it is that worse in other countries, but he knows for sure that in Germany and Austria the situation is similar. He encouraged local authorities and governments to communicate very positively and proactively about 5G and to offer scientific facts and information. The Swiss government is hesitant about it and it is the biggest challenge they have, according to him.

In terms of infrastructure, fibre connectivity to a 5G antenna is necessary. Only in very few exceptional cases, you could use a microwave link instead, but in general, you need fibre. Therefore, the infrastructure must be there. Swisscom has financed it itself, and 99% of the sites are fibre connected. If it cannot be done based on private investments, you must create somewhere a fund to do it, otherwise you cannot run 5G reasonably.

Robert Henkel confirmed that the problem is not very different in other European countries. The EC has problems with hysteric and irrational ideas in Switzerland, Austria, Germany, Belgium and France. He said that it is very interesting to see which countries are in the list. The EC has been fighting against disinformation at European level for one year. The EC has distributed data via their website and there are many other websites with worldwide studies available. There is no reason for fear. A good example is Belgium, where government and industry are working together to inform people and to come over this disinformation handicap. Stemmler agreed with Henkel and advised to be proactive and start as soon as possible with these campaigns. He added that there were problems in the UK as well, where they even had some sabotage actions against antennas.

The debate reached its end and the moderator thanked all speakers for their contribution and insights on behalf of DIPLOCAT.

Annex. Participants

> ROBERT HENKEL

SENIOR POLICY OFFICER AT DG CONNECT, EUROPEAN COMMISSION

Robert Henkel was initially a researcher in the area of astrophysics between 1984 and 1990. Between 1990 and1995 he was a Programme and Scientific Officer of the German Federal Ministry of Research and Technology and inter alia responsible for space, energy and environment research policy. Between 1995 and 2000 he directly assisted the Deputy Director General of DG Research of the European Commission, the Director General of the Joint Research Centre and the President of the European Parliament. After that he was an adviser for research policy in the Federation of German Industries BDI between 2000 and 2002. Further he was as head of sector responsible for the planning and coordination of communication activities in the Information and Communication Unit of DG CONNECT of the European Commission between 2002 and 2006. Between 2007 and 2012 he was seconded from DG CONNECT to the German Government to develop the German Broadband Strategy and to implement it. Since 2012 he has been responsible for the Broadband Policy in DG CONNECT.

> XAVIER FLORES

5G TECHNOLOGY PROJECT MANAGER AT THE CENTER FOR TELECOMMUNICATION AND INFORMATION TECHNOLOGY (CTTI) OF THE GOVERNMENT OF CATALONIA

Xavier Flores is a Telecommunications and Electronics Engineer, with more than 20 years of experience in innovation projects based on wireless communications. For more than 10 years he has been working for the Catalan government on various projects related to mobile communications services and since 2019 he is the coordinator of the government's 5G Strategy for Catalonia.

> LAURA FORESTER

SECRETARY GENERAL OF DIPLOCAT

Laura Foraster is the Secretary General of DIPLOCAT. She holds a degree in Economics and Business Administration at the Universitat Pompeu Fabra (UPF), a degree in Humanities at the Universitat Oberta de Catalunya (UOC) and an MA in European Studies at the KU Leuven. She also has specific education in Public Diplomacy and in Election Observation Missions. Prior to her current position as Secretary General of DIPLOCAT, she was Executive Director of the entity until its temporary closure in April 2018. Foraster has been Chief of Cabinet of the Minister for Innovation, Universities and Enterprise and of the Minister for Trade, Tourism and Consumer Affairs of the Government of Catalonia during two consecutive legislative terms, where she was responsible for the management of the Minister's

Cabinet, the political assistance to the Minister and for European Union and international issues. Her previous professional experience includes Parliamentary Assistant to Catalan Members of the European Parliament in Brussels and Strasbourg, following the Foreign Affairs, Human Rights, Common Foreign and Security Policy Committee and the Constitutional Affairs Committee. In Brussels, she also worked for the European Commission, the Committee of the Regions and the Catalan Government Delegation in the EU.

> MARJA MATINMIKKO-BLUE

6G FLAGSHIP RESEARCH COORDINATOR AND SENIOR RESEARCH FELLOW AT THE CWC, UNIVERSITY OF OULU

Marja Matinmikko-Blue is 6G Flagship Research Coordinator and Senior Research Fellow at CWC, University of Oulu, Finland, where she holds an Adjunct Professor position in spectrum management. She conducts multi-disciplinary research on technical, business and regulatory aspects of mobile communication systems in close collaboration with industry, academia and regulators. She holds a Dr.Sc. degree in telecommunications engineering and a Ph.D. degree in management sciences received from the University of Oulu in 2012 and 2018. She has coordinated several national research project consortia that have successfully demonstrated the world's first licensed shared access (LSA) spectrum sharing trials. She has published 150+ scientific publications and prepared 150+ contributions to regulatory bodies in national, European and international levels. She coordinated the preparation of twelve 6G White Papers in 6G Flagship and led the development of the White Paper on 6G Drivers and the UN SDGs. Her research has focused on the development of new local 5G operator concept to allow different stakeholders to deploy own networks in geographically confined premises or rural areas. She published the first a paper on local 5G micro operators in 2017 and a follow up paper on regulations for 5G introducing local spectrum licensing model in 2018. Since then, research on local 5G networks has increased and new local operator models are gradually becoming possible in many countries through local spectrum licenses.

> THOMAS STEMMLER

HEAD OF STRATEGY IT, NETWORK & INFRASTRUCTURE AT SWISSCOM

Thomas Stemmler has worked his whole professional carrier in the telecommunications business with a focus on mobile networks. He holds a MSc in physics and worked at CERN in Geneva in the 1990s. In Germany and Switzerland, he participated in the boom times of mobile communication with the establishment of 2G, 3G and 4G networks for various mobile operators. Joining Swisscom, the leading Swiss telco, in 2016 he developed the 5G strategy and obtained recently the responsibility for the strategy for networks, infrastructure and IT. He is looking for solutions to address the telco challenges: delivering ever-growing data volumes at ever-faster speeds, better services with highest reliability at continuously decreasing cost; exploring new business models and offerings with innovative technology to enable new growth; and transforming traditional organizations into lean, agile and diverse BizDevOps teams.

> SERGI FIGUEROLA

MODERATOR. CTIO OF THE I2CAT FOUNDATION AND CTO OF 5G BARCELONA

Sergi Figuerola is the Chief Technology and Innovation Officer at i2CAT since May 2013 and founder member, and CTO, of the 5GBarcelona initiative. He has been the coordinator for the definition of the New Space's Catalan Strategy. He is MSc and PhD in Telecommunication Engineering by the Theory and Signal Communications department of the UPC, PDG from IESE Business School and Masters in Project Management from La Salle. At i2CAT he supervises different areas: Innovation Business Development, EC R&I Policy and Strategy, Knowledge and Technology Marketing and the different R&D areas (5G/6G, IA, Cybersecurity, Space Communications and Media Networks). For the last 18 years he has acted as Project Coordinator, (i.e. 5GCity 5GPPP H2020 among others), Technical Manager and work package leader in several EC research projects. He has participated in more than 50 peer reviewed scientific papers and acted as TPC from different conferences (OFC, TNC), as ICT projects reviewer, chair of working groups, speaker, and moderator in several conferences. His main research interests are related to 5G/6G, new architectures, Future Internet, New Space and Open Innovation.

The member entities of DIPLOCAT

Public institutions and municipal entities

- Government of Catalonia
- Barcelona City Council
- Tarragona City Council
- Girona City Council
- Lleida City Council
- Vielha e Mijaran City Council
- Barcelona Provincial Council
- Tarragona Provincial Council
- Girona Provincial Council
- Lleida Provincial Council
- Conselh Generau d'Aran
- Catalan Association of Municipalities and Counties
- Federation of Municipalities of Catalonia

Entities of the business sector

- General Council of the Official Chambers of Commerce, Industry and Navigation of Catalonia
- Entrepreneurs association Foment del Treball Nacional
- Association of Micro-, Small and Medium-Sized Enterprises of Catalonia (PIMEC)
- Confederation of Cooperatives of Catalonia
- Multi-Sector Business Association (AMEC)
- Private Foundation of Entrepreneurs (FemCAT)

Entities of the social, trade union and sports sector

- The Group of Entities of the Voluntary Sector of Catalonia
- Trade union Unió General de Treballadors de Catalunya (UGT)
- Trade union Comissions Obreres de Catalunya (CCOO)
- Football Club Barcelona

Universities, business schools and academic institutions

- University of Barcelona (UB)
- Autonomous University of Barcelona (UAB)
- Technical University of Catalonia (UPC)
- Pompeu Fabra University (UPF)
- University of Lleida (UdL)
- University of Girona (UdG)
- Rovira i Virgili University (URV)
- Ramon Llull University (URL)
- Open University of Catalonia (UOC)
- University of Vic - Central University of Catalonia (UVic-UCC)
- International University of Catalonia (UIC)
- Abat Oliba CEU University (UAO CEU)
- Barcelona Institute of International Studies (IBEI)
- EADA Business School
- Barcelona Graduate School of Economics (Barcelona GSE)