BACKGROUND PAPER

Infrastructure sharing and co-deployment in Europe: good practices based on collaborative regulation

Version 1.2

ACKNOWLEDGMENTS

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The paper was prepared as the background contribution to the ITU Regional Regulatory Forum for Europe on Regulation Supporting Digital Transformation, held on 30 November and 1 December 2020. Version 1.1 of this document is an advanced draft. Following the event, it will incorporate comments received from participants of the ITU Regional Regulatory Forum for Europe and will be submitted for further inputs and comments to the authorities of the three case studies incorporated in this report: Germany, Portugal and Poland.

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1. Introduction

Context and objective

The use of technological means to facilitate communication has become an integral part of modern-day societies around the globe. Every day, new digital applications, processes and products are being spawned and shape the ways we communicate, work and spend our leisure time.

Current events, like the SARS-CoV-2 Pandemic, have highlighted the importance of digital solutions even further. These events are proof that telecommunications cannot be thought separately from the rest of human activity. In this regard, the pandemic has accelerated a process that was already ongoing: the understanding of telecommunication networks as an unavoidable means to an end that facilitates human interactions.

In parallel to the expansion of digital services, generated content and the general use of the Internet, the number of operators of telecommunication infrastructure has increased. The traditional model of a vertically integrated company (see model 6 identified in Figure 1) serving all layers of the fixed and mobile telecommunications value chain is still existing, but several new players entered the market since these were liberalised. This leads to a new scenario characterised by a variety of actors such as for example utility providers renting out their ducts, tower companies managing passive and active infrastructure sharing, municipalities providing dark-fibre networks, state-owned broadband providers or public-private partnerships. The changing telecommunications ecosystem is challenging the traditional business model and fostered the deployment of new networks.

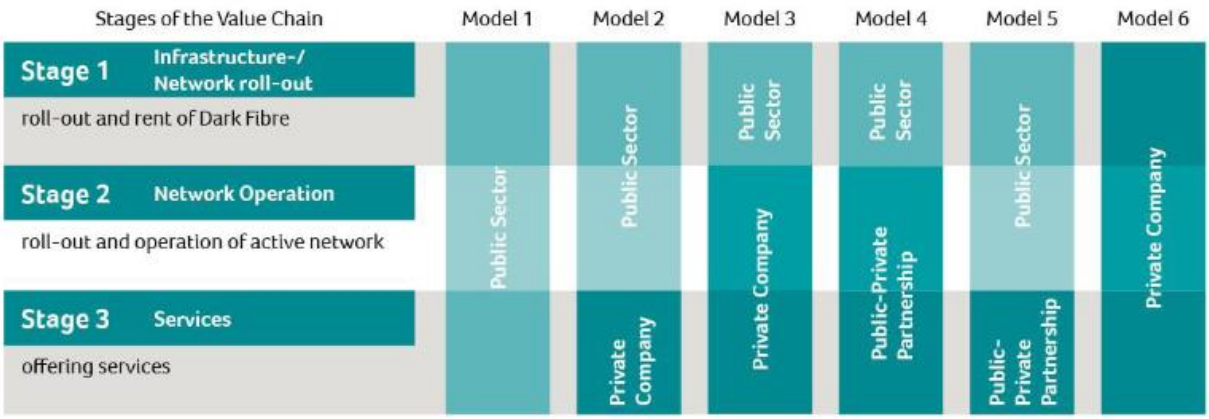


Figure 1 Operational Models for Broadband Deployment (Feldmann, Kohdabaksh, Valiucko, Beck, & Weber)

But how does the increasing variety of actors affect the regulatory approaches that currently govern the networks and their uses? This background paper prepared for the ITU Regional Regulatory Forum for Europe on Regulation Supporting the Digital Transformation will further examine this question.

The main aspect of this paper will be to understand how a regulatory environment can be built to encourage private investment in networks by fostering collaboration among key players. In order to do so, it will analyse some regulatory approaches across Europe that can foster and incentivise the collaborative roll-out of very high capacity networks and level the playing field for all actors across different sectors.

The European landscape

Europe as a region can serve as comprehensive field where to carry out research on the matters outlined above. The economic, social, demographic, topographic and even language diversity is relatively high in comparison to its size, while the majority of its constituents enjoy the same regulatory framework of the EU's single market, interpreted by the specific circumstances of its Member States.

As with other characteristics stated above, there is also diversity in network technologies across Europe. Several European economies (especially in Western Europe) suffer from the 'curse' of legacy networks, which often remain competitive due to ongoing upgrades, while other economies that do not have competitive copper-based networks directly invest in FTTB/FTTH. So much so, that according to the European Union, xDSL is still the main source of connectivity with a market share of some 57% (European Commission, 2020), with 65% of such connections being VDSL-based. This leads to a situation whereby it is increasingly hard to further unlock private capital for new networks since significant investments for FTTB/H deployment are needed but market prospects are unclear.

As VDSL is sufficient for most applications available nowadays, market demand does not provide yet clear incentives to switch technologies, thereby increasing the risk of market-based endeavours. Furthermore, underserved areas within Europe are usually remote rural areas with low population density and a challenging topography where the potential for new customers is relatively low while the costs for deployment of the fixed networks are remarkably higher than in urban contexts.

The main cost of establishing new fixed networks is determined by the costs of civil works. According to the British government and depending on the locale of the project, more than 80% of the project costs usually will be found in civil (excavation) works (Department for Culture, Media & Sport, 2015). Especially in countries with low acceptance of cost-saving methods of deployment (e.g. aerial, in some cases also trenching), the costs of subterranean deployment drive total costs substantially higher. Accordingly, BCG estimates show that an investment of 660 billion Euros (360 Billion for fixed networks; 200 Billion for Mobile networks, mainly 5G; 100 Billion for Data Centres) is needed to achieve the European gigabit connectivity targets by 2025 (The Boston Consulting Group, 2016). To fill the gap and unlock the necessary resources, policies and regulations play a crucial role.

The main question in this context is, how can public entities reduce the costs of deployment to an extent that private investment keeps pace in the Member States, especially in underserved areas? The European landscape sees several collaborative approaches seeking to foster the development of digital infrastructure while decrease the costs of private investors at the same time. Some of these include:

1. Public co-investment;
2. Co-deployment of new infrastructures;
3. Technical regulations to allow for economies of scale and reduction of transactional costs
4. Shared use of existing infrastructures;
5. Harmonising existing rules and regulations for conducting business.

All of these approaches are capable of lowering the costs of deployment significantly by involving collaboration between telecommunication companies, other network operators (especially utility providers) as well as local and national government authorities.

This paper will provide an overview of the practical implementation of most of these approaches. Following this introduction, the European legislative and regulatory environment will be summarised. Afterwards, three EU Member States (Germany, Portugal, Poland) in which collaborative approaches have been implemented will serve as case studies to discuss the matter more in detail.

Section 4 will then focus on how a comprehensive collaborative regulatory approach can be implemented and why this is important. The section will also include a short overview of the ITU's Fifth Generation Collaborative Regulation (G5) framework. Finally, a short conclusion will sum up the results.

This background paper is based on desk research and direct contact with ministries and regulators of the countries taken into consideration. As such, it has some limitations. Given that the scope of this paper is to provide an overview of the regulatory framework on co-deployment and infrastructure sharing in Europe, it is not supposed to benchmark the European Member States.

The case studies have not been selected on criteria where the 'best' outcome has been chosen and therefore should not be considered to be ´best practices´. Rather, they indicate three different ways in which regulation has fostered stakeholders working together.

2. Review of EU policies and regulatory frameworks established to support infrastructure sharing and co-deployment

The European Union has shown determination to establish a competitive and well developed ´digital (single) market´ where companies from all its Member States can engage in fair competition for its roughly 450 million citizens.

There are several documents describing the pathway to a fully integrated digital single market. The ´Digital Agenda for Europe´ (2010) first outlined connectivity targets for all Member states. In 2018, the ´Connectivity for a European Gigabit Society´ updated these targets and clarified that the future of EU connectivity will require gigabit bandwidths – though reiterating technology neutrality. In February 2020, the Commission published its new EU's digital strategy (Shaping Europe's Digital Future). It outlines how digital connectivity can be used to increase business opportunities, foster democratic societies and help fight climate change.

Box 1: The Evolution of EU Connectivity targets

Digital Agenda for Europe (2010)

- 100 % household coverage with basic broadband
- 100 % household coverage with 30 Mbit/s or more (downstream) by 2020
- 50 % of households subscribing to 100 Mbit/s or more (downstream) by 2020

Connectivity for a European Gigabit Society (2018)

- 100 % household coverage with 100 Mbit/s by 2025 with possibility to upgrade to much higher capabilities (meaning gigabit connectivity)
- All socio-economic drivers (e.g. schools, universities, research centres, hospitals, public administration, enterprises relying on digital technologies) should have gigabit connectivity by 2025
- Uninterrupted 5G coverage in all urban areas and all major terrestrial transport paths by 2025

In all of these strategic documents, the European Union acknowledges the fact that significant investments will be needed to roll-out new infrastructure and build that digital single market. Therefore, many of the EU's legislative and regulatory initiatives define the rules under which costs of investment can be reduced or shared without distorting the competitive landscape of the European telecommunications networks market.

The following sections shall describe the most relevant aspects of the European regulatory and legal framework, its policy initiatives and further developments that foster the development of the digital infrastructure.

2.1 State Aid Guidelines for Broadband Deployment

The European Union has certain restrictions in place to avoid market distortion and ensure fair competition within the 'European single market'. As a general rule, the market for telecommunication networks is free and competitive, and infrastructure-based competition is considered the best approach to ensure high quality of services at competitive prices. This means that in principle public investment is prohibited to avoid distorting the ´level playing field´ whereby networks compete for consumers under fair conditions.

Therefore, the use of public funds is considered an exceptional measure which must comply with a set of rules to avoid the potential dominance of state-backed corporations.

In general, if a Member State intends to initiate a public funding program to (co-)finance broadband projects, it shall notify the European Union in advance about its plans and undergo an evaluation of compatibility with the common rules on state aid.

There are very few exemptions from this procedure. The GBER (General Block Exemption Regulation), or de-minimis, for example, allows state aid initiatives with a very limited scope without prior notification process. Even though they still have to be monitored and reported, these exemptions give Member States certain flexibility to establish testbeds, pilot projects and support projects which are so limited in scope that a distortion of the single market is not to be expected.

Box 2: Distinction between White, Grey and Black areas

White Areas: Those areas, where there are no connections available that offer 30 Mbit/s or more (downstream). Also, there are no plans by any provider to establish these access networks within a 3-year period. This is an indication of market failure and state aid can be legally applied.

Grey areas: Those areas, where one infrastructure-based operator offers 30 Mbit/s or more (downstream), but there are no plans for a second infrastructure-based operator to establish a network within a 3-year period. Thus, there is no infrastructure-based competition and further analysis is needed to legally apply state aid.

Black areas: Those areas, where two or more infrastructure-based operators offer access networks with 30 Mbit/s or more (downstream), currently or within a 3-year period. Within these areas, infrastructure-based competition exists. State aid can only be applied under strict rules

Source: (European Commission, 2013)

The concrete deployment of telecommunications networks, however, in most cases exceeds the thresholds of the GBER and/or de-minimis. Accordingly, the European Union has established the ´EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks 2013/C 25/01´ (European Commission, 2013)´[1] which endow Member States with indications to support proposals for national funding schemes.

As generally applicable within the realm of state aid in the European Union, state aid is considered a distortion of the market that should be avoided as long as the market is performing . Thus, it is important to identify a market failure before state aid may be used to improve the level of connectivity as there are clear rules which state that aid to achieve a technological step change must be subject to identification of market failure. However, this approach is rather uncommon, usually relatively small in scope and disputed due to the risk of ´crowding out´ of private investment. Most of the national

[1] The contents of this section are based on the´ Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks´ (European Commission, 2013) and will not be quoted separately

funding approaches therefore try to reach the so-called white areas where there are no NGA networks and where market failure clearly occurs rather than focusing on upgrading networks.

To evaluate market failure, the state aid guidelines are based on the then-current connectivity targets of the European Union (most important: 100 % coverage with 30 Mbit/s for all households by 2020). This means that a current or near-future availability of 30 Mbit/s or more indicate that there is no market failure in a given area. Usually, a market consultation takes place to assess the landscape and discern objections from the private sector. If there are any currently existing or planned infrastructures with the indicated capabilities, there is no reason to make use of state aid to deploy networks of higher capacity. This provision is supposed to protect private investment from public competition.

However, the practical implementation of this provision has proven to be somewhat controversial. Since there are usually no retribution mechanisms and a time span of three years is difficult to assess for network operators, often an announcement of private investment can deter public investments and then risk actually not taking place at all. As such, this presents as an unsatisfying situation for both private operators as well as municipalities and their citizens.

Another highly controversial issue lies in the possible effect of ´crowding-out´ private investment through public investment. This discussion is exacerbated by ongoing efforts of Member States to use state aid in the so-called ´grey areas´, where at least one infrastructure-based operator is already able to provide NGA services. Several Member States (e.g. Germany on a federal level, as well as the Bavarian program (Stehmann, 2019)) are pursuing this approach to have instruments at hand to increase pressure on the market and thus speed up the deployment of new networks.

Member States have made extensive use of the broadband guidelines, acknowledging the fact that 100% coverage with very high capacity networks is unlikely to happen via a market-based approach only. There are several examples of national or state-level funding schemes that even exceed the amount of a billion Euro. Member States with this kind of investment (partly in combination with EU-funds) are Germany, France and Poland, among others.

In addition to national state aid schemes, the European Union also started to contribute with its own financial means directly to projects that are suitable to expand the communication networks across Europe. For achieving this, the EU has partly established its own capacities or contracted external partners as an intermediary (see box 3).

The extensive application of the current state aid guidelines by the Member States made it clear that there is a need for public intervention and that the overall principles of the guidelines are suitable for practical implementation. However, the system is often considered to be not flexible enough to cover the specifics of any given situation.

Box 3: Funding Mechanisms on EU Level

CEF2Digital (non-paper status)

- 3 Billion EUR for 2021-2027.
- 75% of its budget to support 5G rollout.
- 25% of its budget for cross-border infrastructures.
- 30% to 100% co-financing depending on the project type (100% only for small scale technical assistance).

Wifi4EU

- Voucher Scheme based on calls.
- Up to 15.000 € per municipality for Wifi Equipment.
- Municipality pays for maintenance and operation.

Connecting Europe Broadband Fund (CEBF)

- Managed by a third party.
- Market based approach, unlocking 1.7 Bn. €.
- Sponsored by three major promotional banks (KfW, Caisse des Dépôts, Caissa depositi e prestiti).

Source: Author's research, various sources

As a result, a public consultation is taking place to evaluate the current state aid guidelines and discuss possible changes. The public consultation will end on 5 January 2021. (European Commission, 2020)

2.2 Directive on Broadband Cost Reduction (DBCR)

Directive 2014/61/CE on measures to reduce the cost of deploying high-speed electronic communications networks (European Parliament, 2014)[2] represents a major milestone in creating a favourable environment for cross-sector collaboration. Most member states have fully transposed the DBCR (WIK consult; VVA consulting) by now. Although some Member States already had legislative and regulatory practices in place which resembled parts of DBCR, the common provisions often amended these to harmonise the regulatory framework across the EU.

DBCR's main idea is to establish a marketplace for digital infrastructure, where the public sector, utility and telecommunications companies exchange data about existing and future infrastructure to gain or grant access to each other's facilities. It is designed to reduce the costs of deployment of new networks, decrease friction between different network operators and incentivise the establishment of new very high capacity networks.

[2] The contents of this section are based on the primary source and will not be quoted separately

The DBCR consists of four main pillars and some additional procedural provisions that will be summarised in the following sections.

1. Pilar 1: Access to & transparency of existing physical infrastructure

The first pillar of the DBCR addresses access to existing physical infrastructures for co-use by different actors to deploy their own networks. These physical infrastructures are, for example, ducts, poles, and manholes—although cables or dark fibre are being excluded from this definition. The first pillar gives the right to entities from different sectors (mainly Telecommunications companies, utility providers) to access existing infrastructure as well as the obligation to meet reasonable requests by others to access their respective physical infrastructures on a commercial basis under fair terms and conditions. Although there are still reasons to decline the request (e.g. based on security, capacity and other sound reasons), this first pillar of the DBCR is defining the very idea of the directive itself which states that there should be an open market for physical infrastructure to decrease costs, avoid network duplications and drive the deployment of new networks.

As a second provision of the first pillar, the DBCR states that network operators and public entities must provide minimum information regarding their infrastructures (location and route; type and current use of existing infrastructure) and that they need to have a designated contact point to access the information. The information must be given at a specific project request as long as there are no sound reasons (e.g. security, national defense, public safety, etc.) not to comply with the demand. Holders of infrastructures must consent to on-site surveys, as long as the access seeker bears the costs of these surveys.

2. Pillar 2: Coordination & transparency of planned civil works

The second pillar defines the right of network operators to coordinate their civil works with electronic communications providers. Additionally, in case civil works are partially or fully financed by public means (state aid), network operators have the right to demand coordination of these works as long as it is a reasonable request, timely made and additional costs are covered by the network provider.

Furthermore, the provision of the second pillar defines terms and conditions to make the coordination of civil works feasible. This includes that planned civil works must be made public six months in advance so that interested parties have enough time to evaluate if a coordination of works will be advantageous. If these plans are met by a request to coordinate, the network operator has to disclose minimum information about the planned works. This request may be declined in case there is already public information available or a Single Information Point exists where the data can be accessed. Member States have the right to define ‘minimum information’ regarding their concerns of security, national defence, public health and safety as well as confidentiality and business secrets.

3. Pillar 3: Permit granting

The third pillar defines that all relevant information on procedures for granting permits for civil works must be available via a Single Information Point. This pillar also defines that any permit related to network deployment should be made in general within four months unless there is specific national legislation defining other timeframes. Furthermore, Member States should have electronic means available to apply for permits, if possible.

4. Pilar 4: In-building infrastructure

The fourth pillar defines that all new building shall be equipped with physical infrastructures, such as mini-ducts, capable of hosting high-speed networks as well as with an access point, which can be easily accessed by the providers of public communications networks. In case a building needs major renovations, it should likewise be equipped. Member States have the right to exempt some buildings from these provisions, in case it may not be appropriate due to their use cases, e.g. monuments or military buildings.

As a second part of the fourth pillar, the DBCR states that communication network providers have the right to use the access point at their own costs and through it also any existing physical infrastructure within the building. Owners of the access points and other physical infrastructure are obliged to meet reasonable requests for access of in-building infrastructures under fair and non-discriminatory terms and conditions, including price. Again, Member States have the right to grant exemptions from these obligations when fair and non-discriminatory access to in-building infrastructure is already ensured (e.g. via open access models).

Box 4: Broadband-ready Labels across Europe

Labeling inhouse-infrastructure is a measure to make sure the inhouse wiring will not be the bottleneck of a high capacity access network. These labels usually address the technical standards for inhouse-wiring as well as the qualities the materials used during construction should boast. Depending on the practical procedures, building plans or site surveys will be used to determine if the building is awarded the label at all, and if, at what grade.

Labeling in-house wiring increases transparency for tenants as well as potential buyers and might have a positive effect on rents and prices.

The cost reduction directive gives Member States the freedom to develop their own national label, if desired.

Broadband-ready labels exist around the globe (e.g. Republic of Korea). In Europe, they are not well established yet so far, but several initiatives are being implemented. Examples include Germany (‘Gütesiegel Breitband’), France (‘Zone fibrée’) or Belgium (‘Fibre ready’).

Source: Author’s research, various sources

Besides the four pillars, the DBCR also describes how an exchange of information and handling of disputes should be organised. Member States have to appoint one or more Single Information Points where information on physical infrastructure and on permits can be made available. Member States shall also appoint one or more independent bodies to resolve disputes between network operators. They have the right to either appoint already existing bodies or create new bodies to fulfil these tasks. Usually, the national regulatory authority is the government body that gets appointed (e.g. COMREG in Ireland).

Overall, the DBCR has led to a significant change within the European landscape of telecommunications as it harmonised the rules for sharing infrastructure across the EU. Especially data collection and exchange as well as infrastructure and investment mapping have gained strength due to the provisions laid out in the DBCR.

2.3 European Electronic Communications Code (EECC)

The European Electronic Communications Code (EECC) (European Parliament, 2018)[3] was a major step for updating and harmonising the European communications law. It encompasses rules and regulations for telecommunication networks, telecommunication services and even applications and content.

Article 124 of the EECC states, that: "The Member States shall adopt and publish, by 21 December 2020, the laws, regulations and administrative provisions necessary to comply with this Directive." All aspects of the EECC should thus be transposed to the national laws soon, however, several Member States have not fully implemented the EECC yet.

The EECC's objective is to encourage further investment in high-performance networks (including fixed, mobile, and wireless networks) for all EU citizens and businesses throughout the European Union. Other objectives are the promotion of infrastructure-based competition, further development of the digital single market and consumer protection.

Due to the extensive approach of the EECC, several sectors of national legislation are affected by the transposition to national laws as, depending on national settings, provisions might affect the following: legislation regarding the provision and deployment of telecommunications networks and services, legislation for equality of persons with disabilities, legislation regarding content regulation, legislation regarding competition, legislation regarding investments and financing, legislation ensuring consumers protection and transparency of market and providers.

The EECC states that broadband Internet access for all consumers, regardless of location or income, must be affordable and adequately available, with the intention to prevent social exclusion. On the one hand, this includes providing rural areas with broadband Internet access and, on the other hand, providing equal access to telecommunications services for people with disabilities. However, there is no clear pathway for how this is going to be achieved by Member States and it is therefore up to each country to consider appropriate measures.

Most relevant in this context is the promotion of wholesale-only businesses. The EECC encourages incumbent operators' separation in a wholesale and a retail arm, promising to roll back access regulation under the condition that the "netco" will not engage in retail market activities. This means less regulatory remedies on SMP wholesale-only operators and additional possibilities to impose symmetric access regulation under certain conditions. These provisions should make it easier for new entrants to invest in new infrastructure, including in remote areas while ensuring effective market regulation. In this context, the EECC's recognition of over-the-top media services (OTT) as telecommunication services further levels the playing field.

With the EECC Directive, the EU has been paving the way for an update of its regulatory approach, including the strengthening of the Body of European Regulators for Electronic Communications (BEREC) and the Agency to assist BEREC (BEREC Office). Although both BEREC and the BEREC Office have existed long before, the EECC defined a newly harmonised set of responsibilities and duties, expanding their sphere of influence.

As one example of this expansion of responsibility, Article 22 is worth mentioning. This article obliges NRAs or other competent authorities to conduct geographical surveys on broadband coverage. This mapping obligation will then be used to gain a picture on the current status of network coverage, but also to conduct a three-years forecast, which will be essential to examine if market failure exist and state aid might be allocated, in line with the EU State aid guidelines for broadband deployment.

[3] The contents of this section are based on the EECC (European Parliament, 2018) and will not be quoted separately

Another example is Article 76 which addresses the regulatory treatment of new very high-capacity network (VHCN) elements, with particular focus to SMP operators, and requires BEREC to publish guidelines to foster NRA's consistent application of the conditions to be met when assessing co-investment offers.

Finally, consumer protection is strengthened within the EECC by enabling maximum benefits in terms of choice, price and quality based on effective competition, by maintaining the security of networks and services, by ensuring consumer protection through specific and standardised rules, and by considering the needs of disadvantaged social groups.

It is noteworthy that the EECC is an important approach to linking different regulatory aspects and thereby harmonise the regulatory environment. The Directive steers the Member States towards collaborative approaches within and among the national regulatory bodies through BEREC.

3. General review of the implementation of EU provisions with discussion of good practices across Europe

The following section of this background paper will showcase some initiatives and tools the Member States have taken to operationalize the framework described in section two of this paper. The countries to be discussed will be Germany, Portugal and Poland which have implemented different regulations and tools to incentivise collaboration.

3.1 Country case study Germany: *Infrastrukturatlas*, an infrastructure mapping system to facilitate joint deployment and shared use

The German *Infrastrukturatlas* was developed by the German national regulatory authority, the Federal Network Agency for Gas, Electricity, Telecommunications, Post and Railway (Bundesnetzagentur, or BNetzA). It is the central information tool for broadband development in the Federal Republic of Germany. It was released in late 2012 and contains the data of almost 3,000 network operators (infrastructure holders such as TelCos, utility providers or public sector entities). Access to this data might be granted to private companies, but also to the federal government, states and municipalities (Bundesnetzagentur, 2020).[4]

The *Infrastrukturatlas* is a web GIS system which contains the information portals ISA Planning for deploying new infrastructure and ISA Sharing for accessing existing infrastructure. As usual with Geoinformation systems, there are different layers of data on a thematic digital topographic map and data is displayed as point or line geometries. From 2020 onwards construction works were also introduced as polygones.

Data suppliers for the *Infrastrukturatlas* are:

1. Local authorities, including the federal government, states, counties, cities, and municipalities.
2. Owner or operator of public utility or telecommunications networks;
3. Contractors, insofar as they support broadband rollout planning on behalf of other authorised parties;

[4] The information regarding the *Infrastrukturatlas* have been obtained by the Bundesnetzagentur's official website and will not be quoted separately

4. Other parties involved in the expansion of public supply networks insofar as the project is intended to create facilities that can be used for telecommunications purposes;
5. The Federal Ministry of Transport and Digital Infrastructure.

In order to supply information, an application must be submitted to the Federal Central Information Office (CIS, a department within the Bundesnetzagentur). Various infrastructures can then be specified in the data supply process, such as fibre optics, sewers, masts, streetlights (relevant for 5G), buildings, main distribution frames, cable distributors or others. The data is georeferenced and vectorised and transmitted together with the data delivery sheet to the BNetzA.

To facilitate and quicken infrastructure access, the owner or operator of public supply networks may also publish standard offers for shared use of their infrastructure via the Federal Network Agency as the central information point (fulfilling the demands of the cost reduction directive). These offers should contain, among others, the fair and reasonable terms and conditions for shared use.

Access to the data is granted upon request and is generally limited to a specific project area where the operator wishes to deploy new infrastructures. In case the user is a public authority, the project area usually corresponds with the territory of the respective authority. To avoid misuse of data, the party authorised to access the *Infrastrukturatlas* must specify a single person (including his or her address and e-mail address) who will receive the login data. The right to consult the *Infrastrukturatlas* is granted for a limited period of time. The time limit will be determined on a project-specific basis, although the Federal Network Agency regularly considers a period of three months to be sufficient.

The following illustration (Figure 2) shows the use of the *Infrastrukturatlas*. It depicts street cabinets, access points, traffic lights, construction work and empty ducts on a relatively small scale, whereas the subsequent illustration (Figure 3) shows a geographical area on a larger scale for comparison.

Figure 2 Example of the 'Infrastrukturatlas on small scale' (Bundesnetzagentur, 2020)

Figure 3 Example 'Infrastrukturatlas' on large scale (Bundesnetzagentur, 2020)

The following graph illustrates the demand side, the number of users and projects accessing the data included in the *Infrastrukturatlas* (Figure 4) from May 2018 to 15.09.2020. The steady increase in users (in blue) and the number of broadband expansion projects (yellow) is clearly visible. The double increase since March 2020 is mainly due to the 'Kommunenaktion 2020' and the introduction of the online application for local authorities. With the 'Kommunenaktion 2020,' the Federal Network Agency is focusing primarily on acquiring data from municipalities, which are obliged by law to comply and supply data.

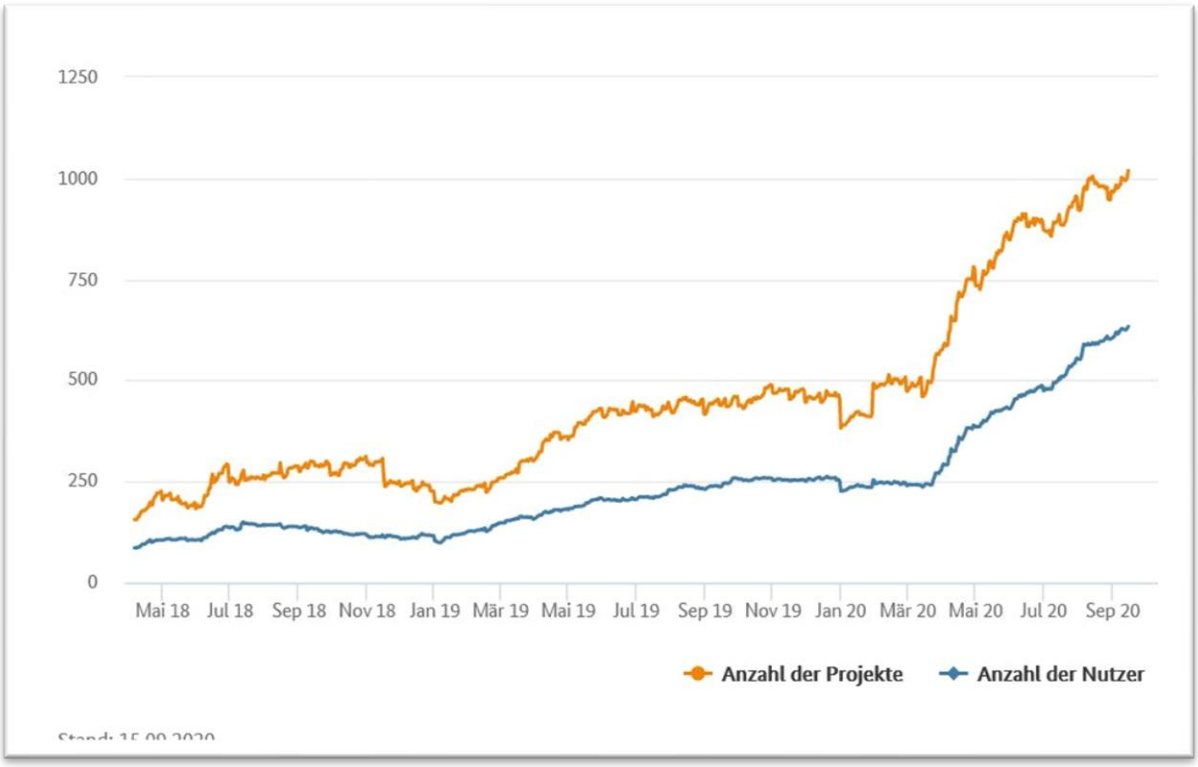


Figure 4 Number of projects and users over time (Bundesnetzagentur, 2020)

Consequently, by the end of February 2020, the number of data suppliers for the *Infrastrukturatlas* had risen to almost 1,500, and since then, more than 1,000 new data suppliers have been added.

Figure 5 illustrates in contrast the supply side. Here, the overall amount of data suppliers is shown based on the ´reason´ for supplying data. ´Vertrag´ means a free contractual cooperation, ´Bescheid´ is a public notice to supply data and "geförderte Infrastrukturen´ means data deliveries as a result of state aid backed infrastructure expansion developments.

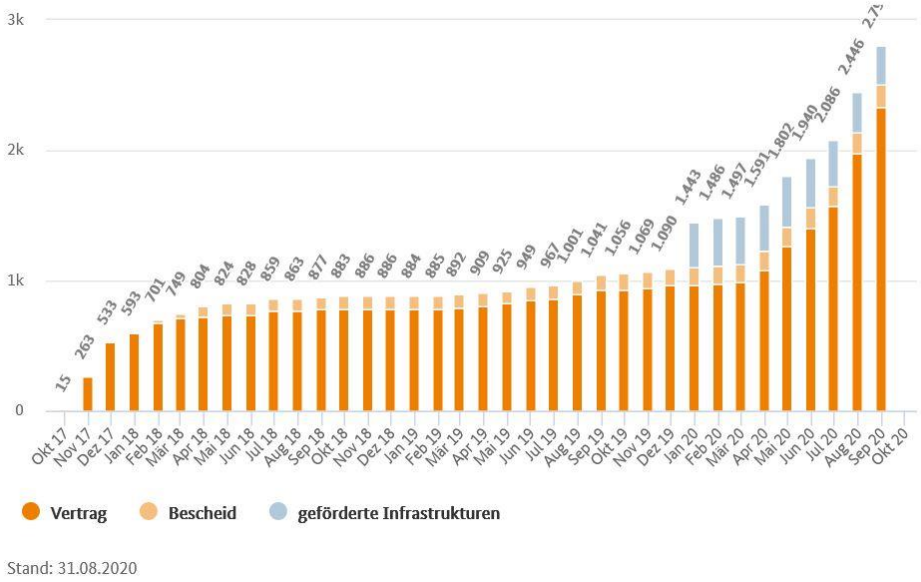


Figure 5 Number of data suppliers based on type of cooperation (Bundesnetzagentur, 2020)

According to the German Bundestag in 2016, annual costs of 135,000 € are expected for maintenance and operation of the system (Deutscher Bundestag , 2016). The Bundestag estimated that the (providers') costs for delivering data would amount to some 1 mio. € p.a., while it expects the costs on the public side to add up to roughly 265,000 €. However, estimations were that the *Infrastrukturatlas* would substitute some processes within public administrations more efficiently, saving 630,000 € annually. Overall, the German government expects that the combined costs of the system are comparable to 0.001% of its potential savings. However, there is no data available on whether that estimate became reality.

Besides the intended main use of the *Infrastrukturatlas*, there are also other synergetic uses. For example, the *Infrastrukturatlas* is a crucial tool for the federal state aid scheme. In this context, it is being used to verify the plausibility of the planned projects, verify market failure and to avoid duplication of networks.

Furthermore, it is made sure that the network plans of the funded projects are compatible to the system and exchanged with the BNetzA. This is an important aspect about the open access obligations that are part of the state aid guidelines. It is ensured that the documentation about publicly financed infrastructure is available and that there are sufficient spare capacities so that any access seeker can actually take advantage of infrastructure sharing.

Overall, the *Infrastrukturatlas* is by now a well-established tool that incentivizes collaboration between infrastructure operators. The growing number of uses as well as the number of data suppliers show its acceptance and the positive impacts of such mapping system on the telecommunications market.

3.2 Country case study Portugal: In-house regulation as a part to incentivize co-investment and standardize parts of the access networks

This section will outline the strategic and regulatory framework for broadband deployment in Portugal. It will first outline the general approach and then focus on how this approach reflects on in-house cabling. It will highlight the practical advantages of this approach and display the increased fibre coverage this regulation has led to.

Portugal's regulatory framework is built around the principles of collaboration, co-investment, non-discrimination, and technological neutrality. These principles were first formalised in the Telecommunications Act of 2000, and amended in 2004 (Diário da República, 2004) and 2017 (Diário da República, 2017).

Within the strategy, Portugal committed already in 2004 to opening ducts for next-generation networks (based on SMP), to deregulating networks and to establishing and maintaining a centralised information system. Portugal thus pioneered similar ideas as the EU's current framework, well before the cost reduction directive came into effect.

Referring specifically to in-house infrastructure, Decree-Law 123/2009, published in May of 2009, amended the provisions of the telecommunications act regarding inhouse-wiring to a broader approach. The installation of fibre optics in the scope of in-house-wiring standards (ITED) has been made compulsory as it was for the copper and coaxial cables, thereby introducing a technology-neutral approach.

Article 30 of the decree-law determines that operators and providers of telecommunications services have the right to access telecommunications infrastructure in buildings on equal conditions. Telco companies are encouraged to collaborate where in-house access does not yet exist. Moreover, there is also a legal provision requiring the establishment of proper inhouse infrastructures and the obligation to use them in case they already exist. The 2009 decree-law also included provisions on the right of way and right of access, stipulating that the access to infrastructures must be ensured on equal, transparent and non-discriminatory conditions, subject to cost-based remuneration. This means a full-scale symmetric regulation on in-house wiring.

To achieve the symmetric access on a practical level, the national regulatory authority ANACOM (Autoridade Nacional de Comunicações) defined a construction standard regarding in-house-wiring (ITED Standard, Infraestruturas de Telecomunicações em Edifícios; Telecommunications Infrastructures in Buildings (ANACOM, 2014), a manual for symmetric and reciprocal infrastructural access.

ANACOM specified and constantly updated the technical standards on the design and set up of these infrastructures. CENELEC standards (EN) 50173 and 50174 are defined as the minimum requirement for all buildings both new and old and regardless of the terrain in which they are located (ANACOM, 2014) (ANACOM, 2018).

Some of the technical specifications are as follows. In the 2020 ITED fourth edition standard, three types of distribution points are most relevant. In this case, a point of distribution is defined as the place where a network of cables meets a different network of cables.

- CAM (*Caixa de Acesso Multioperador*) or CVM (Câmara de Visita Multioperador): Multi-operator Chamber or building entry point, the place where all incoming networks are

combined. Legally defined as part of the inhouse infrastructure, even if it may be located outside the actual building.

- ATE (*Armário de Telecomunicações de Edifício*): Buildings telecommunication cabinet, the place where the transition between operator networks and building networks takes place. It is mandatory to install in all buildings, except for single-family houses. It is the installation location of the general distributors (RG).
- ATI (*Armário de Telecomunicações Individual*): Individual communication's cabinet, the place where the transition between collective networks and individual networks takes place, or between operator networks and individual (home) networks. This is the installation location of the customer distributors (RC)

The general Idea is that there should be a technology neutral "common" infrastructure for all operators. Due to this infrastructure, all operators are able to serve the individual housing unit/appartement.

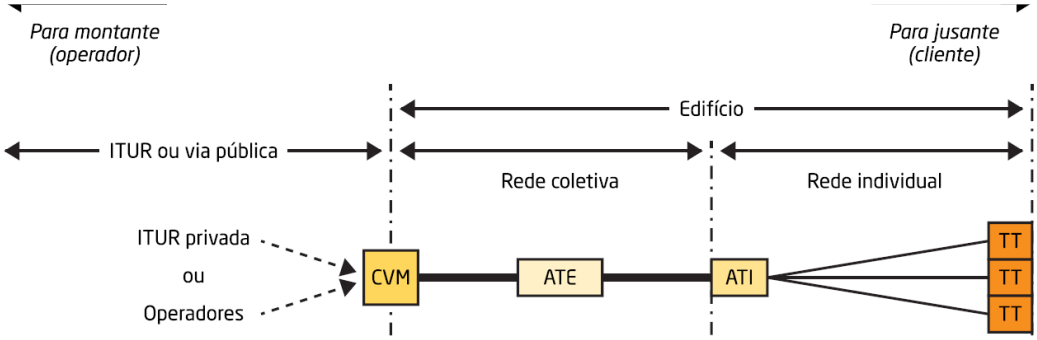
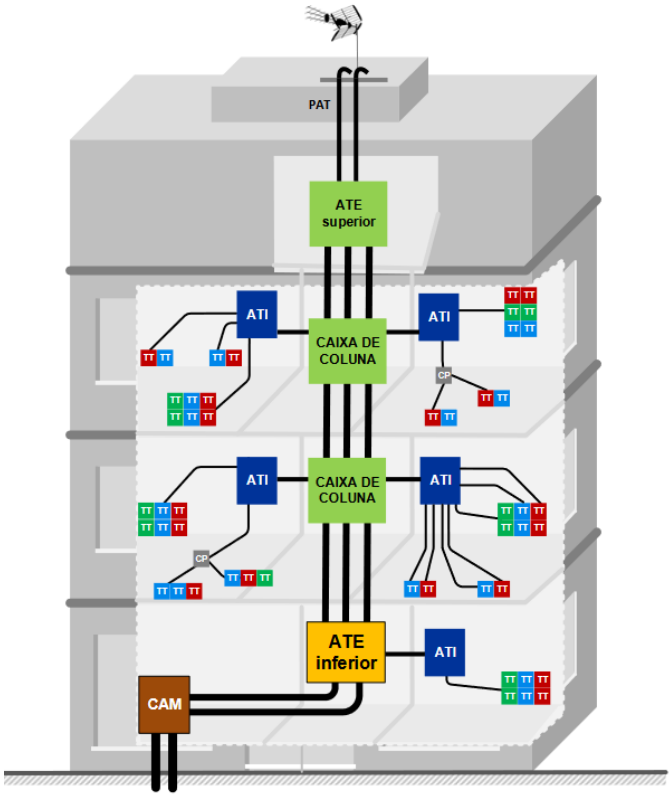


Figure 6 ITED Network Architecture with multiple Customers (ANACOM, 2020)

Based on these technical instructions, in-house cabling can take one of two forms, depending on whether the building in question a single or multi-dwelling unit.



Legend:

ATI: Individual telecommunications cabinet
ATE: building telecommunications cabinet
CAM/CVM: multi-operator chamber, which is part of the wired network, even if it is installed outside the building
TT: Telecommunications outlet
RFO: space reserved for fibre
PAT: transition to roof area
CP: passage box
Blue=copper, red=coaxial cable, green=optical fibre

Figure 7 ITED Infrastructure in a multi-dwelling unit (ANACOM, 2020)

This illustration shows how a multi-dwelling unit should be equipped with in-house cabling to allow for a technology-neutral deployment and freedom of choice regarding the technologies. This illustration displays the general idea of this standardised approach, especially with regard to the shared infrastructure in the middle of the building.

Regarding ownership of the ATE and ATI, Article 14 of the 2004 telecommunications act first determined that both constitute part of the building's infrastructure, even in cases if the CVM/CAM is located outside the building (which is common). This makes the building entry point not owned by any of the operators, but by the building owner/proprietor, irrespective of the original constructor.

Regarding in-house cabling in a single-dwelling unit, the technical specifications are of course a bit less complex and detailed in the following illustration.

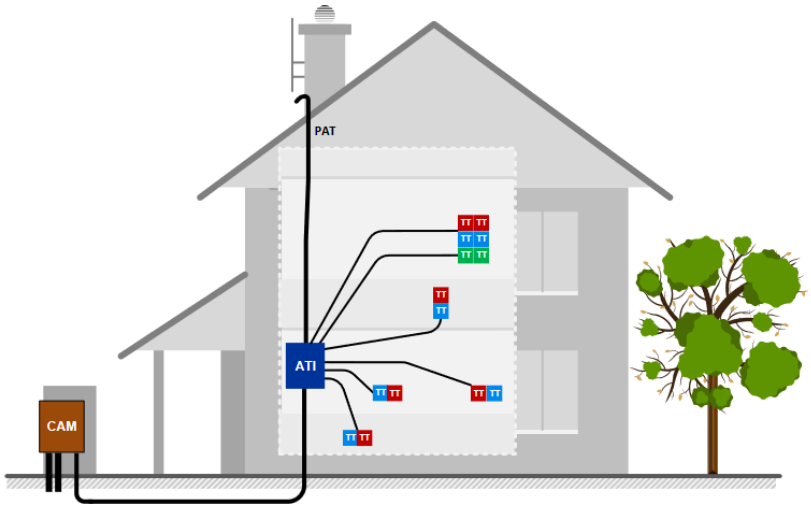


Figure 8 ITED Infrastructure in a single-dwelling unit (ANACOM, 2020)

In terms of pricing, the same 2004 telecommunications act stipulated in article 75 that while access to infrastructures must be ensured, it is subject to cost-oriented remuneration. Redistributable costs are defined at fair and reasonable prices, the basis of which must be demonstrated by bills and cost estimations. If proof of expenses cannot be provided, industry-standard costs will be defined by ANACOM. In the absence of agreement on access to existing in-house infrastructure, any party may request a conflict resolution procedure from ANACOM.

As a general rule for reimbursement: the first operator to reach a building (already built) has to install at least two fibres per home and associated infrastructure to be shared by other operators. The second operator reaching the building will pay 50% of the costs incurred in the installation of the shared infrastructure. The third operator will pay 33% and so on.

The symmetric access regulation and detailed technical standards for Portuguese buildings had a significant impact on the Portuguese market. On the one hand, due to transparent pricing and standardised in-house equipment, investment was encouraged, and uncertainty reduced. The risk posed by the investor's lack of knowledge on whether the inhouse wiring will be capable of transmitting the desired QoS parameters, was taken out of the equation. Furthermore, it encouraged providers to expand their in-house-cooperation to outside plant deployment as well. This resulted in reciprocal access deals (e.g. between Vodafone and Portugal Telecom) as well as substantial co-investment, making the country one of the leading countries in Europe regarding its FTTB/FTTH connectivity.

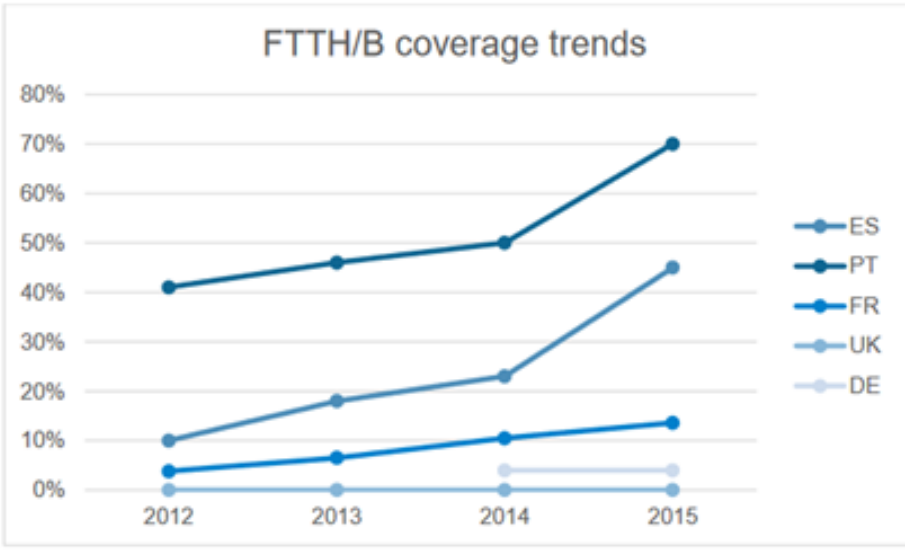


Figure 9 FTTB/H coverage in some European Countries (WIK consult, 2017)

As shown in Figure 9, we have seen a significant increase of FTTB/H coverage in Portugal, especially in comparison to its European peers. Research suggests that this increase can at least partly be explained by the regulatory framework. As Spain follows a similar regulatory approach, it is striking that these two countries have both registered a similar spike in fibre deployment.

From an economic perspective, as the main costs of network deployment occur due to the civil engineering needed, extensive rules on duct access and access to inhouse cabling decrease capital expenditures and thus lower entrance barriers for new entrants. As a result, new entrants were able to enter the market and the pressure from new FTTB/FTTH operators was the main reason for the incumbents to switch to FTTB deployment instead of upgrading xDSL infrastructures (WIK consult, 2017).

Overall, the case of Portugal's regulatory approach to in-house cabling shows that regulation can play a crucial part in incentivising collaboration between different actors.

3.3 Country case study Poland: Codes of practices and standardised contracts for cross-sectoral cooperation

According to the Polish National Broadband Plan, the government's objective is to provide access to advanced fixed and mobile electronic communications services to all citizens. This is to be achieved in cooperation with the private sector deploying most of the country's telecommunications infrastructure. Regarding the development of new next-generation networks in Poland, there has been also substantial progress through the use of public investment (see section 2.1 on state aid). From the funds of the operational program *Digital Poland* almost 2 million households will gain access to fast and very fast Internet. Investments on a similar level are also to expected on a commercial basis for the coming few years.

The polish telecommunication act 'Megaustawa' (hereafter Mega Act) (Rzeczypospolitej Polskiej, 2016) has been established in 2010. It has been amended and revised in 2019 for transposing Directive 2014/61/EU of the European Parliament and the Council of Europe into the Polish legislative system. The recent changes in the law are designed to make it easier for companies to invest in telecommunication networks, exchange data, share infrastructures and foster the cross-sectoral infrastructure market. The amendment of the Mega Act has thereby removed several obstacles to telecommunications investments and reduced uncertainty within the market.

However, since legislative barriers are not the only factor hindering further network deployment, the Polish government made an attempt to support investors and other telecommunications market participants interpreting the recent legislative regulations correctly. With this in mind, codes of practice have been created that describe how cross sectoral collaboration should be conducted.

For example, two of these *codes of practice* cover the implementation and maintenance of telecommunications infrastructure along public roads as well as the use of pier foundations of energy lines for collocating telecommunications equipment (Ministerstwo Cyfryzacji, 2020).

The respective technical specifications for deployment were already defined by the provisions of the law of 21 March 1985 on public roads and the law of 7 May 2010 on support for the development of telecommunications services and networks. However, with the recent *codes of practice*, the Polish government tried to specify these rules and avoid eventual misinterpretation due to the transposition of the cost reduction directive.

The *codes of practice* achieve clarity by explicitly stating rights and duties of the participating partners. They describe the liabilities of both partners as well as the legal boundaries both parties have to abide by. The documents are written for practical use, meaning they are very specific and comprehensively describe and explain single use cases in non-legal terms , thereby eliminating space for interpretation and clarifying responsibilities.

To put that into practice in the case of collaboration between electricity providers and telecommunications companies: for the use of mast foundations for digital infrastructures, the *codes of practice* explain and harmonise the main processes, starting from the application for access, through the installation of telecommunications infrastructure on the substructure, up to the operational phase.

The documents are very detailed and offer support for a variety of situations. For example, it is highlighted that electricity providers may require investors to take protective actions in the event that during the works poles or power lines are damaged, including damage resulting in interruptions in the provision of services. In case of use of public roads for network deployment, the *codes of practice* show a similar level of detail and clarification.

The *codes of practice* have not only been developed as a guideline to resolve the identified inconsistencies between the law and its application. The Polish government also expects that these documents will prove to be a useful handbook in the event of any disputes emerging from cross-sector collaboration. At the same time, it will help to remove barriers to investment, increase the stability and predictability of the investment process and reduce investment costs.

The modification of the Mega Act also introduced innovative competencies for local governments. One of them is the possibility of signing a new type of investment agreement where the investor agrees in advance to make the investment in the local municipality. In return, the municipality will reduce the investor's local (way of rights) fees. This serves as an additional tool for local municipalities to be and remain attractive for their investment area, giving all residents equal access to high-speed Internet access.

In order to familiarize local governments and potential investors with the assumptions behind the legal structure of the investment agreement, the Ministry of Digital Affairs in cooperation with the Instytut Techniki Budowlanej (ItB) have prepared a template agreement together with a guide for the practical application of the individual provisions. The content of the provided template is universal and can be used for preparing investment agreements of various types—from telecommunication networks up to energy infrastructure.

The developed draft contract contains only the proposed wording of the individual contract terms. As mentioned above, in a given case the content of the contract can be freely modified (e.g. in the course of negotiations conducted by the parties) as long as the final content of the contract contains all the elements required by law, the so-called Essentialia Negotii, which in the case of an investment agreement are:

- The type of investment, indicating the purpose of its conclusion with a focus on meeting the collective needs of the community;
- Type, place, and detailed conditions of investment implementation;
- The rates of charges for the occupation of a road lane in relation to technical infrastructure equipment on the road lane in connection with the implementation of the investment;

Further standardised documents (appendix of the contract) are used to support the actual contract. These standardised documents and project management tools include:

- Conceptual design template (including a plan of deployment, description of technologies to be used etc.;
- A timetable of the implementation:
    - Phase of investment implementation;
    - Date of completion of the investment;
- Standardised table showing progress and responsibilities;
- Protocol on partial completion and end of the project:
    - e.g. start and end of acceptance activities;
    - e.g. name of the local government unit that is a party to the contract:
    - e.g. information on discovered irregularities;
- Standardised application form.

Overall, the Polish approach to foster cooperation at the local level might be useful to resolve practical issues regarding cooperation between the public and the private sector. Often, projects are being delayed because of asymmetric information. Smaller municipalities in particular do not have the capacities to draft mutually desirable contracts with telecommunications providers due to a lack of special knowledge or experience, while it is the core business of the telecommunications provider.

As a result, tendering and contracting might be delayed and situations often get even more complex if state aid is being applied. Therefore, to standardize a deployment project through codes of practice defining the roles of each participant within cross-sector cooperation as well as standardised contracts and project management tools might be a decisive help to decrease costs and time.

The *codes of practice* as well as the standardised contract are too new to have data regarding their respective success. However, the need for removing potential obstacles within cross-sector cooperation is evident and taking steps in this regards may result very beneficial. For example, the

German federal funding scheme recently made standardised contracts obligatory withing its gap funding approach.

As a result of these efforts, we can expect smoother cross-sector collaboration, increased coverage with high-end telecommunications networks, better access to e-government, e-health, e-work or other services and solutions for citizens, which will have an impact on the development of local municipalities, the economy and even demographics.

4. Benchmarks for regulatory excellence and market performance

As the pace of digital transformation accelerates, formulating an effective regulatory approach becomes a defining moment. A new regulatory paradigm has emerged that seeks to fast forward digital transformation for all – and that paradigm is embodied in collaborative regulation. Such collaboration must engage a broad and diverse range of stakeholders in informed, evidence-based rulemaking and decision-making, with both social and economic impact in mind – and with priority granted to the latter. Collaborative regulation applies readily to multiple areas of regulatory work; infrastructure sharing, and co-deployment are no exception and can substantially benefit from the introduction and effective use of collaborative governance and data-driven regulatory instruments.

This section provides a brief introduction to the high-level concept of collaborative regulation and an insight into the new ITU Benchmark for Fifth generation collaborative regulation (G5 Benchmark). It is important to include this section to show how in general and apart from the singular approaches in section 3 a modernised regulatory framework can be achieved.

As part of G5 Benchmark, infrastructure mapping has been identified as one of the practical tools to help markets for digital services grow and adapt to economic and technological conjuncture and better balance supply, demand and state intervention.

Collaborative regulation – key to unlocking digital transformation

ITU forged the concept of 'collaborative regulation' in 2016 and have tested it annually at every Global Symposium for Regulators (GSR) since. While the concept continues to evolve, it can best be cast in 2020 as a framework to discuss the evolution of regulatory pattern and policy while charting the way ahead for industry and regulators as one constituency, towards digital transformation.

Box 5: Collaborative regulation: a forward-looking concept

Collaborative regulation or 5th generation regulation (G5) is a broad notion that ITU has defined based on the concept of generations of ICT regulation. It marks a fundamental shift in the way regulation is executed, its holistic policy ground and the stakeholders that it brings together – from policymakers, single-sector and cross-sector regulators to market players of any size. It also shifts regulatory focus on behaviours and impact on markets and development.

Collaborative regulation puts a new emphasis on consumer benefits and protection, and leverages the resources of government institutions and industry to deliver them, through organic consultation, collaboration and conciliation. Collaborative regulation is driven by leadership, incentive and evidence rather than by command and control schemes. The concept also refers to the set of new tools used by regulators to tackle the issues related to digital transformation and the data economy.

Source: (ITU, 2020)

Why do we need collaborative regulation?

All roads now point to more collaboration, better channels and more bandwidth. But while the case for collaboration is irrefutable, progress has been stalled by power battles, lack of resources and misconceptions. Good progress towards inclusive, collaborative regulation is needed for the good of all users of digital services, now and into the future – a need borne out by four fundamentals:

- **Digital transformation is a game changer – especially in "the new normal" amid the current global pandemic**

ICTs have become the foundation for every economic sector and a sine qua non of business performance, national growth and more recently - resilience. Regulators need to ensure that the regulation achieves its objectives in the most effective and efficient manner, in particular network resilience and enhancing both the capacity and coverage of networks without imposing disproportionate, redundant or overlapping burden on the market.

- **The new digital world needs a new take on regulation**

ICTs can dramatically transform education, health care, environmental management, agriculture, trade and entrepreneurship, the provision of government services – and so much more. For this to happen, enabling frameworks of policy and regulation, and the right networks and services need to be put in place.

- **Holistic and harmonised approach can deliver greater impact**

Silo-style ICT sector regulation isn't viable in the digital world. Collaborative regulation will mirror the interplay between digital infrastructure, services and content across industries and national borders. It will also harmonize rules and ensure consistent implementation of policy and regulatory frameworks that have evolved independently in many sectors over the years.

- **Development and inclusion have become a primary focus of regulation**

Collaborative regulation is people-centred regulation – it looks at sustainability and long-term gains as opposed to industry profit maximization and exclusive economic growth. Collaborative regulation champions are also engaged in connecting marginalised individuals, persons with disabilities, low-

income communities, communities challenged by educational impoverishment, and remote or isolated populations which may also lack basic infrastructure such as electricity – so we need to be much more innovative and collaborative in our approach to policymaking.

The Benchmark of Fifth Generation Collaborative Regulation (G5 Benchmark) – fast-track to collaborative regulation

Through complementary ITU regulatory metrics, the now established ICT Regulatory Tracker and the new Benchmark of Fifth Generation Collaborative Regulation (G5 Benchmark (ITU, 2019))[5], the ITU has identified the broad tracks for regulatory reform and has pinpointed how countries can accelerate progress towards the next regulatory generation.

The G5 Benchmark is built around an extensive and varied set of indicators. These indicators are clustered into three tracks: collaborative governance, policy design principles and G5 toolbox. The cross-sector regulatory frameworks captured through the various indicators are pivotal in creating a digital marketplace that is inclusive, sustainable and pro-development and a cornerstone of digital transformation.

The Benchmark occupies high ground, and affords perspectives on the regulatory road already travelled as well as on the pathways into the future. It:

• Reflects how digital transformation is shifting regulatory perspective and patterns and the need for new tools;

• Reveals regulatory gaps, and helps with building custom roadmaps for navigating the digital transformation;

• Facilitates high-value debate on the future of markets and regulation, based on unbiased, non-judgmental evidence.

[5] Note that the term 'G5' used in relation to the Benchmark should not be confused with '5G' which refers to wireless technology.

Box 6: Connectivity mapping as a tool for evidence-based decision-making

Substantial research and evidence suggest that best-practice regulation does matter and both the design and the effective enforcement of regulatory frameworks are essential for digital markets to thrive. The digital transformation brings about challenges to regulators and grounding regulatory decisions in robust, multifaceted and thoughtfully interpreted evidence can prove instrumental in generating positive market dynamics in the short and long term….

We [the regulators participating in the 2019 Global Symposium for Regulators] recommend [the] main clusters of benchmarks for regulators:

- Connectivity mapping: Tracking the deployment of the various kinds of digital infrastructure can inform the regulatory process and allow regulators to identify market gaps and market stakeholders – to turn them into opportunities for investment and growth.

… In order to leverage on these evidence-based instruments, the volume and quality of data accessible to regulators need to be increased, and their sources diversified.

These instruments can also enable market players to reflect on their performance and impact on the economy and development, and engage in self-regulation.

Source: GSR-19 Best Practice Guidelines to "Fast forward digital connectivity for all" (ITU, 2019)

New refined framework for the G5 benchmark

The G5 Benchmark was first conceptualised in 2019 to set out new goals for regulatory excellence. The pilot version for 84 countries and economies was presented at the Heads of Regulators' Round Table at GSR-19 and benefited from the extensive comments by regulatory executives.

The initial analysis based on the G5 Benchmark (ITU, 2020) allowed to test drive the concepts underpinning the new composite metric and assess its robustness and the pertinence of the choice of indicators. Throughout 2020, the broad consultation with ITU Member States, regulatory practitioners and other stakeholders allowed to crowd-source ideas and feed them into a design thinking process of enhancing the initial framework with key components of a next generation regulatory blue print.

Based on the insights gathered and the new thinking generated around the topic, the methodological framework and the rational for the G5 Benchmark have been refined to capture the gold standard for collaboration amongst regulators and policy makers, and for digital policy design that accelerates digital transformation. While the indicators from the pilot edition remain in place, additional ones were brought in to complement the framework.

The G5 Benchmark will be expanded to cover all ITU Member States leveraging the new refined methodological framework and a new edition will be released ahead of the World Telecommunication Development Conference 2021 (WTDC-21).

5. Conclusions

Europe has a diverse telecommunications market and according to the ITU's G5 Benchmark, several European countries have some of the most mature regulatory frameworks to enable the digital transformation (ITU, 2019). A small group of EU countries are already leading the way to an extensive collaborative G5 approach, where regulators of different sectors work together to define a regulatory framework that reflects the convergence of different economic sectors due to generalized digitalization and the take-up of new digital technologies.

If we compare the regulatory framework of the European Union (section 2 of this paper) with the ITU's G5 Benchmark (discussed in section 4), it becomes clear that several components of the G5 framework are already incorporated in European initiatives to build and maintain the *digital single market*. Among these are not only strategic approaches that define connectivity targets, but also legislation on infrastructure sharing, coverage mapping and access regulation, all regulatory initiatives which elevates the EU and its Member States towards a modernised regulatory environment.

The research approach undertaken in this paper has shown that there are several good practices that translate the spirit of the European laws and regulations into specific measures to foster the development of infrastructure markets. The examples discussed in sections 2 and 3 of this paper outline some provisions that have proven to bring positive outcomes at the European level as well as the level of EU Member States. Notably, all these approaches have in common that they included a variety of stakeholders in their conception and implementation.

As for use cases, the German *Infrastrukturatlas* on infrastructure mapping and co-deployment, the Portuguese regulations regarding in-house-wiring and the Polish *codes of practices* and standardised contracts for cross-sector and public-private cooperation have been discussed in detail. Overall, all of these examples try to achieve win-win situations, while none are top-down approaches, but rather reflect the idea of incorporating the interests of as many stakeholders as possible within the practical implementation.

For example, the *Infrastrukturatlas* brings benefits to all involved actors. It is in the common interest that infrastructure and information about infrastructure can easily be accessed, although not all parties benefit equally from such projects since the holders of the vastest networks gain less than competitors with fewer own infrastructure. The inclusion of additional infrastructure with considerable market potential (e.g. municipal infrastructures like street lights, utility provider networks) enables new streams of revenue and leads to lower the costs of new broadband projects.

The same is true for the Portuguese case: the standardisation of in-house wiring in Portugal has been successful because the application of the principle of technology neutrality in a very specific sector has increased the benefits while minimizing the drawbacks to parties involved. Usually, network providers compete with their networks outside-plant where network coverage is being gained, coverage being usually one of the most important aspects to win new customers. However, although in-house wiring is not crucial to winning a customer, cutting the cost and the burdensome process for a new connection can provide substantial benefits to all operators. Therefore, it is in the interest of all parties that in-house cabling is standardised, symmetric access is given to all parties and the respective costs are shared among commercial players. This essentially reduces operational risks, gives certainty to investors, and fosters cooperation that may lead to improved outside-plant co-investments.

In the case of Poland too, the standardisation of contracts between the public and the private sector as well as law application guidelines on cooperation between network operators from different sectors has created win-win situations. The adopted *codes of practice* define the roles and responsibilities of the different actors thereby providing a common understanding of the practical aspects of collaboration and clarifying regulatory arrangements, which helps all parties in an infrastructure project. Furthermore, readily accessible tools providing symmetric information enable quicker

decisions and lead to fewer disputes, which in turn decreases the time and costs of network development.

The lessons learnt from these case studies witness that cooperation between regulators and market players is crucial to achieve win-win situations and further incentivize the deployment of new networks for digital services. This is consistent with previous ITU research showing that modern regulation needs to be driven by collaboration, incentives and new regulatory patterns as opposed to approached based on command, control and sanctions.

Efficient and effective approaches to achieving a high-end nation-wide network coverage rely on fostering cooperation, opening networks, harmonising technical standards as well as supporting the public sector in facilitating fibre deployment. Section 4 has outlined how a pathway to such a regulatory framework may look like. If implemented mindfully, collaborative regulatory frameworks can generate positive effects on digital market development and leverage institutional and infrastructure resources across multiple sectors, including energy, telecommunications, finance, content regulation, while enhancing the competitiveness and inclusiveness of the EU Digital Single Market.

Building on the region-specific legal frameworks and county-case studies, our research has shown that Europe, and especially the European Union, is leading the way to a harmonised digital single market, where actors from different sectors can compete under fair and transparent conditions to deploy the best communication networks for European customers. For future research, it will be worth exploring whether the European approach may be replicable in other regions.

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