cerre Centre on Regulation in Europe

REPORT

November 2020

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COOPERATION BETWEEN FIRMS TO DEPLOY VERY HIGH CAPACITY NETWORKS

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- the widely acknowledged academic credentials and policy experience of its team and associated staff members;
- its scientific independence and impartiality;
- the direct relevance and timeliness of its contributions to the policy and regulatory development process applicable to network industries and the markets for their services.

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Executive summary

Telecom networks are in the midst of an enormous transition and, with that transition, the opportunities for allowing co-operation without compromising competition are also changing. The existing rules have yet to recognise this and are also inconsistent in their treatment of different types of network (fixed and mobile). This study reviews these changes and considers how the costs and benefits should be weighted. Fixed networks are migrating to fibre based networks and away from copper and cable via private and state investment (National Broadband Plan), whilst the next generation of mobile technologies is much more than a simple increment over the previous generation of mobile networks. 5G promises significantly better network performance, not just across existing metrics but also introducing new metrics for latency and error parameters. The way networks interact and interconnect is also changing with Software Defined Networking (SDN) and Network Function Virtualisation (NFV)[1] allowing network functionality and performance to be almost independent of the underlying infrastructure. The resulting networks will have much higher capacity and far greater functionality which can be managed independently and remotely. In the future, network services could be supplied as effectively by an entity with little or no network infrastructure as it could be by the network manager. This is equally true for high performance and complex connectivity solutions that can only be supplied by network owners today. The network slicing most commonly associated with 5G is another way that these technology changes are culminating whereby multiple 'virtual' networks with very specialised and specific characteristics can sit on a common infrastructure with no impact on each other. Some of these technological changes may change the way policy makers view and police networks in the future.

The impact of these changes on the sector will be profound. Not only will the nature of networks change but the regulation that will be required is also likely to change fundamentally. For instance, network virtualisation will allow technical alternatives to interconnection whereby network controls are extended beyond the physical network to bring everything on-net. The entity that delivers telecom services in the EU may be headquartered in New York or Beijing with only physical network maintenance being conducted in Europe. This could create significant jurisdictional and security issues. It could be that markets will become less contestable or more contestable depending on how networks evolve.

The fundamental role of connectivity in delivering on the potential of all sectors of the economy, especially now as highlighted by the Covid-19 crisis, means that the continued development of networks and network functionality will be central to the success of the European economy.

To realise the potential of these new networks though, significant new investments are required in the telecom sector and encouraging that investment is the central objective of both the recent reforms of the telecom regulatory framework[2] and ongoing legislative activities. The Commission's connectivity package[3] previously flagged as part of its respond to the Covid-19 crisis[4] seeks to accelerate both VHCN and 5G network investments with various measures brought forward from the BCRD and the future 5G/6G Action plan highlighting the perceived urgency of the need to act.

[1] SDN seeks to separate network control functions from network forwarding functions, while NFV seeks to abstract network forwarding and other networking functions from the hardware on which it runs. Thus, both depend heavily on virtualization to enable network design and infrastructure to be abstracted in software and then implemented by underlying software across hardware platforms and devices. When SDN executes on an NFV infrastructure, SDN forwards data packets from one network device to another. At the same time, SDN's networking control functions for routing, policy definition and applications run in a virtual machine somewhere on the network. Thus, NFV provides basic networking functions, while SDN controls and orchestrates them for specific uses. SDN further allows configuration and behaviour to be programmatically defined and modified.

[2] Directive (EU) 2018/1972

[3] https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=69383

[4] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_940

Determining what might drive those investments and which policy levers would encourage those investments has proven more elusive than was anticipated. 5G's own network requirements both in terms of cellular network densification and the need to have sufficient fibre deployed to facilitate 5G backhaul means that very substantial network investments still have to be made. The Covid-19 pandemic and the need to maintain lockdown in knowledge-based economies has created a new urgency in ensuring that adequate network investments are made in a timely manner. This requires appropriate policy measures to facilitate (or at least not impede) those investments. Connectivity has always been seen as a critically important policy objective but because of the new role of connectivity in the broader economy and now the requirement to work remotely, it is more important than ever. The creation of a policy objective for National Regulatory Authorities to promote the availability and take up of fixed and mobile VHCNs gives a clear objective and a strong legislative mandate for action.

The best means to achieve that policy objective and encourage those investments are still under discussions. There are, as pointed out in previous CERRE reports, various advantages and disadvantages resulting from infrastructure sharing and the way in which that sharing is done. The advantages arise from lowering costs for operators which in turn may increase the geographic scope of investment and may encourage more investment and facilitate competitive entry. The disadvantages of sharing are that it could lower competition, either by making co-ordinated effects (via information sharing for instance) or via unilateral effects (parties having a common cost base). The view on the balance between the advantages versus the risks depends on a number of factors, including whether the sharing involves active or passive infrastructure, and the geographic scope of cooperation.

One advantage that current policy makers have is the availability of more data on what factors are driving fixed network investments and which policy levers can stimulate those factors. While it is true that investments get made for many reasons in many different countries and that 'no one size fits all', there are a number of common elements that can act as drivers (even if their impact might be different depending on market circumstances). Lowering entry barriers by sharing passive elements seems a universally positive measure to stimulate investment based on the evidence. Where infrastructure based competition is feasible, making virtual remedies available and pricing them at cost will have a negative effect on investment. The experience of market developments is reflected too in a changing approach to regulation and the policy levers being pulled and these changes are set out in the new approach set out in the EECC. That new approach reaffirms the gradation of remedies and the primacy of removing entry barriers and it is supported by a variety of instruments which are either legislative (BCRD) or non-legislative (NGA/NDCM Recommendations).

However, several of these legacy instruments in Europe originate from a time when there was less emphasis on achieving VHCN and more emphasis on a different interpretation of technological neutrality; in addition there is now a greater emphasis on infrastructure based competition as a means to stimulate investment and with it there is more emphasis on lowering entry barriers particularly via infrastructure sharing.

The prevailing policy objectives at the time that these legacy instruments were issued do not mean that the advice and guidance issued is contradictory, but there is a distinct difference in tone and emphasis. It is also problematic that so many instruments address the same issues. Opportunities exist to streamline the advice on several topics.

A previous CERRE study (May 2020) looked in detail at co-investment and network sharing provision (Article 76) in the EECC to stimulate network investment. The current report adopts a broader perspective looking in particular at Article 80 'wholesale-only' operators, another mechanism used to promote VHCN investment in the code. The emergence of these operators predates the code and appears to have been driven by financial engineering consideration. However, within the EECC, the Commission is signalling a very strong preference for this form of market entry by making Article 80 operators exempt from many provisions of the code (whether they are SMP or not). There is a

therefore a strong emphasis in the EECC, at least in a fixed network context, on structurally separated or wholesale-only entry. Wholesale-only operators have been very effective entrants in a number of European markets, particularly markets which had fallen behind in VHCN investments such as Italy and the UK for instance. The move towards wholesale-only entry created a new dynamic in those markets – not least because such operators created a new product in the eyes of many financial investors and this represented a long term infrastructure investment with long payback periods and low risk (reflected in a lower cost of capital). From a policy perspective, the investment dynamic that has been stimulated is very positive. There is however a contradiction in all of this, financial markets appear to be assuming a quasi-monopoly position on the market – policy makers are making an opposite assumption, someone must be wrong.

There are risks associated with wholesale-only operators however which we consider and those risks concern investment co-ordination and investment hold-out issues on the next wave of network investments. The move to all fibre networks (or indeed the move to 5G in a mobile context) does not represent an end-point in the network investment cycle. Investment increments and evolutions in VHCN networks will continue in the future and wholesale-only operators that bear the investment risks associated with network investment will not reap the rewards which principally accrue in the retail market. Such operators may consequently be reluctant to invest. The presence of vertically integrated competitors means that such concerns will be mitigated through competitive pressure in the short term but that it ought to be a consideration in the medium term for regulators especially if the competitive reaction to wholesale-only operators is for vertically integrated operators to separate themselves.

At an EU level there is a practical difference between the regimes that are in place for network sharing and co-investing in a fixed context versus in a mobile context. In a fixed context the EECC and the associated soft law instruments are often linked to a finding of regulatory SMP in the fixed access markets and the modification or removal of SMP remedies as an incentive for VHCN investment, consistent with the Gigabit Society policy objective of universally available VHCN. Rapid deployment of 5G is also a key policy objective of the Gigabit Society communication. However, the EECC's system of SMP-based regulatory incentives for investment does not apply to mobile networks. In a mobile context, the relevant mobile access market was removed from the (anticipated) scope of regulation in 2008 with the retirement of Mobile Access and Call Origination from the list of relevant markets. In a mobile network context there is almost no possibility for a finding of SMP for mobile access. The applicable regime for network sharing and co-investing is therefore generally determined by competition law. Within competition law there is no specific telecom policy context and those policy instruments that do focus on telecom markets such as Broadband State Aid, General Block Exemption Regulation and so on are significantly out of step with the current objectives of the EECC and telecom policy.

While the co-existence of competition law and ex ante regulation creates a healthy system of checks and balances, we believe there is scope for better coordination between the two. Gigabit Society objectives could be more explicitly addressed in competition law and state aid guidance, as well as new technological developments that may change the competitive dynamics of network sharing. The use of Software Defined Networks (SDN) and Network Functionality Virtualisation (NFV) deployed in very high capacity mobile networks permits network slicing, effectively the ability to run autonomous (virtual) networks in parallel, each with its own QoS parameters and each, potentially, with a separate development path thereby reducing the risk of anti-competitive coordination. This could be considered analogous in a fixed network context to a point to point overlay using wave division multiplexing on a point to multipoint network. Individual wave lengths could be assigned to specific operators.

It should be noted that the issue in a mobile context is that the technology changes allow service development to be separated from the physical network (with implications for innovation and competition) while the issues addressed in a fixed network context concern separation of network from retail services, raising issues of investment co-ordination and economic efficiency.

The analysis in the paper leads us to the following policy recommendations.

1. **Infrastructure based competition is the most powerful form of competition for network investment. Measures to lower entry barriers and promote infrastructure based competition should be enhanced, in particular by strengthening the Broadband Cost Reduction Directive.**

Network competition has not always been a policy priority but the importance of infrastructure based competition is now recognised clearly in the EECC. Instruments that stem from a period that pre-dates the shift in telecom policy to infrastructure based competition ought to be reviewed to ensure the measures contained therein are not counter-productive to that aim (cost-based virtual access products over VHCN for instance). There are already a number of mechanisms available to co-ordinate access and sharing of civil engineering infrastructure and these should be strengthened in the BCRD. The geographic scope of infrastructure based competition will be limited but if a large enough part of a market can support infrastructure competition that may move the whole market in the medium term; where a large enough part of the market cannot support infrastructure based competition other forms of regulated access will be needed even in the medium term.

2. **Competition law guidelines need to be updated to reflect a more unified policy perspective that covers both fixed and mobile networks sharing.**

Competition law's focus is narrower than that of telecom policy, which can lead to friction, particularly in the field of network sharing. This friction is healthy as it can allow the two approaches to act as a check on each other. Moreover, competition law is highly case specific, making it difficult to fix common rules. Nevertheless, several competition law guidelines – State Aid Guidelines, the Block Exemption Regulation for State Aid, and the Horizontal Cooperation Guidelines -- seem out of date compared to new technological developments in VHCN and 5G, and the new policy objectives expressed in the Commission's Gigabit Society Communication.

This inconsistency risks confusing market actors. We recommend that State Aid Guidelines and the Block Exemption Regulation be updated to reflect the policy objectives of the EECC and the Gigabit Society Communication, and that the Horizontal Cooperation Guidelines be supplemented with a section specifically addressing network sharing in the context of VHCN and 5G. The Horizontal Cooperation Guidelines should focus in particular on new technological developments such as Network Function Virtualisation (NFV) and Software Defined Networks (SDN) and their potential impact on the competition analysis of network sharing, particularly the traditional "active versus passive" network element dichotomy.

3. **There is a broad need to streamline regulatory provisions.**

Many aspects of the current framework were devised at a time when the policy objectives were quite different (NGA, NDCM Recommendations, BCRD, State Aid Guidelines, GBER) and a number of those instruments overlap (EECC, NGA and NDCM Recommendations, Connectivity Recommendation and the BCRD Directive). It would make sense to retire some instruments such as the NGA and NDCM Recommendations and include those advice still considered necessary in another instrument (such as the BCRD which is currently under review).

Streamlining the regulatory advice in this way would serve the dual function of ensuring that the overall objective remains clear whilst ensuring that when detailed guidance is offered it is fully aligned with those objectives.

4. **Entrant Wholesale-Only operators should be encouraged but with a caution that reflects the risks associated with such operators. Exemptions available for vertically integrated operators that choose to separate should be limited and this should be signalled in advance.**

It makes sense to continue to promote entrant Wholesale-Only operators. Their entry has created a new market dynamic in certain large moribund VHCN markets. However, there are clear risks associated with such operators concerning investment co-ordination and investment holdout and delay. In the short term, the presence of vertically integrated operators will act to mitigate the risks associated with investment coordination since those vertically integrated operators will be a source of competition. This situation may change over time, particularly where the competitive reaction for the whole market is to structurally separate. In this case, concerns about investment co-ordination, hold-out etc. will arise in the absence of other infrastructure based competitors, at least some of whom are vertically integrated. Regulators should signal ahead of time that exemptions available in a voluntary separation scenario will be limited.

01

INTRODUCTION

1 Introduction

Telecom networks are in the midst of an enormous transition. Fixed networks are migrating to fibre based networks and away from copper and cable via private and state investment (National Broadband Plan), whilst the next generation of mobile technologies is much more than a simple increment over the previous generation of mobile networks. 5G promises significantly better network performance, not just across existing metrics but also introducing new metrics for latency and error parameters. The way networks interact and interconnect is also changing with Software Driven Networking (SDN) and Network Function Virtualisation (NFV)[5] allowing network functionality and performance to be almost independent of the underlying infrastructure. The resulting networks will have much higher capacity and far greater functionality which can be managed independently and remotely.

In the future, network services could be supplied as effectively by an entity with little or no network infrastructure (like a digital platform player) as it could be by the network manager. This is equally true for high performance and complex connectivity solutions that can only be supplied by network owners today. The network slicing most commonly associated with 5G is another way that these technology changes are culminating, whereby multiple 'virtual' networks with very specialised and specific characteristics can sit on a common infrastructure with no impact on each other. Some of these technological changes may change the way policy makers view and police networks in the future.

The impact of these changes on the sector will be profound. Not only will the nature of networks change but the regulation that will be required is also likely to change fundamentally. For instance, network virtualisation will allow technical alternatives to interconnection whereby networks are extended to cover target customers. The entity that delivers telecom services in the EU may be headquartered in New York or Beijing with only physical network maintenance being conducted in Europe. This could create significant jurisdictional and security issues. It could be that markets will become less contestable or more contestable depending on how networks evolve.

The fundamental role of connectivity in delivering on the potential of all sectors of the economy, especially now as highlighted by the Covid-19 crisis, means that the continued development of networks and network functionality will be central to the success of the European economy.

To realise the potential of these new networks though, significant new investments are required in the telecom sector and encouraging that investment is the central objective of both the recent reforms of the telecom regulatory framework[6] and ongoing legislative activities. The Commission's connectivity package[7] previously flagged as part of its response to the Covid-19 crisis[8] seeks to accelerate both VHCN and 5G network investments with various measures brought forward from the BCRD and the future 5G/6G Action plan highlighting the perceived urgency of the need to act.

[5] SDN seeks to separate network control functions from network forwarding functions, while NFV seeks to abstract network forwarding and other networking functions from the hardware on which it runs. Thus, both depend heavily on virtualization to enable network design and infrastructure to be abstracted in software and then implemented by underlying software across hardware platforms and devices. When SDN executes on an NFV infrastructure, SDN forwards data packets from one network device to another. At the same time, SDN's networking control functions for routing, policy definition and applications run in a virtual machine somewhere on the network. Thus, NFV provides basic networking functions, while SDN controls and orchestrates them for specific uses. SDN further allows configuration and behaviour to be programmatically defined and modified.

[6] Directive (EU) 2018/1972

[7] https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=69383

[8] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_940

These measures are the latest in a series (with a Revision to the Broadband Cost Reduction Directive – the BCRD – and an updated 5G/6G action plan anticipated early next year). The importance of the deployment and take-up of Very High Capacity Networks (VHCN) is central to the development of a European Union fit for the digital age and one of the pillars of the Von der Leyen Commission.

The Commission has set ambitious connectivity targets in the Gigabit Communications of 2016[9] and highlighted the importance of the deployment and take-up of Very High Capacity Networks (VHCN) under the guise of 'a European Union fit for the digital age'. This has led to the inclusion of a new policy objective in the European Electronic Communications Code (the EECC): 'the promotion of connectivity and access to, and take-up of, very high capacity networks, including fixed, mobile and wireless networks, by all citizens and businesses of the EU'.[10] This objective was re-affirmed by the Commission last February in a communication entitled "Shaping Europe's Digital Future", its Digital Strategy Communication adopted in February 2020[11], and it has been further reinforced by the Commission Recommendation on Connectivity which is a reaction to the current Covid-19 crisis.

Given the crucial importance of telecommunications networks for the resilience of the economy and the society, this CERRE study is part of the research track on the policies and regulation to stimulate the deployment of Very High Capacity (VHC) networks in Europe. This research track includes previous CERRE projects[12] and will look at the supply side and the demand side of VHC networks deployment, seeking to connect EU policy and legislative initiatives.

This specific study focuses on the need for cooperation within the telecom sector and beyond (in particular, utilities in other network industries) to speed up the deployment of fixed and mobile VHC networks. This need for cooperation is reinforced by:

- technological progress, in particular 5G, which moves the intelligence from the telecom hardware to the telecom software (e.g. Software Defined Network), making cooperation in hardware deployment possibly less risky for competition than previously;[13]
- the need for VHC networks becoming more pressing than ever due to the current Covid-19 crisis.

Those two substantial evolutions affect the trade-offs behind cooperation decisions by market participants and the evaluation of those decisions by State authorities. Such trade-offs involve the effects of network cooperation on competition, investment, innovation and resilience.

[9] Communication from the Commission of 14 September 2016, Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society, COM(2016) 587.

[10] Directive 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code, OJ [2018] L 321/36, art.3(2a).

[11] Communication from the Commission of 19 February 2020, Shaping Europe's Digital Future, https://ec.europa.eu/info/sites/info/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf. The Commission notes that 'Europe must invest more in the strategic capacities that allow us to develop and use digital solutions at scale and to strive for interoperability in key digital infrastructures, such as extensive 5G (and future 6G) networks and deep tech. To take just one example: connectivity is the most fundamental building block of the digital transformation. It is what enables data to flow, people to collaborate wherever they are, and to connect more objects to the Internet, transforming manufacturing, mobility and logistic chains. Gigabit connectivity, powered with secure fiber and 5G infrastructures, is vital if we are to tap into Europe's digital growth potential. To this end, adequate investments at EU, national and regional levels are necessary to achieve the EU 2025 connectivity objectives.'

[12] Such as Implementing Co-Investment and Network Sharing (2020), State Aids for broadband infrastructure in Europe (2018), Demand-Side Policies to Accelerate the Transition to Ultrafast Broadband (2017), Towards the successful deployment of 5G in Europe (2017); Policy towards competition in high speed broadband Europe (2017).

[13] See CERRE Recommendation for next Commission, Sept 2019.

It is important that those changes and new trade-offs are reflected in the series of EU laws and policies which regulate network cooperation agreements between telecom and/or utilities or the different players in 5G verticals.

- Some of those rules have recently been changed, such as the new EECC[14], which contains new provisions on co-investment that are currently being transposed in the Member States[15].
- A major focus of the Code is in creating an environment conducive to large scale investment. Provisions in the Code encourage investment by structurally separated network operators via various provisions concerning wholesale-only operators (defined under Article 80).
- In order to lower barriers to entry and facilitate investment, significant attention is being paid to measures such as a revision of the Broadband Cost Reduction Directive (the BCRD)[16] and in terms of possible access and pricing mechanisms, to a revision of the Next Generation Access (NGA) and the Non-Discrimination and Costing Methodologies (NDCM) Recommendation.
- The pressure on network availability due to the Covid-19 crisis has driven the Recommendation on Connectivity[17] published in September, which inter alia brings forward some elements of BCRD as well as seeking to ensure sufficient 5G spectrum is available at a favourable price.
- Many of the provisions of the EECC and the supporting Recommendations and Directives apply only in the context of SMP markets and SMP access markets in particular – mobile networks fall outside these provisions and network sharing and network access effectively falls under a parallel regime set out by DG Competition (even if certain measures do exist under the EECC and conditions can be attached to spectrum assignments). Those competition rules are also being reviewed by the Commission such as the *General Block Exemption Regulation* and *Horizontal Cooperation Guidelines* under Article 101 TFEU[18].
- Moreover, some rules may be revised after the Covid-19 crisis such as the *Broadband State Aids Guidelines*, new rules may be adopted in the context of the EU and national Recovery Plans, and the Broadband State Aid rules are currently subject to public consultation with a revision anticipated in 2021.

This study builds on the report on co-investment and network sharing presented in May 2020. While that report on network sharing concentrated more on Article 76 measures dealing with co-investment and takes the EU rules as given, this new project adopts a broader perspective, looking also at Article 80 operators, and makes policy proposals in the new technological and societal context.

[14] DIRECTIVE (EU) 2018/1972 establishing the European Electronic Communications Code (EECC)

[15] EECC, art.76.

[16] Directive 2014/61 of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks, OJ [2014] L 155/1

[17] Commission Recommendation of 18.9.2020 on a common Union toolbox for reducing the cost of deploying very high capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union.

[18] Commission Guidelines of 14 December 2010 on the applicability of Article 101 TFEU to horizontal cooperation agreements, O.J. [2011] C 11/1. According to EVP Vestager, the Commission could use the possibility provided for by Art. 10 of Reg 1/2003 to shed more clarity on how businesses can cooperate without harming competition: Keeping the EU Competitive in a green and digital world, Speech 2 March 2020: https://ec.europa.eu/commission/commissioners/2019-2024/vestager/announcements/keeping-eucompetitive-green-and-digital-world_en

The report is structured as follows, it considers the trade-offs (between competition, investment, innovation and resilience) that authorities need to arbitrate to decide on a network cooperation agreement, it looks at the drivers of investment in VHCN, the shifting approach adopted under the EECC, the renewed emphasis on infrastructure based competition, and the policy implications stemming from that approach. It then looks at advantages and disadvantages of Article 80 operators and their impact on the market. There is then a consideration of the various instruments used to support the EECC with recommendations for streamlining. Finally, the report considers the ongoing technological changes underway and considers how ex-ante and ex-post regimes need to interact in the future.

02

PROS AND CONS OF INFRASTRUCTURE SHARING

2 Pros and cons of infrastructure sharing

Infrastructure sharing agreements in the fixed and mobile markets have benefits but also potential costs or drawbacks. Therefore, in general, a balancing test must be conducted by regulatory authorities or competition authorities to assess whether the benefits are higher than the costs, and the deal must be cleared.

First, we discuss the potential benefits accruing from infrastructure sharing in the fixed and mobile markets. Then, we analyze the potential drawbacks, which correspond mainly to the risk of anti-competitive effects of those deals. Finally, we discuss the trade-offs for society and firms associated with infrastructure sharing.

2.1 Potential benefits of infrastructure sharing

When sharing a network, operators also share the associated costs. Cost-sharing is the first obvious benefit of infrastructure sharing. Firms share the fixed costs of the infrastructure, i.e., the capital expenditures necessary to deploy the network, such as a fiber network in a local area, or sites and masts (sharing can take place after the infrastructure has been built, but in this case too, firms can decide to share the deployment costs). Those cost savings arise because firms share a joint infrastructure instead of deploying duplicate networks. Besides, firms can also share some of the operational (variable) costs of their common infrastructure, such as maintenance costs.

How much firms share of the infrastructure determines how much of the costs they can share. For example, in the mobile sector, active sharing, where firms share the radio access network (RAN), implies higher cost savings for the firms than passive sharing, where they share the sites and masts, but each deploys their own RAN.

Infrastructure sharing may also imply other forms of cost-sharing. When firms face transaction costs for the deployment of their infrastructure (e.g., when contracting with a municipality for the use of civil works or the deployment of mobile sites), sharing implies a reduction of those costs for the firms. A joint network may also allow firms to benefit from synergies, for example, if they bring specific technical know-how. Finally, when investment implies a certain level of risk, due to uncertainty about demand or costs, for example, sharing infrastructure also means sharing risk.

The question for public authorities is the potential effect of sharing, and the associated cost savings, on market outcomes, in particular in terms of prices for consumers and investment in network infrastructure.

In the short term, infrastructure sharing allows competition to emerge in a given local area based on services. This is particularly the case if, in the absence of sharing, only one operator would be viable in the area. As the operators that share the infrastructure compete to attract consumers, prices are lower, which benefits the consumers. Besides, consumers enjoy a wider choice of network products, particularly if the operators offer differentiated services. Finally, as sharing implies lower costs for the firms, we can expect some of those cost savings to be passed through to the consumers, which would lead to even lower prices.

A recent contribution by Aimene, Lebourges and Liang (2019) provides empirical evidence of those pro-competitive effects for the French fiber market in the period 2015-2018. Using detailed data at the municipality level, the authors show that co-investment for FTTH networks' deployment is associated with higher take-up of ultrafast broadband and stronger competition in the local area where co-investment takes place.

In the longer term, infrastructure sharing also affects firms' incentives to invest in network infrastructure. Since the costs of rolling out a new infrastructure or upgrading an existing one are lower, as shared, we can expect investment to be stimulated. In the fixed market, it may mean a wider and faster roll-out of fixed broadband networks. In the mobile market, where coverage is

mostly determined by regulatory constraints (e.g., license obligations), infrastructure sharing is less likely to affect coverage. Still, we can expect network (quality) upgrades to be accelerated (e.g., the transition to a new mobile technology, such as 5G).

Whereas short-term competition and long-term investment incentives are sometimes opposed, it is interesting to note that infrastructure sharing can bring both types of benefits. This was shown, for example, in a theoretical contribution by Bourreau, Cambini and Hoernig (2018). The authors show that infrastructure sharing tends to intensify competition in the areas where it occurs but the significant cost savings it generates also lead to higher investment in coverage by firms. In another theoretical contribution, Motta and Tarantino (2017) consider an investment in quality upgrades rather than an investment in coverage, which better fits the mobile market. Consistent with Bourreau et al. (2018)'s findings, they show that an infrastructure sharing deal between two competitors leads to lower prices and higher investment in an oligopolistic market than in the benchmark situation where firms would all invest independently. In a recent paper, Maier-Rigaud, Ivaldi and Heller (2020) provide empirical evidence of the effect of infrastructure sharing on prices and investment for the mobile market. The authors analyze a network sharing agreement in the Czech Republic for 4G and show that this deal led to lower prices for consumers and increased network quality.

Finally, OECD (2014) and BEREC (2019) highlight that infrastructure sharing may not only have benefits in terms of market competition, but also environmental benefits, since it is less costly for the environment to have a single infrastructure rather than multiple ones.

2.2 Potential drawbacks of infrastructure sharing

An important concern for regulatory and competition authorities is that infrastructure sharing may entail anti-competitive effects. We can distinguish two types of competition problems related to the potential unilateral effects and coordinated effects of infrastructure sharing deals.

Once an infrastructure sharing agreement is implemented, different unilateral effects can arise and be harmful to consumers.

First, since firms share a joint network, their incentive to compete through network facilities' deployment and quality upgrades can be weakened. Given that the infrastructure is shared, any technology upgrades realized by one firm on the infrastructure benefit all partners through spillovers, limiting each partner's incentive to upgrade. For example, BEREC (2020) argues that sharing may reduce investment incentives because "*any gains in service offering (relating, for example, to coverage, network quality etc.) […] are likely to be shared with other parties*." Due to this externality, partners in an infrastructure sharing agreement may under-invest compared to a situation without sharing where they would have to invest independently. In other words, while infrastructure sharing stimulates service based competition, as we have seen above, it may come at the cost of less intense infrastructure based competition.

A related drawback of infrastructure sharing is that it may reduce service differentiation between partners, compared to the situation where firms deploy and operate their infrastructure independently (BEREC, 2018). The idea is that sharing a network restrains each partner's ability to differentiate. This is probably less and less the case with the most recent network technologies, such as 5G for mobile, where especially Open-RAN combined with NFV and SDNs will allow each sharing party to deploy their network and configure their services independently.

Note that the sharing agreement itself can also be designed in such a way as to limit a partner's ability to differentiate or to conduct independent service innovation.

Besides, the firms participating in a sharing agreement may have the incentive and ability to raise their retail prices, for example, by setting up high (internal or external) access or transfer prices for using the joint infrastructure. Since consumers pay higher prices, this is, of course, harmful to them.

Finally, firms may have the incentive and ability to foreclose potential competitors from using their joint infrastructure. For example, partner firms may charge prohibitive access prices to third parties, thereby deterring entry.

A proper design of the infrastructure sharing agreement can limit the risk that those unilateral effects occur. In our previous CERRE report,[19] we proposed a checklist that an agreement should comply with to mitigate those anti-competitive effects.

There is also the concern of coordinated effects, where infrastructure sharing would facilitate (tacit or explicit) collusion between operators. One reason is that allowing coordination in one dimension (here, the joint deployment and operation of a network) can make it easier for firms to coordinate in *other* dimensions, where their coordination would be harmful to consumers. For example, firms may agree on high retail prices for their services or reduce their independent investment in the partner's 'turf' to soften competition. Once again, the proper design of the infrastructure sharing agreement can reduce the risk of collusion. For example, information sharing can be restricted to the strict minimum necessary for the joint infrastructure operation.

Finally, some argue that infrastructure sharing may reduce network resilience (see, e.g., BEREC, 2020). Intuitively, having one shared infrastructure rather than multiple ones means that consumers cannot switch to an alternative infrastructure if one network has problems. For the moment, it probably concerns only rural areas, where a single (shared) infrastructure may operate, rather than urban areas where, even if sharing occurs, multiple networks are probably still available to the consumers.

2.3 Trade-offs for society

For regulators and competition authorities, as we have seen, infrastructure sharing involves various trade-offs in terms of competition and investment, as well as regards to the unilateral and coordinated effects that it can entail.

On the one hand, as discussed above, infrastructure sharing stimulates service based competition and spurs investment by allowing firms to share their investment costs. On the other hand, infrastructure sharing reduces infrastructure based competition, which can negatively affect investment.

These trade-offs can be affected by market characteristics, and in particular, by market structure. Market structure can vary across product markets (e.g., markets are more concentrated in fixed than in mobile) or geographic markets (e.g., we observe heterogeneity in the number of mobile operators in the European Member States). Market structure can affect how much of the variable cost savings are passed through to the consumers, with the idea that firms will pass through more of their cost savings in a more competitive market environment (and hence, a less concentrated market). Market structure can also affect investment dynamics in terms of network deployment or technology upgrades, and the relation between cost savings and investment dynamics. Here, it is less clear whether investment is lower or higher in a less concentrated market.

Technology can also affect the trade-offs between the benefits and potential costs of infrastructure sharing, particularly regarding investment. In the fixed and mobile markets, entrant firms mainly invest in rolling out new very high capacity (fiber or 5G) networks and extending their coverage. In contrast, for existing network operators, firms invest mainly in upgrading their existing network to the new technologies without necessarily increasing coverage. Infrastructure sharing can affect firms' investment strategies differently in the fixed and mobile markets, in so far as the investment cost functions can be different, or investment may be driven by various obligations (e.g., coverage obligations in the mobile sector).

[19] See Bourreau, M., Hoernig, S. and W. Maxwell (2019).

Finally, the characteristics and extent of the deal are essential. For example, competition authorities tend to be more favorable if the agreement concerns low-density areas, and firms keep up competing in high-density areas with independent infrastructure. In this case, the competitive pressure existing in high-density areas is expected to mitigate any anti-competitive concerns from the deal.

2.4 Trade-offs for firms

According to BEREC (2018), in the mobile market, most network sharing agreements are commercial deals between firms. Those firms which decide to share their network infrastructure on a commercial basis also face various trade-offs.

A first trade-off is between the cost savings that infrastructure sharing can generate and the (possible) intensification of service based competition. If the firms are sufficiently differentiated, cost savings may dominate the reduction of profits due to more intense competition. Another form of cost for the firms are the transaction costs of setting up, operating, and eventually terminating the infrastructure sharing agreement. Finally, if the partners' incentives are not well aligned, there is also the risk for a firm to be "held back" by its partners in an infrastructure sharing agreement.

03

THE DRIVERS AND REGULATORY LEVERS FOR NETWORK INVESTMENT

3 The drivers and regulatory levers for network investment

The transition that telecom networks are undergoing raises efficiency concerns; policy makers want as little network duplication as possible, so long as it is consistent with preserving competition. The boundary between where this can happen changes over time and is changing at the moment. The opportunities for allowing co-operation without compromising competition are changing. The existing rules have yet to recognise this, but policy and regulation needs to take this change on board and reflect it in their approach.

Towards the end of 2019 BEREC published a report[20] that it had commissioned on what were the determinants of investment. The study looked at capital cost, the determinants of the rollout costs (e.g. availability of ducts), the role of infrastructure based competition, the degree of co-investment, wholesale access conditions, operating costs, retail demand and willingness to pay for higher bandwidths. The study looked at a variety of models and an evidence base to develop a systems-based narratives of specific VHCN market evolutions and describe the factors at work in very different market circumstances and how very different determinants could drive VHCN penetration in countries as diverse as Spain, Sweden and Ireland.

One of the main findings of the study is that while the drivers of investment may be universal, the individual elements involved are heavily dependent on factors that differ across markets. What will be key to driving investment in one country may have little influence in another. Path dependencies and national/regional conditions can determine the strength of the drivers of investment and the impact of policies on investment rates in a given market.

Lessons from markets can be applied to other markets as these markets evolve and the lessons may become relevant because markets evolve and conditions change and that impacts revenue potential, capital cost and risk.

The study suggests that regulatory and national policies should consider the impact across the range of operator business models – the study identified a wide range of operator business models that have been able to tune net present value (NPV) business cases to meet particular market segment conditions, from vertically integrated to structurally separated, from predetermined demand to conditional drivers. Regulatory actions may impact each of these operator business models differently across regions of the country.

The system dynamics approach of the study shows how deployment costs and cashflows are intrinsically linked. The NPV models can be used to understand how the costs of deployment in different markets effectively sets a scale of revenue generation needed to reach sufficient positive NPV that will initiate investment activity. Where deployment costs are higher for instance a greater pre-commitment may be necessary or the avoidance of competing infrastructures. This is critical to a view on whether a market is likely to support infrastructure competition and possible overbuild. This also implies that the same regulations applied to different countries or regions may have very different impacts on investment, competition and prices.

Business risk profiles also affect the cost of finance with some risk profiles being preferable to certain investors. Certain sources of finance, in particular the long term investment community such as the insurance sector, traditionally felt that there were no suitable investment products in the telecom sector. These investors were looking for long term, low risk investment products. With the entrance of wholesale-only operators that perception changed. BEREC's study found that incumbent, retail operators and wholesale-only operators each have very different business models attracting a

[20] BoR (19) 246 VHCN Determinants of Investment Study

broader range of sources of capital being attracted to the sector with different financing conditions attached.

The study also found that the level of competition in a market did have a strong impact on investment – it found that even services based competition where higher level access products allowed the introduction of retail competition and alternate operators focusing on access seeking could develop business cases with low capital needs and 'aggressive' subscriber acquisition. They could then invest in own infrastructure if investment costs per household were low. In the case where infrastructure competition arises, the incumbent is likely to lose further retail revenue and erosion of wholesale cashflows that they would have retained had the entrant remained at the retail level only. Taken together with CATV networks' advantageous incremental upgrade strategies, and/or investments from communities or utilities, this can force the incumbent to react with its own investment in order to retain market share.

The study prepared for BEREC also demonstrated that markets at very different stages of VHCN penetration and path dependence can still share the same challenges within their VHCN ecosystems - even Spain and Portugal where very high coverage and penetration can still mask the challenge for rural areas with high VHCN build costs – a problem shared by many other countries. Nevertheless, the significant savings in operational costs of a fibre-only network is a factor that in some countries might eventually lead to a swift deployment in rural areas.

While the specificities of markets are important in determining the relevant drivers or weights attached to them, there are a number of consistent elements. Infrastructure based competition is more effective in stimulating investment in VHCN, with measures that facilitate infrastructure based competition being the most important factor in determining success.

3.1 The EECC and network investment

Many of these identified drivers are addressed in the EECC which suggests that a consensus on what the drivers are is emerging. That new regulatory framework was put forward by the Commission in September 2016 after an 18-month period of consultation. During that initial consultation period, it became clear that the European policy makers were thinking very differently about access regulation than they had under the previous Commission.

Two things in particular appeared to have changed. The first was a determination to induce an accelerated rollout of 5G, with the objective to avoid falling behind the US, Asia or other regions of the World. The second big change was a perceptible softening of the 'technological neutrality' mantra. Technological neutrality had come to be interpreted by European policymakers in such a way that they should not say anything about what might be seen as desirable technology choices – so much so that targets were set so that no technology solution would be excluded[21]. This interpretation of technological neutrality gave weight to the argument that the same regulatory terms should be applied to copper upgrades such as VDSL as to FTTP. Given that the upgrades were much cheaper and met short term demand, the transition away from the legacy networks was slowed[22]. Network entry was to be facilitated but was clearly not seen as likely with upgrades of existing copper networks seen as the mostly likely route to fibre networks. This perspective was given full voice with the adoption of the NGA Recommendation[23] and the Non-Discrimination and Cost Methodologies (NDCM)

[21] Which might correspond to a distorted option 3 in the classification set out in their paper by Winston Maxwell and Marc Bourreau, Technology neutrality in Internet, telecoms and data protection legislation, *Computer and Telecommunications Law Rev.* (2015), available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2529680.
[22] A review of the trade-offs is available at OECD (2011), "Fibre Access: Network Developments in the OECD Area", OECD Digital Economy Papers, No. 182, OECD Publishing, Paris, https://doi.org/10.1787/5kg9sqzz9mlx-en.
[23] Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) 2010/572/EU.

Recommendation[24] which set out clearly the indifference to technology choice and the continuity of the copper network access regime.

The new European Electronic Communications Code (EECC)[25] is a very significant change in approach from that policy perspective and reflects an understanding that a necessary but not sufficient condition for 5G to succeed in Europe is that fixed VHCN needs to be deployed very deep in the 5G network. Investment in fibre networks is a primary objective in itself, but its supporting role in facilitating 5G is also important even if most policies to promote 5G can be identified in spectrum management. There is an acknowledgement of the importance of latency and other network characteristics to support 5G and also in the context of certain IoT applications, for autonomous driving, factories of the future, etc. The Commission was also aware that the evidence emerging from across Europe showed the success of inter-network (infrastructure based) competition rather than intra-network (service based) competition in driving investment, for instance, in Spain and Portugal (see below our discussion of the relative merits of service based and infrastructure based competition)[26]. The evidence also suggested that adherence to the NGA and NDCM Recommendations led to poorer network investment outcomes, even if many consumer outcomes were comparable in the short term over upgraded copper networks, it left those markets poorly placed in terms of network competition and ability to make the transition to fibre network.

Under the EECC that takes effect from the end of 2020, the basic regulatory model stays the same, i.e. where significant market power (SMP) is found on a market, then a number of obligations are imposed. In the first instance, those obligations should seek to remove the cause of the dominance (normally by removing or reducing a barrier to entry) and failing that, by measures which would seek to control the exercise of SMP, normally via access obligations, price controls etc.

The EECC reaffirmation of this basic approach is important because over time, the emphasis on removing the barrier to entry had weakened, with many NRAs imposing a suite of access and price control obligations whenever SMP was found, whereas the sequencing of remedies is now clearly restated in the EECC. While certain provisions in the EECC seek to lower entry barriers by granting access to passive infrastructures, the main vehicle remains the Broadband Cost Reduction Directive (the BCRD), which is to be reviewed in 2021 (see below). In addition, a number of specific remedies and measures are elaborated in the Code with the objective of enabling and stimulating network investment, with a singular emphasis on investment in Very High Capacity Networks or VHCN (i.e., FTTH/B or its equivalent[27]).

Within the EECC, certain measures are facilitative of network investment by lowering entry barriers (such as Articles 61, 72 and 73 on access to in-building wiring, civil engineering and specific network elements). Other provisions seek to stimulate investment through the use of a number of exemptions or exceptions that are applied depending on the form of the operator or the structure of the investment agreement. Therefore, it appears that the legislators have opted for a twin approach – take measures to enable investment and lower deployment costs on the one hand, whilst on the other hand, the aim appears to be to shape those entrant investors to be more separated in their

[24] Commission Recommendation of 11 September 2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment 2013/466/EU.
[25] DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of … establishing the European Electronic Communications Code (Recast).
[26] Cave, Martin and Tony Shortall (2016) "How incumbents can shape technological choice and market structure – the case of fixed broadband in Europe", *INFO*, Vol. 18.
[27] VHCN is defined in Article 2 of the Code as: 'very high capacity network' means either an electronic communications network which consists wholly of optical fibre elements at least up to the distribution point at the serving location, or an electronic communications network which is capable of delivering, under usual peak-time conditions, similar network performance in terms of available downlink and uplink bandwidth, resilience, error-related parameters, and latency and its variation; network performance can be considered similar regardless of whether the end-user experience varies due to the inherently different characteristics of the medium by which the network ultimately connects with the network termination point;

business model by expressing a preference for structurally separated entrants via the various exemptions that apply to Article 80 operators (and even reshape existing operators in that mode).

Specifically, the EECC contains a number of provisions which deal explicitly with the issue of fixed network separation. There are five main provisions which address this topic: there is an article dealing with the imposition of a 'functional separation' remedy (Article 77) and a second article dealing with 'voluntary separation' of a vertically integrated incumbent (Article 78), both of which were initially introduced, although never used, in the 2009 Framework review. The existing ability to impose full structural separation under the European regulatory Code is also carried over (albeit with increased oversight) in the revised Article 68 which replaces the former Article 8(3) of the Access Directive (2002/EC/19 as amended) dealing with exceptional measures[28].

In addition to these historical measures, a number of entirely new articles set out provisions on separation, including one article (Article 80) on regulatory rules that would apply to *de novo* vertically separate undertakings or Wholesale-Only (WO) operators as they are better known and finally, the extremely complicated provision dealing with co-investment in Article 76 and the associated Annex IV (which like the functional separation provision of 2009 may end up being rarely used due to its complexity). This provision is included since it is unlikely that many co-investment vehicles that seek an Article 76 exemption will operate except where there is a separation between the network operator and the various retail divisions given the obvious conflicts that would arise (hence, SIRO in Ireland – have network management structures separate from any retail actors).

We interpret this dual approach for fixed VHCN – stimulating investment through lower deployment cost, while encouraging or facilitating separation – as an indication that European policy makers view the move towards vertically separated networks in the telecom sector as a significant part of the efforts to achieve widespread roll-out of VHCN.

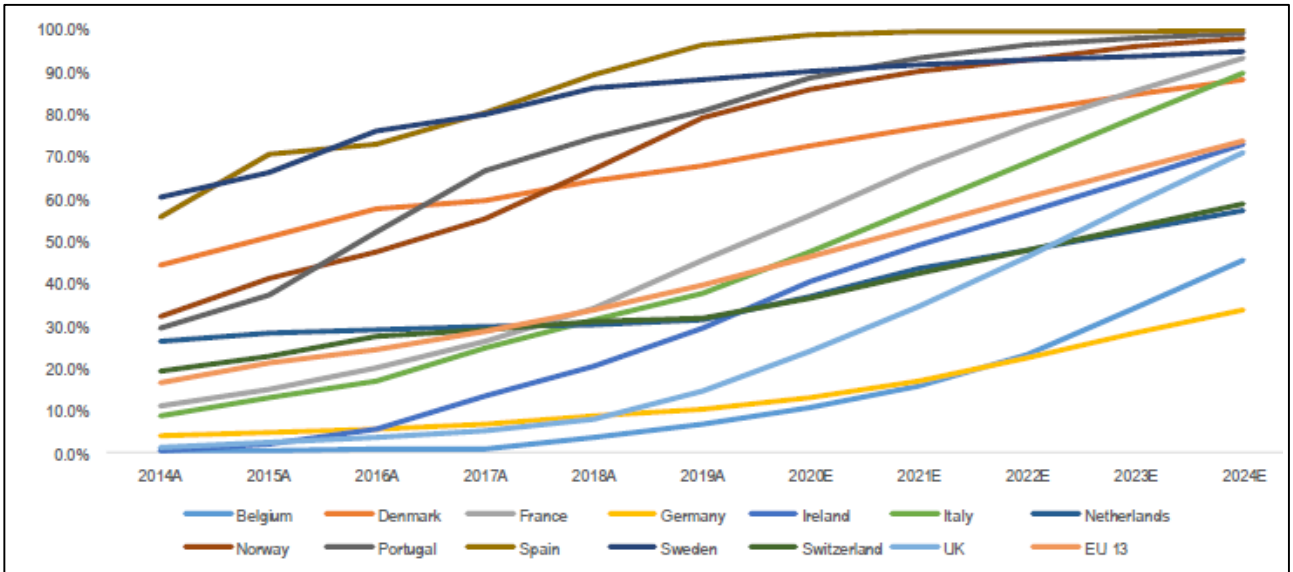
[28] Shortall, Tony (2020). Separation Remedies in Regulated Telecom Markets.

3.2 A view from today

The entry of firms operating separated business units may have a profound impact on investment in network infrastructures. While there is thus far limited evidence of Wholesale-only (WO) operators in the market, the investment dynamics associated with this type of firms seem positive.

Figure 1 below shows that in Italy, there is now a real prospect that more than 50% of homes will have access to VHCN in 2021, with the UK hitting that level of deployment in 2022. Forecasts previously prepared in 2014/2015 showed that these two countries were amongst the least dynamic and that there was no prospect at the time of those forecasts of reaching these kinds of penetration levels even within 15 years (not to mention within 5).[29] The dramatic change in the fortune of those countries occurs at the same time as the entry of WO operators into those markets. Though we cannot claim any causal impact of WO operators' entry on the acceleration on VHCN deployments (we only observe a correlation), our conjecture is that WO operators can indeed stimulate investment in new infrastructures.

Figure 1: VHCN Deployments in selected EU Countries[30]



Source: Company data, Credit Suisse estimates

3.3 Service based versus infrastructure based competition

In telecommunications markets, competition can take two different forms: service based competition and infrastructure based competition. Service based competition occurs when entrants rely on the incumbent operator's infrastructure to provide their services. Infrastructure based competition implies that entrant operators build their own network and rely on them to offer services to consumers. But these are two extreme situations. The reality might be in between, with entrant operators building part of a complete network while relying on the incumbent's for the other part.

Infrastructure based competition is typically preferred by policy makers. This is because experience has shown that the benefits of infrastructure based competition far outweigh those of service based

[29] Heavy Reading: European FTTH Forecast, 2014-2019 http://www.heavyreading.com
[30] Credit Suisse 2020 'Building the Gigabit Society'.

competition in the long run[31]. These benefits accrue from increased service innovation and differentiation possibilities, and lighter regulatory oversight to deal with potential (price or non-price) discrimination (see below). Infrastructure based competition is also seen as a necessary condition for achieving sustainable competition in the long term.

While infrastructure based competition is the most powerful form of competition, it can require longer timeframes to be implemented and significant investments, which are duplicative to some extent, on the side of the competing firms.

The alternative and quicker solution is to foster service based competition, whereby competitors use access to the incumbent operator's network to provide their services. The level of required investment is less, and the development of a competitive market is quicker, but two main drawbacks exist.

The first drawback is regulatory complexity. Under service based competition, setting appropriate access points and determining the correct access prices are critical to the success of the model. Therefore, the efficacy of the regulator and the regulatory regime are particularly important for service competition to be fully functional.

Another significant drawback is the risk of undermining the development of infrastructure based competition. For instance, cheap and easy access will enable service based entry, but it will discourage investment in expensive infrastructure.[32] Even if priced correctly, how to account for risk is extremely problematic- how does a regulator take account of the preference of a putative investor to avoid risking capital upfront in the presence of technological choices? While risk options are available in theory, they are extremely difficult to price so as to be either credible or effective. In a nutshell, the service based and infrastructure based competition regimes are substitutes to some extent.

This conclusion was challenged, though, by Ingo Vogelsang and Martin Cave. They developed the idea of a "ladder of investment," whereby entrant operators would first enter the market via access, leading to a phase of service based competition, and then invest progressively in their infrastructures, leading eventually to a regime of infrastructure based competition.[33] As noted by Ingo Vogelsang and Martin Cave, this requires fine-tuned regulation (hence, their "ladder of investment approach"). Thus, it raises even more the importance of the regulator in making this model a success.[34]

A prerequisite for service based competition is some form of mandatory access to the incumbent's infrastructure so as to allow competitors the possibility to use this network on reasonable conditions.

In this situation, the incumbent controls access to the upstream market (wholesale access infrastructure, i.e., the so-called "last mile") which shows significant scale economies and therefore tends towards monopoly, while the downstream market (the retail market, which involves the provision of services to the final users) is potentially competitive.

Access allows entrant operators to benefit from the same scale economies as the network owner. However, the production of telecommunications services may also involve *economies of scope*. Economies of scope exist if the joint production of several outputs is cheaper than the production of

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[31] See, for example, Bourreau, Marc, and Pınar Doğan. "Service based vs. facility-based competition in local access networks." *Information Economics and Policy* 16.2 (2004): 287-306. Cave, Martin. "The ladder of investment in Europe, in retrospect and prospect." *Telecommunications Policy* 38.8 (2014): 674-683.

[32] The negative impact of service based competition on investment by entrants is demonstrated, for example, by Grajek, Michał, and Lars-Hendrik Röller. "Regulation and investment in network industries: Evidence from European telecoms." *Journal of Law and Economics* 55.1 (2012): 189-216.

[33] Cave, Martin. "The ladder of investment." *Telecommunications Policy* 38.8 (2014): 674-683.

[34] See Bourreau, Marc, Doğan, Pınar and Matthieu Manant. "A Critical Review of the "Ladder of Investment" Approach." *Telecommunications Policy*, 34.11 (2010), 683-696. Cave, Martin. "The ladder of investment in Europe, in retrospect and prospect." *Telecommunications Policy* 38.8 (2014): 674-683.

the same outputs by means of separated specialised firms. Economies of scope exist if and only if there are *shared inputs* in the production process.[35] In the case of telecommunication networks, economies of scope exist where several products use the same inputs (telephony, broadband, broadcast all use the same network, for instance), implying that costs can be shared across multiple products.

When pricing access to the incumbent's infrastructure, significant issues arise concerning the allocation of costs across different services if economies of scope are important. In particular, the location of potentially competitive network elements can and does shift over time due to market demand changes and particularly technology changes (for instance, before ULL and broadband, the point at which competitive delivery of voice services happened was radically different than today).

Another challenge concerns the risks of price and non-price discrimination from the incumbent operator. As it controls the upstream access infrastructure while facing competition in the downstream market, the incumbent has the incentive, and the ability, to engage in anticompetitive behaviour either in the form of price or non-price discrimination. Price discrimination consists in charging excessively high wholesale prices on competitors or in applying predatory retail prices, in order to drive new entrants out of the market or severely curtail their ability to compete. A large number of non-price-based forms of discriminatory behaviour are available, many involving the quality of service offered to other firms.

A slew of regulatory obligations exist in Europe for regulators to impose on operators when economic dominance, or SMP in the language of sector specific regulation, has been determined. However, concerns have existed on the efficacy of these obligations to control price discrimination but more critically, non-price discrimination. The Commission's previous regime sought to use the NGA and NDCM Recommendations to specify pricing rules and behavioural obligations to navigate these issues. However, as noted earlier, that regime saw service based competition as the most likely path forward with particular emphasis on pricing and non-discrimination in that context. Since then, the objective has shifted significantly with a renewed emphasis on promoting infrastructure based competition, by lowering entry barriers and encouraging the entry of new, separated entities.

To sum up, regulation under a regime of service based competition is particularly complex and challenging. At the same time, there are strong benefits to infrastructure based competition, in terms of flexibility for service innovation, for instance. Infrastructure based competition also appears to have a much stronger effect on the investment dynamic. So, our recommendation would be to keep the emphasis on developing infrastructure based rather than on service based competition, limiting therefore the extent of virtual access products.

3.4 The role of network separation

Regulators have historically seen forms of business separation as an effective way to deter and to detect both price and non-price discrimination in particular. Martin Cave[36] first suggested a classification system for separation in which a first step is accounting separation, which requires separate accounts for the separated branches to allow the regulator to detect too high wholesale margins or too low retail profits (indicating excessive access prices applied to competitors or predatory prices in the downstream segment). Pricing rules have been developed at length by the Commission in recent years to protect against other price discrimination concerns, notably on the pricing of copper and also the appropriate mechanisms for testing margin squeeze.

[35] Panzar, John C. and Robert D. Willig. "Economies of Scope." *American Economic Review* 71.2 (1981): 268-272.
[36] Cave, Martin E. "Six degrees of separation operational separation as a remedy in European telecommunications regulation." (2006).

However, even if price discrimination can be detected with these solutions and many concerns arise about the allocation of costs in the presence of scope-economies, it is non-price discrimination that is much more difficult to identify, detect or remedy and are the general rationale for considering more aggressive forms of business separation in telecommunications. That is not to say that ex-post competition law cannot or has not made interventions to remedy non-price discrimination in telecom markets but it is a significantly more difficult route than through the use of ex-ante remedies[37].

Under the aforementioned model developed by Martin Cave, separation in telecom markets can take a number of forms which range from the mentioned accounting separation to the extreme option of ownership separation (whereby the network owner has to divest the access network such that the legal ownership of the network and the rest of the firm results in two different entities) which has been implemented in some countries for other network industries (e.g. electricity). Many analysts do not consider separation as a suitable option for telecoms for several reasons, the most important of which are the lack of a natural monopoly boundary in telecom networks owing in particular to technology change and the ability to exploit of economies of scope and functional coordination across the ownership boundaries. The need to make significant investment decisions and to co-ordinate those decisions between different business areas (retail/wholesale) in a complex technology environment is already difficult.

In certain network industries a natural monopoly boundary exists – for instance it is not proposed to ever duplicate the electricity wires in electrical distribution networks since the costs of replication would be so great as to vastly outweigh any possible benefit of competition in that part of the market, a similar dynamic exists in water or gas distribution.

However, in telecommunication networks technological change affects the areas where such natural monopolies might be said to have existed – 40 years ago it might have been said that the copper network was a natural monopoly for voice telephony and it might even have been true at that time but then mobile telephony and the adaptation of cable tv networks created competing access links. Other examples exist in other service markets but what is important is that, over time technological change means that the boundaries of competition and the boundaries of markets can shift, and can shift considerably, in the telecom sector. Few other regulated sectors are subject to the same disruptions caused by technological change. This is the principal reason why telecom networks were not separated from services at the point of liberalisation in Europe when electricity network was[38].

The ability of an integrated firm to avail of economies of scope is a related issue. Again, over time, new services can be developed that can be delivered over existing infrastructures (for example VoIP, IPTV, etc. can be added to a basic broadband service). Since the input and the input cost is common (the network for instance), then the incentive to develop new services for consumers is very high since the new production process is virtually free – in a separate entity, the service provider would contract for access for the service, new services would require a new access agreement and the incentive to develop the service would necessarily be weakened.

That loss of incentive to develop new services would be exacerbated where significant changes to the network would be required to deliver the services. The investments (and associated risks) would be with the network owner while the potential gains if the new service is successful would be mostly with the service provider. Such asymmetric payoffs would lead to the co-ordination difficulties just mentioned. While in theory these could be dealt with through contractual arrangements, in practice it is very hard to align incentives and outcomes.

In an effort to avoid these pitfalls, functional separation came to be seen as an intermediate solution which can be effective against non-price discrimination and at the same time, limit the disadvantages

[37] COMMISSION DECISION of 22 June 2011 relating to a proceeding under Article 102 of the Treaty on the Functioning of the European Union (TFEU) (COMP/39.525 – Telekomunikacja Polska)
[38] Pelkmans, Jacques. "Making EU network markets competitive." Oxford Review of Economic Policy 17.3 (2001): 432-456.

of deeper forms of break-up. It can itself be ranked in several degrees, ranging from the creation of a wholesale division to legal separation (legally separate entities under the same ownership). In functional separation, remedies are principally concerned to ensure that their separate operation is better than alternative options.

In this context it is reasonable to question whether some of the disadvantages previously mentioned for ownership separation are likely to occur also implementing the softer functional separation option, albeit in a weaker form. For instance, the impossibility to avail of economies of scale or scope and share production factors (which in principle could be common between products or stages of production), or to transfer information relevant for coordination activities could produce inefficiencies in term of loss of economies of vertical integration. While the availability of the bottleneck assets for competitors on favourable conditions may be useful to foster service based competition, the reality is that it is likely to reduce the incentive of entrants to invest in their own infrastructure, thus delaying the implementation of infrastructure based competition which delivers superior outcomes.

It is therefore necessary to also identify the potential pros and cons of separation, even if implemented in a "softer" form such as functional separation, and to understand the magnitude of gains and costs, which must be correctly balanced in terms of losses in economies of vertical integration, of the implementation of functional separation in European Countries. If such economies of scale or scope did not exist or were not relevant, then this would constitute a strong argument in favour of separation since this solution would benefit consumers through improved competition via lower prices without significant efficiency losses in production. On the other hand, if these effects are present they would represent a direct cost of separation, which should be implemented only if the gains in term of competition were large enough to offset those efficiency losses[39].

Strong and broadly accepted theoretical reasons support forms of separation as a mean to foster competition; however (and, again, in theory), such a solution could in principle generate important drawbacks, in terms of reduced incentives to investment and innovation, and in term of losses of (vertical) economies of scope. Whether or not the competition benefits offset the efficiency losses is mainly an empirical question, whose answer needs to quantify both the gains and the costs.

Hence, considerable conditions were attached to the implementation of the 'softer' form of functional separation provisions under Article 13a of the 2009 Regulatory Framework, the provisions of which are carried forward almost verbatim in Article 77 of the EECC[40]. In practice, it is difficult to see a country in Europe where these conditions could be met but the need for a rigorous assessment of the various trades-offs in implementing such a decision are clear.

3.5 The role of wholesale-only operators and their financing task

This dichotomy, that separation in its various forms might undermine investment, was acknowledged by the Commission in its consideration[41] of the different incentives it might put forward to encourage investment in the EECC:

"As regards indirect effects, there is a risk that provisions concerning wholesale-only models may foster separation and therefore increase reliance on regulated wholesale access to the detriment of potential developments in infrastructure based competition[118] thereby impeding incentives in fast infrastructure investment.[119] On the other hand, it would reassure investors regarding the regulatory approach to local fibre networks whose market power at the local level may be found to be significant.

[39] See also Gonçalves, Ricardo, and Álvaro Nascimento. "The momentum for network separation: A guide for regulators." Telecommunications Policy 34.7 (2010): 355-365.
[40] DIRECTIVE (EU) 2018/1972 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 establishing the European Electronic Communications Code
[41] COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposals for a Directive of the European Parliament and of the Council establishing the European Electronic Communications Code (Recast) and a Regulation of the European Parliament and of the Council establishing the Body of European Regulators for Electronic Communications {COM(2016) 590} {COM(2016) 591} - SWD(2016) 303 final PART 1/3

If a single wholesale-only fibre network is deployed, infrastructure competition is also likely to be of lesser relevance in attaining the various objectives of the Framework. Separation or wholesale-only models may result in increased service competition, which may boost broadband take-up through reduced retail prices and service innovation.[120] Moreover the risk of impacting infrastructure competition could be mitigated if separation is incentivised in areas or circumstances where infrastructure based competition is unlikely to arise.[121] [42]

The conclusion therefore might be that although separation remedies may eliminate discriminatory behaviours on the part of the upstream firm, the general impact on the incentive to invest in competing infrastructures may reduce the level of infrastructure based competition (because potential competitive investors to the WO operator know that they will get as good a deal as any other operator on that network).

On the other hand, since vertically integrated incumbent telecom operators and vertically integrated CATV operators would continue to exist on most markets, the impact of separated entrants is unclear and may simply add to infrastructure based competition, at least in the short term.

However, if the competitive reaction from vertically integrated firms is to separate themselves then considerations would change. In that circumstance, the various wholesale-only operators would have comparable incentives to make network investments in products where virtually all the rents occur at the retail level. Would one seek to steal a march on the other by assuming all the risk and hoping to capture more wholesale customers if the retail product is a success, or will both choose not to invest? The latter seems much more likely.

It should also be noted that such effects are unlikely to be uniform across countries or even within countries. The risk to infrastructure based competition arising from separated entities may not be an important effect in less densely populated areas where the cost of multiple networks would not be supported and where separation may be a first best solution; but it could be an important negative in urban areas where end-to-end infrastructure based competition would be possible. Population density is one of the largest single drivers of cost and is the single most important determinant of where infrastructure based competition might or might not be possible.

[118] It is notable for example that there is limited infrastructure based competition in the UK beyond the pre-existing copper and cable infrastructure. BT introduced functional separation (under pressure from the UK regulatory authority Ofcom), in 2005. It is possible that this approach reduced incentives for infrastructure based competition..

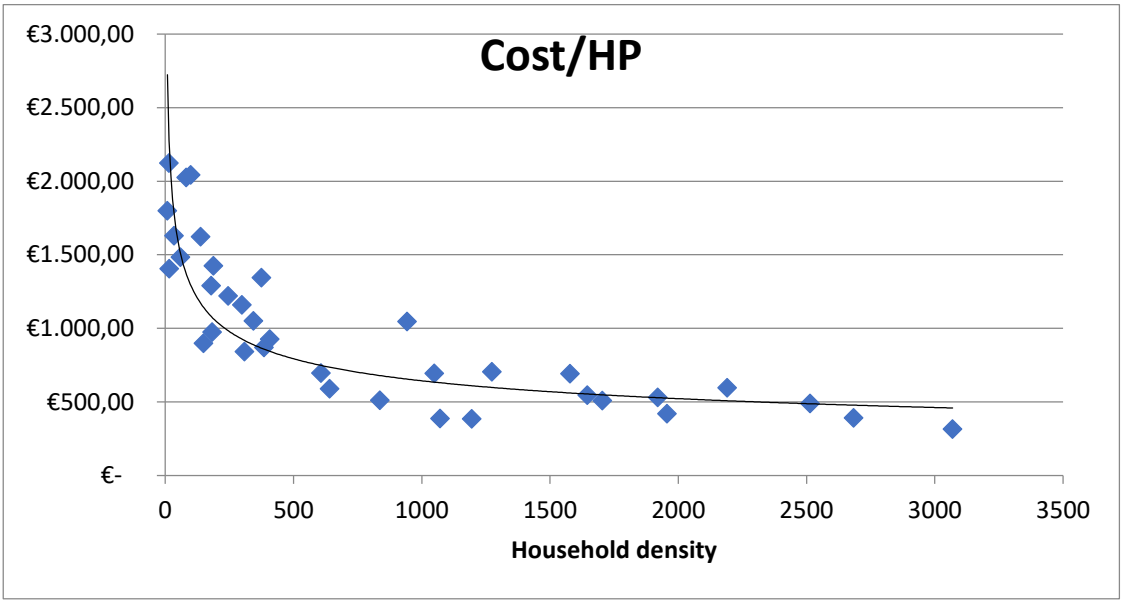
[119] Case studies from SMART 2015/0002 suggest that structural separation/wholesale-only models can support the business case for fibre by aggregating demand from several service providers. This strategy has been adopted in particular by regional and municipal investors such as Stokab and Reggefiber to support a fibre business case. However, the study also finds that separation may not itself drive technological upgrades.

[120] Econometric assessments conducted in the context of SMART 2015/0002 and annexed to this report found that NGA take-up was linked to lower NGA prices which were in turn associated with increased access-based competition

[121] Costs for the deployment of NGA increase in less densely populated areas, reducing the prospects for network replicability. See discussion in SMART 2015/0002 as well as WIK (2008) economics of NGA

Figure 2 below comes from a Cost Study on FTTH Deployments and shows the 'cost per home' for 36 sampled areas with varying household density. The total sum of living units (homes) for the new trend lines (amounts to almost 2m sample points). These sample points are then used to calculate a best-fitting curve. The cost of deployment increases rapidly below a certain level of units per km^2 which strongly suggests that the scope for infrastructure based competition in less densely populated areas is significantly less.

Figure 2: The cost per Home Passed for 36 sample areas with a varying density[43]



Infrastructure competition is facilitated by the many measures in the code that enable access to internal wiring, civil infrastructures etc. Article 61 of the EECC is the most extensive set of general obligations in the EECC and extends the possibility to impose a general obligation on all operators who control non-replicable wires and cables connecting end-users to the network to give access to the entire loop to competitors where replication of such network elements is economically inefficient or physically impracticable.

There is considerable regulatory oversight by the Commission and BEREC on the use of these measures and the Commission will be able to block the measures of NRAs when deemed unsuitable if BEREC agrees (referred to as the 'double lock veto' mechanism). In particular Article 61 (2) generally grants access to inbuilding wiring and up to the first concentration point (for telecom operators and everyone else) and this should have a big impact on reducing deployment costs. The text goes on to permit regulators to go beyond the first concentration point in the case where there is an insufficient number of end-users for access to be viable or to require, in extremis, a virtual access remedy to be offered.

However Article 61 (3) goes on to say that Wholesale-only operators (as defined in Article 80) do not have to grant access provided they make …."*available a viable and similar alternative means of access to end-users is made available to any undertaking, provided that the access is offered on fair, non-discriminatory and reasonable terms and conditions to a very high capacity network.*" (which would seem to be their raison d'être) or "*in the case of recently deployed network elements, in particular by smaller local projects, the granting imposition of that access obligations would compromise the economic or financial viability of their a new network deployment in particular by smaller local projects*."

[43] https://ftthcouncil.eu/documents/Reports/2017/FTTH%20Council%20Cost%20Model%202017_final.pdf

The probability therefore of any obligations being imposed on any Wholesale-Only operator under Article 61 are low and so the measures are aimed at encouraging and enabling entry except where that infrastructure is already used by a Wholesale-Only operator.

Infrastructure based entry is also promoted by similar obligations being imposed on SMP operators and NRAs have extensive abilities to use either the general remedies described earlier to impose obligations on access to, and use of, civil engineering including building cables, antennae, poles and ducts, or where appropriate there are a number of SMP specific obligations set out in Articles 72 and 73 which can also be applied. These obligations include many different access products but importantly it includes access to Unbundled Loops and/or access to virtual access products.

However, several exceptions apply again to wholesale-only operators which include the presence of an existing commercial offer in line with Article 61, the technical and economic viability of granting access (given the dominant network architecture is PtMP this is not likely), the impact on future network development (adverse for future developments) and the level of investments, the risks borne by the initial investor etc (high and mitigates against any access).

There are also regulatory reliefs for SMP operators and these are generally set out in the provisions concerning investments in VHCNs and particularly co-investments (Article 76 together with the associated Annex 4). In general these exemptions from regulation are onerous and complex conditions to get regulatory relief (for instance, is access open to any provider? Does the co-investment facilitate competition at the retail level, was participation in the co-investment available 6 months prior to launch? Does it allow access seekers the same T&Cs as investors, etc. etc.). Any regulatory relief achieved under these provisions for vertically integrated entities (traditional incumbents) will likely be rare in a European context and it is difficult to see examples of co-investment which have happened in Europe to date to which these exemptions could apply. In any event, BEREC is also required to issue Guidelines (Article 76(4)) to clarify under what circumstances exemptions might apply. The draft BEREC guidelines[44] clarify some of the issues but the interpretation does imply that the conditions required to qualify for regulatory exemptions will be onerous on the parties.

3.6 Financing VHCN networks

One particular challenge of investment in fixed telecom networks has been the way in which the finance community view and classify these investments. A VHCN investment by a vertically integrated incumbent is normally classified as a technology dependent investment since there is an associated technology component to be deployed to service the retail market. Even though that investment might be 90% based on passive network elements, as an investment risk it is deemed to be a 'technology investment' and therefore deemed high risk – normally requiring a short payback period with a high cost of capital associated with it. On the other hand, if a firm only builds the VHCN network but does not enter the retail market and then goes to the capital markets to seek funds, this is likely to be classified as a long-term, low-risk infrastructure investment. The result of which is that a longer (20-30 year) timeframe can be considered at a much lower cost of capital since it is deemed to be a long term, low risk infrastructure investment.

It is also the case that certain categories of investors (for instance insurance fund managers) who seek assets that are low risk and pay a steady dividend over 20-30 years used to complain that there were no investible products from their perspective in telecom markets, hence the reason that they invested in energy, road, rail and other network sectors but not in telecom. What is striking now is that these new wholesale-only operators have created a new investment class that addresses these needs, so much so that many finance entities are eager to invest in separated VHCN networks[45]. Implicit in this analysis may be a belief that there is a 'new utility' type perspective or that a new

[44] BoR (20) 113 Draft BEREC Guidelines to foster the consistent application of the criteria for assessing co-investments in new very high capacity network elements (Article 76 EECC)
[45] For instance Goldman Sachs investment in Cityfibre, Cassa Depositi e Prestiti Group investment in Open Fiber.

boundary where monopoly assets can be identified- in short whoever builds a fibre network open to the market on non-discriminatory terms (where the incentive to discriminate is removed) wins the market. There is a strong parallel that can be drawn with the recent shift to mobile tower companies. Like Wholesale-Only, these companies are driven primarily by financial engineering considerations. Take that part of the industry where innovation gains are close to zero (steel towers), consolidate the assets and create separate companies with very low risk, so that long term infrastructure investors will invest.

One aspect of investing in fixed Wholesale-Only operators is that these financing entities may be underestimating the level of innovation gains that might still be available. There are a large number of ways to implement a FTTH solution and technology risk driven by network topology mean that certain network deployments could be overbuilt in the future.

3.7 Ongoing technological change in fibre networks

There is sometimes an assumption in fixed telecom markets that with the migration to VHCN (FTTH/B) the rate of technological change at least at the network layer will slow down. If anything the opposite appears to be true and a number of different technological choices are looming for many network operators in the near future. The different technological choices and the different topological choices have been described at length elsewhere[46] but suffice it to note that from a topology perspective, two main choices exist which are to deploy either a point to point network (PtP) or to deploy a point to multi point network (PtMP) with both networks being what their names suggest. In the copper world, telecom operators had PtP networks while CATV networks had a PtMP network topology. Over the new fibre network topologies, different network technologies can be deployed such as PON and its variants, ethernet etc. can also be deployed. As PON technologies are particularly well suited to be deployed over PtMP, the topology and the technology have become synonymous in the vernacular of the industry even though a PON technology could equally be deployed over a PtP network topology. In fact, there is a lot of grey in network descriptions, any PtMP network must at some point become PtP even if that is just from a splitter in the basement to individual units within a building. Normally, a PtMP topology suggests that the splitters (the point at which the fibre becomes shared) are placed either at a street cabinet or ODF (which is not the exchange). Equally, the use of various Wave Division Multiplexing (WDM) technologies would allow a (virtual) PtP technology solutions that could overlay a PtMP topology. WDM splits light into its constituent colours (and even shades of colours can be distinct, although there is a cost implication) and so a 1:32 or 1:64 spit PON topology could in theory have an equal number of lightwaves such that a dedicated colour could be assigned to each line. To a large extent however, investment in PtP networks reduces future technology risk since a dedicated fibre has enormous capacity and avoids the need to use WDM in the nearer term.

However, despite the complexity and fungible nature of network deployments and technologies a few characteristics of FTTH/B networks are important from a public policy perspective. The first characteristic is that a PtP network topology is capable of being rented, line by line, much as copper was under the ULL regime. With an unbundled fibre line (also called a dark fibre line), the renting party can deploy its own technologies and operate completely independently of the network owner. An example of such a provider is Stokab in Sweden where third party operators rent fibre loops and build their own network over those loops[47].

Once a network operator moves away from the PtP topology, that network owner assumes much more control of the technology path, its value and the pace of any technology development. Essentially, any network development, and its timing, becomes the decision of the network owner. With a WDM enabled network and/or with SDN/NFV functionality deployed over the network – the party looking to rent an access line, even if it is a virtual access line, can theoretically operate with

[46] A good overview can be found here https://www.ftthcouncil.eu/documents/Publications/FTTH_Handbook_V7.pdf
[47] https://www.stokab.se/Documents/Nyheter%20bilagor/A%20tale%20of%20five%20cities.pdf

significant independence though these network developments look to be many years away from widespread deployment (and would indeed also need to be made in the first place).

With some notable exceptions (such as the aforementioned Stokab in Sweden) almost every Wholesale-only operator in Europe has deployed a PtMP network. There are many reasons that this may be the case from technology preference to cost concerns which themselves could be driven by a myriad of different factors (whether overhead or not, low take-up, speed of deployment etc.). Cost models and cost studies have generally found that the differences in the two topologies are small[48]. Two unavoidable facts result from a PtMP topology choice are (a) the PtMP network operator will be responsible for, and control, future networks developments and (b) the PtMP network operators will be delivering/controlling far more of the value chain in the markets that it serves. It is analogous to an operator in a copper world only delivering a bitstream service and not unbundled loops.

There is an important caveat to this analysis which is that with a WDM overlay, a PtP network can be created 'virtually' over a PtMP network structure. The extent to which such a transition requires major investment depends critically on the way in which the original PtMP network has been deployed. Some networks (e.g. Spain and Portugal) are 'WDM ready', that is the changing of splitters in the field can be achieved quickly and cheaply whereas in other markets (e.g. France), fully spliced networks predominate such that any network upgrade to WDM could be more expensive and slower[49].

While fixed VHCN investments seek to deliver much higher connectivity rates for their own sake, a major objective is also to support other network deployments such as 5G which will also need very high capacity in the backhaul/fronthaul networks. The two networks might simply supply services in parallel in a kind of hybrid 5G world where wifi and macro-5G cells deliver a seamless service as proposed by some operators in their markets[50]. It can already be anticipated that much higher capacity on the FTTH networks will be needed for future services and also to support 5G. This could be supported using a PtP overlay, especially for the mobile sites but more likely, the whole network will need either more fibres or a WDM overlay. Since WDM splits light waves it becomes effectively like additional fibres and while these could be offered to another operator to deliver retail services, it could also simply be deployed to increase capacity[51].

One implication of all this is that network competition will likely continue as different technical solutions will have winners and losers. Unless PtP has been deployed, significant technology risk remains. If a PtP network has been deployed, the biggest risk may be the regulatory risk that at some point in the future, dark fibre access may be mandated which given the persistence of the NGA and NDCM Recommendations may look like a real risk to any network investor. Another important implication coming from all of these future network developments is that a separated Wholesale-Only operator or an integrated incumbent operator that chooses to separate will likely have to take very significant investment decisions driven by retail considerations and will need to be very co-ordinated and receptive to retail operators' demands. Questions of investment co-ordination and possible hold-out problems will be relevant and are likely to arise in such a context and also in future network contexts.

3.8 Investment co-ordination and the case of vertically integrated incumbents

One of the principal reasons why economists do not favour deeper forms of business separation in telecommunications concerns investment co-ordination. Investment co-ordination problems could be significant under a separation procedure as the organisation running the network would have no, or

[48] See for example the 2017 study by FTTH Council Europe and the antecedent study https://www.ftthcouncil.eu/documents/Reports/2017/FTTH%20Council%20Cost%20Model%202017_final.pdf

[49] OECD (2011), "Fibre Access: Network Developments in the OECD Area", OECD Digital Economy Papers, No. 182, OECD Publishing, Paris, https://doi.org/10.1787/5kg9sqzz9mlx-en.

[50] https://hellofuture.orange.com/en/extreme-5g-coverage/

[51] A co-ordinated 5G/VHCN network deployment where additional fibres for backhaul are deployed in anticipation of 5G/6G deployments can lead to very significant cost savings on the overall project. See for instance https://www.siradel.com/research/ftth-council-europe/

a much weaker, direct relationship with end customers making the benefits of investing for successful services mostly with the access seeker rather than the network owner whilst the cost of unsuccessful services will be borne by the network owner rather than the access seeker. Ensuring appropriate network investments and upgrades clearly becomes more difficult to co-ordinate. Taking this thinking further, if other retail suppliers rather than the separated entity's retail arm would seek to drive the investment decisions, where their customer bases are smaller and their relationships shorter in duration, this would strongly exacerbate these problems. From the network side, if technical developments would be triggered either within the network operator itself, which would then run the risk that the separated retail arms would not be willing to invest in the marketing resources needed to sell the technical solutions to customers, or in individual retail firms, which would then have to persuade the network operator that the anticipated demand for the new service is sufficient to justify what may be a very large investment. Separated entities could seek to allocate risk through contractual terms but the effectiveness of such a system is unknown. The risk that technical change would slow down in such a context seems a very real one.

For currently integrated incumbents, one aspect of more fibre in a network is the associated changing topology of the network with the Main Distribution Frames (MDFs) are likely to disappear in an optimally designed FTTP network. With the integrated incumbent morphing into a separated network operator, a changed ODF or some other NTP point will remain as the demarcation point. The implication is that with deeper separation these developments would require the co-ordination of investments between the different retail operations and the network operator, as well as joint operation of the fibre assets. While a de novo wholesale-only operator would not face such issues, investment decisions could still require a shared view of future revenue streams between a series of wholesale operators selling into the retail market and the network operator as the network operator selling into the wholesale market, which may prove hard to achieve.

Integrated operators have argued that separation of a highly complex vertically integrated company will be difficult, disruptive and costly. Separation of telecommunications networks poses particularly intractable problems at a technical level, given the complexity of current technology solutions and the shifting of active intelligence to different network layers (especially as intelligence moves to the edge)[52]. Setting a clear delineation between wholesale and retail services may not be as easy as in the recent past and is likely to be even more difficult in the future. More importantly, it is not obvious where the future incentives lie for the further development of network capabilities for a network operator that is moving towards being a pure utility wholesale operator.

On the other hand, the line between services and infrastructure is simplified by recent changes such as Open-RAN. Mobile equipment has been service-specific and attached to specific spectrum bands. However, the move to an Open RAN structure results in the disintermediation of services and equipment in a mobile scenario. This is a very important phenomenon as, in practice, this means that the selection of a vendor for a specific solution of service is no longer an absolute requirement, as equipment can now be "mixed and matched" in ways that could not occur 10 years ago (or even 5 years ago). It also creates a brighter line between services and hardware than existed in the past. This move towards Open-Ran is part of a broader trend towards the commoditisation of vendor hardware and the same phenomenon is well established in fixed networks.

The development of fixed telecommunications are currently based on extending fibre to the home or building to enable faster broadband access and to support future 5G deployments. If this investment is to be the responsibility of a separated network operator, how can the critical investment incentives be created for that network operator when there is no direct relationship with the retail consumer.

[52] The adoption of SDN and NFV technologies is particularly relevant as under such a network deployment, network functionality could be delivered remotely by the service provider – in a sense network functionality itself becomes disintermediated from the physical network.

Such risks can be mitigated by careful co-ordination with retail operators, but it is an issue which will continue.

As noted by Patrick Xavier for the OECD[53], one of the principal reasons for vertical and horizontal integration is to reduce risk when there are a number of different technological options to choose from. This is the situation for fixed telecommunications investment today which must consider a multitude of access technologies including vDSL, vectored vDSL, G.Fast, PtP FTTP, PtMP FTTP, WDM PtMP FTTP etc... Prudent investment is likely to involve spreading the risk of employing an appropriate combination of these technologies or moving incrementally between technologies. The difficulty of this task for the network owner is increased by the uncertain demand for new services. Firms are naturally reluctant to invest in infrastructure upgrades if there is uncertainty regarding consumer interest in the new products supplied through the technology. Telecom operators who act as early adopters avoid making commitments to technology that will not be compatible with other communications technologies or that will be expensive relative to facilities that can be deployed in the near future. Therefore the decision is not only about determining the correct technology solution but also about choosing an optimum path to that solution and time to deploy each step in that path.

Even for the separated network operator itself with its close ties to the retail business, it can be difficult to determine the elements of an appropriate network architecture whereas external retail based entrants are likely to find it even harder to accurately forecast future market trends and evaluate the comparative advantages of the different technologies and the risk of unrealistic network demands, when their money is not invested, grows. The investment risks in such a dynamic setting are significant and more easily borne by large, diversified companies. In addition, the large firm can spread the fixed costs of evaluating new technologies with uncertain results over a large number of units.

As noted by the OECD in 2016[54], for any integrated organisation, network design and planning can be done by consultation between those who sell the product, those who make it, and those who supply large parts or systems for it. Together, they forecast future capacity needs and identify product improvements and the necessary investments in new and more specialised equipment which promises better quality and cheaper production costs. If the investment is very specific, vertical integration alleviates the problems that can arise (such as hold-out by one or other party) by eliminating the opportunity to negotiate over the price paid to the owner of the newly created asset.

Under any separation model the decision as to who would decide the type of network to provide and how would the risk be spread needs to be determined as does the weight of the different and potentially diverging views in the ultimate investment decision. With a vertically integrated firm, the risk is internal to the firm. When a telecom operator decides to upgrade its network, it decides both the purpose and the means to achieve that purpose. How this can be handled as separation between the network and retail division deepens is not obvious. How would this wholesale company focused on wholesale services select the right technologies to meet consumer demands in the dynamic telecommunications market where it must now keep the end-customer at arm's length and deal with a range of wholesale customers with likely diverging views on the evolution of the retail market?

Given the degree of uncertainty and highly specific technology choices that are inherent in the telecommunication industry, it seems that a firm which is vertically integrated bear the risks and uncertainty of developing local telecommunications service can more easily than a separated firm, and is better positioned to ensure an optimum network development.

There are concerns over whether there will be adequate investment in network infrastructure when providers are denied the revenues and consequent incentives that flow from vertical integration,

[53] OECD (2003), "The Benefits and Costs of Structural Separation of the Local Loop", OECD Digital Economy Papers, No. 76, OECD Publishing, Paris, https://doi.org/10.1787/232804472031.
[54] http://www.oecd.org/daf/competition/Structural-separation-in-regulated-industries-2016report-en.pdf

even structural separation which denies the network operator the ability to take unilateral investment decision is likely to have the same result. This problem is acute in the telecom industry, where technological change is rapid and where investment demands are the top priority. Problems of co-ordination of investments across wholesale and retail operators would also impede investment as well as innovation –both of which are critical in the telecommunications sector today. These problems could be considerable and could serve to delay the extension of fibre to the customer.

Deeper separation is likely to have some success in regard to promoting services competition and this in turn could promote some forms of network enhancement and certainly, functional separation in the UK was followed by a large expansion of the LLU base when it was implemented. But some analysts voiced concerns that structural separation could be harmful in regard to the promotion of innovation by undermining confidence in incumbents, who could be in the best financial position to enhance the network and the access network in particular. Structural separation threatens to weaken the ability of incumbents to make investments according to this view.

There are also considerable one-off costs from implementation in the form of transaction costs, dislocation costs and risks of interruptions in supply as new lines of command are established.

For existing vertically integrated firms, the costs and benefits point to vertical integration as being the better structure where there are ongoing technological developments. There are still considerable benefits available in network innovation – at a minimum there are a large number of ways in which fibre networks can be deployed and structured, suggesting that the case for maintaining vertical integration is strong. Vertically integrated firms may have unilateral financial engineering incentives to separate, but this has hidden costs in terms of reduced innovation incentives which are not properly taken into consideration when deciding on firm structure.

3.9 Entrant Wholesale-only Operators

Many of the previous considerations do not apply to entrant Wholesale-only operators precisely because they do not have existing retail divisions and because their approach to the market is different. In the first instance, the cost of separation and restructuring will not apply since these Wholesale-only operators are created separated. Wholesale-only operators are also entering the market seeking customers at the wholesale level, not as an incumbent operator doing so under compulsion but willingly because that is their business model. Since they are entering the market with a very low market share, their priority, at least in the initial periods, will be to ensure that there is maximum utilisation of their newly built network. Sensitivity to wholesale customer demands will likely be both very high and based on an anticipatory model of investment.

There is also a significant constraint that comes from existing vertically integrated operators – in the event that investment coordination issues arose for a given retail product requiring a network upgrade, such considerations would be internalised by the vertically integrated firm. The wholesale-only firm would then be required to invest due to the network competition that exists.

There is no suggestion that structural separation might be imposed in Europe (even if such an outcome is provided for the in the Code). However, it is possible that, in the presence of significant Wholesale-Only entry, a vertically integrated operator could choose to structurally separate themselves and seek to compete on equal terms. This is already provided for under Article 78 of the EECC.

Already in Europe there is evidence that entrant Wholesale-Only operators are building in anticipation of 5G investments and that they are seeking to stimulate wholesale demand for these services[55]. This reflects the reality that overrides the economic considerations that apply to integrated incumbents that separate; new entrant wholesale-only operators enter a market that has at least

[55] https://5g.co.uk/news/cityfibre-deploys-massive-pilot-of-5g-ready-infrastructure/4636/

one and often times two vertically integrated competitors that will oftentimes have a greater physical network reach even in the medium term. Privately funded wholesale-only operators will only cover those areas that can deliver a reasonable return over time, normally restricted to higher density areas while public funding would normally be required to push such a model into less densely populated areas[56]. In Europe, densely populated areas have normally two integrated networks (both incumbent and CATV networks) against which a wholesale-only entity must compete both on price and technology developments. Wholesale-only operators today are acting under a constraint that comes from vertically integrated competitors. Without that constraint, even in the presence of other wholesale-only network competitors, theory tells us that they may not meet that market demand so policy makers need to take a more jaundiced approach[57].

It is in light of this consideration that the Commission's exemptions to Wholesale-only operators in the general access conditions must be judged as well as the reality that a vertically integrated incumbent that separates would not necessarily enjoy the same regulatory treatment as a de novo wholesale-only entrant operator. Article 78 of the EECC which deals with vertical separation of an existing entity makes clear that the Article 80 provisions would only apply where appropriate and specifically grants NRAs access to the full suite of access remedies (which do not apply in the context of Article 80). Such an asymmetric approach to what in practice is likely to be identically structured entities may raise eyebrows but in the context of the historical background and the likely market position of the entities concerned is likely to remain appropriate for the foreseeable future.

The conclusions of this analysis are cautionary. There is evidence from markets that have wholesale-only operators that there has been a significant increase in investment in VHCN. Whether it is that the environment that facilitates such operators also drives investment more broadly or whether it is the presence of such operators that drives the broader markets cannot be determined without further study. There are good investment outcomes in those markets so the push in the EECC for more infrastructure based competition and the emphasis on wholesale-only correlated with positive outcomes and should continue.

What is also clear is that further rounds of investment in both fixed and mobile networks can be anticipated. The concerns about investment co-ordination are valid, particularly in markets where might be no vertically integrated operator. Regulators should pay more consideration to these concerns when framing their regulatory responses.

The concerns about investment coordination are constrained by the presence of vertically integrated competitors. If vertically integrated operators feel compelled to structurally separate for financial engineering reasons (or perceive that their regulatory treatment would change radically) then they may move to separate themselves. Such changes would carry significant risks and policy makers should consider signalling ahead of time that exemptions enjoyed under Article 80 are likely to be much more limited under Article 78.

[56] Wholesale-only entrants to date have often aligned or taken onboard either municipal or a utility partner which has conferred access to another physical path to dwellings to enable network deployment.

[57] There is a comprehensive overview of the literature in Krämer, Jan, and Daniel Schnurr. "A unified framework for open access regulation of telecommunications infrastructure: Review of the economic literature and policy guidelines." Telecommunications Policy 38, no. 11 (2014): 1160-1179. A lack of coordination may lead to inefficient investment (De Bijl, 2005; Sidak & Crandall, 2002). Separation and incomplete contracts lead to opportunistic ex post behaviour delaying investments (Crandall et al., 2010). The opposite conclusion on contracting difficulties is arrived at by Cave, Martin, and Chris Doyle. "Contracting Across Separated Networks in Telecommunications." Communications & Strategies 68 (2007).

04

LEGACY LEGISLATIVE INSTRUMENTS

4 Legacy legislative instruments

4.1 Broadband Cost Reduction Directive

The Broadband Cost Reduction Directive (BCRD)[58] is the main instrument to lower entry barriers in network deployments and sets out the rules regarding access to the physical infrastructure of all utilities for the purpose of building broadband networks. It also covers in-building wiring and provides wiring guidelines for new buildings and major refurbishments. It should be noted that some governments already had similar rules in place before the BCRD came into force, notably Spain, Portugal and France, where infrastructure based competition had been a priority for longer.

Since the first draft of the BCRD was published, the Commission's policy objectives and the means of achieving them have shifted significantly, as expressed through the EECC. In terms of goals, European policy now wishes to see investment in very-high-capacity networks (VHCN), which is defined as FTTH/B and its equivalent. While not finalised, BEREC's preliminary view[59] on what constitutes equivalent to FTTH/B has also set a high-performance threshold, in particular in terms of downstream and upstream speed, which implies that any new investment in fixed networks is likely to be fibre. The Gigabit Society vision (COM(2016) 587 Final) has set a target which is 100Mbps universally available and upgradeable to 1Gbps by 2025. In practice, the industry understands that the objective of policy development is now FTTH/B.

With the EECC, facilitating infrastructure based competition is now the main driver of fibre deployment. This has worked in a number of countries that tried it, often where the cost of deployment was low due to existing passive infrastructures that could be shared. A model of infrastructure based competition requires the right facilitation in order to lower the cost of deployment. Therefore, the revision of the BCRD is not only timely and useful, but it is essential to making the implementation of the EECC coherent. As we discuss below, this revision is planned for next year.

Operators described in Article 80 of the EECC (wholesale-only or WO operators) typically rely on other utilities' infrastructures[60] to roll-out their fibre networks. Once a fibre network deployment is started, those utility physical infrastructures are typically exempt from any access obligations to preserve their incentives to invest and maintain their business case.

This approach, first enunciated in the BCRD has been reaffirmed and strengthened in the EECC. These access exemptions appear to have worked (or at least WO operators have been successful) in the absence of a counterfactual.

The BCRD seeks to facilitate measures to enable network deployments, but given the policy context, these measures stopped someway short of what is needed in the new policy context (for instance, in-building wiring being 'high-speed-ready' meant copper was still sufficient even in new buildings).

A report on the effectiveness of the BCRD was published in 2018.[61] This report provides an overview of BCRD's implementation and includes a summary of its impact. The survey responses show that operators believe that there have been improvements in access to physical infrastructure (including in-building infrastructure) and information provision since the Directive was applied. However, operators indicated limited progress on the coordination of civil works, easing the process of applying

[58] Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks.
[59] https://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/9037-draft-berec-guidelines-on-very-high-capa_0.pdf
[60] For instance, Open Fiber uses Enel's infrastructure in Italy, SIRO relies on ESB electricity network in Ireland.
[61] COM(2018) 492 final REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks.

for civil works permits, or facilitating access to buildings for the installation of in-building infrastructure.

The Commission at that time identified the following actions to improve the functioning of the Directive:

- Ensure transparency as a prerequisite for the shared use of physical infrastructure and co-deployment, meaning adequately equipped single information points to enable them to perform their tasks effectively, including proactive approaches such as mapping exercises and pre-notifications for civil works coordination.
- Enhance regulatory certainty in relation to terms and conditions, including prices and cost apportionment, for instance by the development of guidelines (by National Regulatory Authorities (NRAs) or other bodies), indicating which methodology would be used to resolve disputes, how costs for sharing infrastructure or co-deployment would be apportioned and the extent to which regulated utilities could benefit from any cost savings or profits arising out of collaboration.
- Ensure greater overall efficiency of permit-granting procedures, by central availability of information on permits, strict enforcement of deadlines for granting permits and by enabling electronic permit applications.
- Develop standards for and clear rules on access to in-building physical infrastructure; this includes broadband labelling schemes and clear rules concerning the terms, conditions and price of access to in-building infrastructure.
- Promote better cooperation amongst regulators at the regional and local level and between sectoral regulators, but also among regulatory groups at the EU level such as BEREC and ACER.
- Ensure efficient data gathering on key performance indicators to enable continuous monitoring and a future evaluation of the implementation of the Directive (to be carried out by the relevant national authorities).

The implementation of the original BCRD was not very effective. The most significant reasons cited are: (a) failure in institutional design (no one has overall responsibility for implementation), and (b) the inability to systematically designate prices for access.

Institutionally, while efforts have been made such as the use of a single information point (Article 4), no agency takes overall responsibility for administering the BCRD. While NRAs are almost always designated as the identified single information point, NRAs are the body that deals with dispute resolution less than 50% of the time.

Establishing good operational procedures for infrastructure access is complex and difficult. When it came to Local Loop Unbundling for copper networks in the early 2000's, it took 1-2 years for a dedicated agency to get such procedures in place[62]. It also took many more years to establish an effective pricing scheme for that access[63]. Today, the allocation of permits is a lengthy process and the prices that apply for access to civil infrastructure are too high.

The experience that NRAs have with both access procedures and pricing suggests that these agencies could be designated as the lead agency for implementing the BCRD with overall responsibility of all aspects (even if other agencies administer some aspects).

[62] See for example OECD (2003-06-02), "Developments in Local Loop Unbundling", OECD Digital Economy Papers, No. 74
[63] https://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/5441-berec-report-regulatory-accounting-in-pr_0.pdf

The designation of NRAs as the entity responsible for the implementation of the BCRD could also allow the BCRD to move to a standard ex-ante regulatory regime. Currently, the most operative parts of the BCRD require access to be sought and subsequently a dispute resolution to be realised to establish access and prices.

While the dispute resolution procedure does permit prices to be set in the event of a refusal to grant access under faire conditions, the mechanism or requirement for such price setting is not specified in any detail. This approach prevents a consistent application of access prices and conditions and can cause many cases that the competent body cannot deal with in the time provided for in the BCRD. If the NRA is designated as the lead implementing agency, they would be in a better position to issue ex ante guidelines for the definition of access prices and conditions. Such a clear pricing mechanism would allow greater clarity on what those deploying networks might expect and is also likely to diminish the number of disputes arising within a Member State.

Even with elements that may be administered by local government such as permitting and transparency measures, NRAs can play a significant role in promoting advice and best practice.

On certain specific elements such as in-building wiring, this has been addressed through building codes to ensure that all network owners can service customers without the need to deploy multiple fibre infrastructures within the building. However, even here, the NRA can play an important role in advising on an appropriate revision to the relevant agency or government department. One aspect that ought to be considered for revision is that many adaptations to building codes made in response to the 2014 BCRD (Article 8) required new buildings and major renovations to be 'broadband-ready' and even eligible for a broadband-ready label with an infrastructure supporting more than 30Mbps (see for example Part R to the UK Building Code). This of course included copper so that in practice, little changed in building practices. Pricing access under the EECC where the infrastructure is owned by SMP operators leads to a detailed pricing mechanism whereas infrastructure owned by non-SMP operators follows a more *ad hoc* process.

Considering the current VHCN target, this requirement ought to be 'fibre-ready' or `VHCN-ready' or have the passive infrastructure that would allow fibre to be deployed quickly and easily accessible within buildings.

4.2 The recommendation on connectivity

The proposed revision of the BCRD is expected at the start of 2021, with an adoption planned in the end of 2021. This review aims at enabling a more efficient deployment of very capacity networks and ensuring that the rules are aligned with the new Code that has come into force.

In an effort to address some of the most serious weaknesses in the implementation of the BCRD, a number of elements were brought forward in the Recommendation on Connectivity. Justifying the need for the intervention, the Commission noted that:

"(…) limited progress has been made in supporting the coordination of civil works, easing the process of applying for civil works permits or promoting transparency by means of a single information point. Member States have applied different permit-granting practices and many procedures were not completed on time, surpassing the 4 month period within which decisions relating to permits have to be made. Furthermore, only a few Member States have opted for electronic permit applications. When it comes to 5G spectrum assignment, by mid-September 2020, Member States (and the UK) had assigned on average only 27.5% of the 5G pioneer bands."[64]

[64] https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_1604

The Recommendation calls on Member States to identify and share by December 2020 a "Toolbox" of best practices for the implementation of the BCRD to speed up network rollout and coordinate radio spectrum assignment.

It gives guidance to Member States on developing this toolbox in cooperation with BEREC and NRAs, by focusing particularly on measures which facilitate the rollout of very high-capacity networks:

- simpler and faster permit procedures for network deployment,
- a single information point in the administration of public authorities to improve transparency about existing physical infrastructure,
- improved access to existing infrastructure to deploy network elements,
- improved dispute resolution mechanism related to infrastructure access.

In addition, the Member State should provide timely access to radio spectrum for 5G and improve coordination of radio spectrum assignment for 5G across borders.

Member States should agree on the Toolbox of best practices by 30 March 2021. The Toolbox should be implemented in each Member State in the following year.

4.3 NGA and NDCM Recommendations

The NGA Recommendation was first flagged for delivery by the Commission together with the Recommendation on Termination Rates in 2006 and it went through very different stages. From an initial position where it sought to migrate to FTTH/B and rely on infrastructure based competition, it was subsequently re-orientated to ensure a seamless migration from copper- to fibre-based networks for third party network operators. The shift to fibre-based networks was an explicit acceptance of fibre to the cabinet as a 'good enough' network and to be treated on equal terms with FTTH networks under the guise of technological neutrality, NGA now included FTTH/FTTB and FTTC[65]. Ensuring a "smooth transition" from copper to NGA was now one of the primary motivators for the revision[66].

Although the revised NGA Recommendation had a renewed emphasis on sharing of passive infrastructures together with a greater emphasis on geographic differences, the primary basis of the Recommendation was to extend the then regulatory model of regulation onto the new networks. The Commission's final NGA Recommendation did not give advice which differed from then existing practice for copper networks.

There were some exceptions are worth noting, particularly the requirement to unbundle regardless of the architecture of the fibre network. Previously, NRAs had taken a view in specific instances that it is not viable to require network unbundling. Cable networks, which would clearly be very difficult to unbundle physically from both a technical and economic perspective, had generally relied for protection from access obligations on the invocation of a Commission proportionality principle that puts cable access outside the market for unbundled loops. While certain topologies may resemble a cable network more closely, the opposite route of mandatory unbundling was proposed. Reality caught up with this assertion and an enhanced bitstream product, virtual unbundled local access or VULA, became the preferred local access product in upgraded copper networks[67].

There was a requirement to make full bitstream access available from the very start of the regulatory process even in relation to NGA, however a number of NRAs had already decided for a variety of reasons either not to require bitstream access or to limit its availability. In particular, France and

[65] Cable was not considered as access remedies were not available at that time.

[66] http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/274&format=HTML&aged=0&language=EN&guiLanguage=en, 15C (2010) 6223/3.

[67] Cave, Martin. (2010). 'Snakes and ladders: unbundling in a next generation world,' Telecommunications Policy, Vol 34 pp 80-85.

Portugal each avoided imposing a bitstream remedy in respect of their FTTH deployments and, although each was roundly criticised, it remained the practice long enough to show the strength of the results coming from infrastructure based competition. In the case of Spain, access to NGA- based bitstream was mandated, but access was limited to a maximum capacity of 30Mbps (then considered the maximum capacity of copper networks) – again firms that wanted to stay in the market found themselves obliged to invest in their own network[68].

In relation to pricing of access products, NRAs were broadly instructed in the NGA Recommendation to carry on as they did in a copper context. In setting access prices and determining the allowed rate of return for a price-controlled service, NRAs already included an appropriate risk premium (normally through the CAPM aspect of WACC calculation). The Commission advice in this area subsequently became more detailed and prescriptive69.

The NDCM Recommendation was essentially a doubling down on the approach adopted in the NGA Recommendation with a lot of emphasis on technological neutrality, the form of access and pricing of risk in a variety of forms. The objective appeared to be twofold; (i) setting access prices that would nudge a migration of the network owner to a fibre upgrade while (ii) ensuring access seekers relying on access to incumbent network owners infrastructure could survive.

The NGA and NDCM Recommendations, like the BCRD, are currently under review70 but it is useful to consider the dynamic between the objective of the EECC and these other soft law instruments which originated at an earlier stage in the Commission's policy evolution. The experience of market development in a number of southern European Member States which had accelerated VHCN deployments driven by infrastructure based competition was to a large extent achieved in the face of the prevailing regulatory model. The success of this divergence appears to have been a driver of the shift in the EECC towards a general reliance on infrastructure based competition to drive investment.

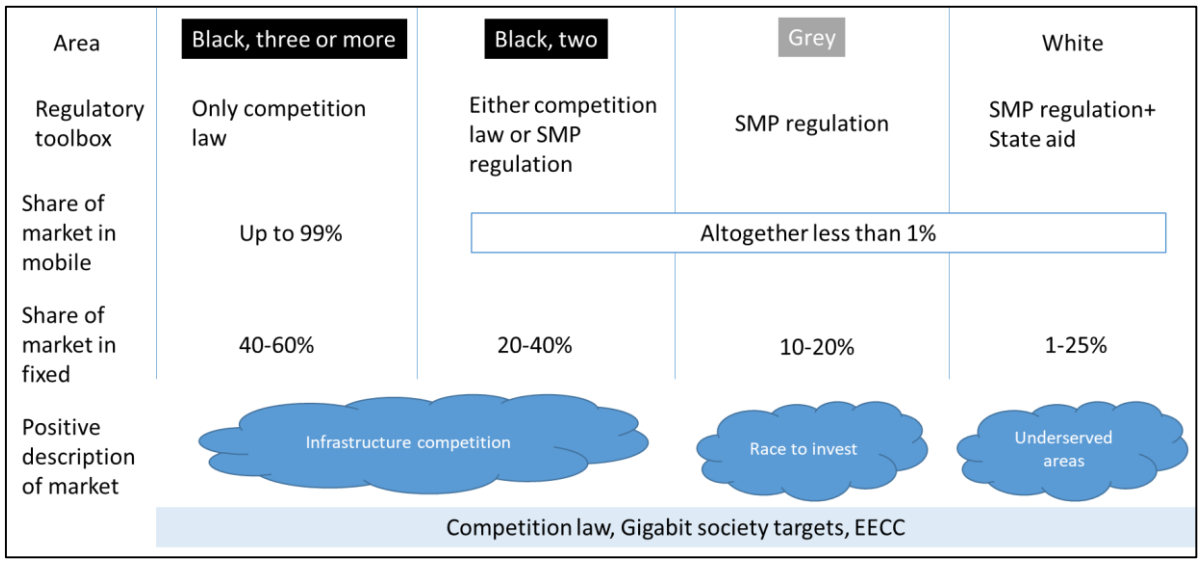
The change in the regulatory approach envisioned in the EECC is not absolute and the range of outcomes and circumstances across the EU implies different likely outcomes and solutions – this too is acknowledged both in the EECC and in the continued need for a variety of remedies and measures under ex-ante regulation and even the use of State Aid and other measures in specific instances. What can be seen therefore is a reorientation of policy to a point which places far more emphasis on infrastructure based competition (with enabling measures to lower entry barriers such as the Broadband Cost Reduction Directive) whilst simultaneously maintaining the possibility that competition over a monopoly fixed VHCN may need to be maintained in certain circumstances.

[68] The original approach put forward in Case ES/2008/805: Wholesale Broadband Access ("WBA") in Spain was subsequently relaxed in 2016 with ES/2016/1952/ES/2016/1951

[69] See for example the Commission Recommendation on Pricing 2013/466/EU

[70] https://ec.europa.eu/digital-single-market/en/news/targeted-consultation-revision-commissions-access-recommendations

Such a graded approach to remedies where the preference is to intervene first in the most upstream market feasible (e.g. granting access to civil infrastructure) and only in the event that such measures are not effective imposing access to other networks is established in the code[71]. It might be considered that markets could be divided into areas where (a) network competition is likely to be sustainable and regulation might be rolled back (b) areas where network competition will be very limited or non-existent even if a migration to VHCN is assured but where competition will happen only at the services layer and (c) areas where network investment to achieve VHCN is unlikely. This might be considered conceptually as below.



Across this range of outcomes a variety of regulatory tools will be required. One risk that is identified is that there are a proliferating number of instruments which are now addressing very similar issues and that considerable overlap between those instruments. For instance, where access is being granted, pricing that regulated access in a way that reflects the risks the investor has taken on in making its initial investment is dealt with in the NDCM and NGA Recommendations but also in the EECC. There is not necessarily an inconsistency between the advice, but the emphasis is certainly different between the different instruments reflecting the changing approach and emphasis in achieving VHCN investments. Similarly, the preference for 'Equivalence of Inputs' created with the NDCM Recommendation is reflected at different points with the EECC. Access and the terms of access to civil-engineering infrastructures to facilitate network deployment is addressed in the BCRD, the NGA and NDCM recommendations as well as the EECC.

Despite the increased scope for competition enabled through the move to fibre and the measures to lower deployment costs, a full range of measures are likely to be necessary even if it is over a smaller portion of the overall market. Several aspects of the current framework were devised at a time when the policy objectives were different, specifically where achieving VHCN was not an objective (NGA, NDCM Recommendations, BCRD, State Aid Guidelines, GBER). Much of the ex-ante guidance overlaps with provisions in the EECC and with each other and while much of the guidance remains valid, reshaping some of those Guidelines and Recommendations to accommodate the new policy objectives may prove more difficult than retiring certain elements or amalgamating elements in a more streamlined approach. A number of the instruments overlap (EECC, NGA and NDCM Recommendations, Connectivity Recommendation and the BCRD Directive) and it could make sense to retire some instruments such as the NGA and NDCM Recommendations and include the advice still considered necessary in another instrument (such as the BCRD which is also currently under review).

[71] See for example recitals 27, 28, 29 of the EECC.

Streamlining the regulatory advice in this way would serve the dual function of ensuring that the overall objective remains clear whilst ensuring that when detailed guidance in offered it is fully aligned with those objectives.

The conclusion from a review of the various instruments addressing infrastructure sharing and access pricing is that many of these instruments were fashioned at a time when policy focussed on a different path to VHCN, indeed the regulatory objective was much more nuanced than it is today. The risk emanating from this context is that the focus of the advice being given is different – this advice is also repeated across a number of instruments, some legislative and some not. Driven in particular by the origins of some of those instruments, it may be more efficient to retire some of the Recommendations, in particular the NGA and NDCM and find another path to address topics where clarification is required. With a number of instruments under revision (and relatively imminent) there is a ready vehicle to carry forward any advice omitted by the retirement of those Recommendations.

4.4 The EECC provides incentives for fixed network sharing

The term VHCN is technologically neutral on its face. Yet the EECC's measures to promote network sharing, co-investment and wholesale-only network deployment in fact only apply to fixed VHCNs. This is because the regulatory "carrots" offered concern SMP-related access obligations, and those obligations only apply to fixed networks. The only access market for mobile (mobile access and call origination) was removed from the list of relevant markets in 2008. In this way, geographic segmentation of markets (or remedies), the provisions around infrastructure sharing (Article 72 and Article 73) and other obligations around access apply in practice only in a fixed context where SMP is present. The EECC's emphasis on network sharing is motivated by policy objectives put forward in the Gigabit Society documents[72] and should in theory apply equally to fixed and mobile networks. Yet in practice, only fixed networks are covered by the EECC's ex ante regulatory incentives.

Ex-ante regulation, including coverage obligations and national roaming, may apply to mobile networks through the mechanism of spectrum assignments. BEREC sees its NRAs having a number of levers to enforce mobile network sharing[73] but these levers relate to conditions of spectrum award or are limited to passive infrastructures (via the BCRD) other than in the most exceptional of circumstances or on environmental grounds (see Articles 44 and Article 61.4 of the EECC).

In spite of this, most of the issues relating to mobile network sharing arise under competition law as opposed to the EECC. There are good reasons for this beyond regulatory demarcation line, fixed network sharing normally occurs under highly asymmetric conditions in which one firm has little incentive to share voluntarily. Mobile markets are more symmetric and so incentives are likely to be more aligned. This is a key difference and it explains why the regimes have developed in the way they have. Nevertheless, under the current regulatory approach, fixed and mobile network deployments are supervised and operate under quite distinct regulatory regimes.

While fixed network deployment, its initialisation and operational activities are clearly governed by the EECC and supporting legislation such at the Broadband Cost Reduction Directive, mobile network deployment and operational activities which are not unilateral are largely governed by competition law. The coexistence of ex ante regulation and competition law is not a bad thing.

Competition law's focus is narrower than that of telecom policy, and the friction between the two bodies of law is healthy. Nevertheless, 5G and fiber VHCNs will increasingly be deployed in a coordinated fashion[74], and network slicing will increasingly permit competition at the service layer

[72] COM(2016) 587: Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society
[73] BoR (19) 110 BEREC Common Position on Mobile Infrastructure Sharing
[74] These savings can be on the radio network, see Mobile Network Sharing Karl-Heinz Neumann and Thomas Plückebaum (14th ITS Asia-Pacific Regional Conference, Kyoto 2017) or can be achieved over co-ordinated fixed mobile deployments see https://www.ftthcouncil.eu/documents/COM-190313-FibreFor5G-ConvergenceStudy-Presentation-RafMeersman%20-%20v4%20-%20publish.pdf

over both fixed and mobile 5G networks. This convergence pleads for a more coordinated approach in assessing fixed and mobile network sharing.

The absence of coordination is visible in the revised text of the GBER in 2019, which did not mention fibre in access networks when addressing broadband networks. The revised GBER text proposed in 2020 does not do much better and fails to mention the Commission's telecom network policy objectives.

The presence of a policy mismatch between telecom policy objectives and the application of competition law has been highlighted by others[75] not least in the context of the decision resulting from the Czech case. From a mobile network sharing perspective, there is nothing extraordinary about the structure of the Czech mobile market – to achieve 5G Europe will need some form of active network sharing – some way to square that circle will have to be found.

4.5 Mobile regulation

As noted in the European Commission's Working Paper[76] 5G proposes to create a wireless link permitting a variety of Internet of Things (IoT) applications, as well as very high bandwidth links that approach those of fibre optic networks. The ITU has classified 5G use cases into three categories: eMBB (enhanced mobile broadband), mMTC (massive machine type communications) and cMTC (critical machine type communications).[77] Many mMTC and cMTC applications will use spectrum in the 3.6 GHz band, and can rely in large part on operators' existing 4G sites. By contrast, new ultrafast eMBB will use spectrum in the 28 GHz band which will require the construction of a dense network of new small cell sites, up to 800 per square kilometre, each with fiber backhaul.[78]

5G will also bring two significant changes in network technology. The first is the rise of Software Defined Networks ("SDNs"), which will allow the control of network resources to be opened up to third parties, with the possibility for these third parties to manage their own physical or virtual resources individually. For example, given that emergency or military networks require complete operational autonomy, 5G could provide them with the capability of being part of an existing network rather than being positioned beside it, as is the case today. The second is Network Function Virtualisation, which offers the prospect of specific network functions being implemented in software which runs on generic hardware, without the need for costly hardware-specific machines; in short, this will provide the speed with which to deploy new services and functions that can otherwise be deployed by traditional telecommunications operators over a period of perhaps 18 months or longer.

More broadly, however, the importance of each of the characteristics listed above will also vary by reference to its application and usage. Very low latency[79] will have many relevant applications ranging from connected cars to a variety of IoT[80] applications, many of which will need very low bandwidth but also a very low latency (for instance, bespoke advertising). Similarly, medical applications are clear candidates for services requiring reliability and availability, but these characteristics are also required for other types of public services. The low energy and energy consumption characteristics will invariably be very important, especially in remote areas in IoT applications such as farming sensors that indicate soil moisture on a fortnightly basis.

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[75] Geradin, D. and Karanikioti, T., 2020. Network Sharing and EU Competition Law in the 5G Era: A Case of Policy Mismatch. Available at SSRN 3628250.

[76] Refer to the European Commission's Communication, "5G for Europe: An Action Plan", COM(2016) 588 final (https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-588-EN-F1-1.PDF).

[77] European Parliament, '5G Deployment, State of Play in Europe, USA and Asia', policy department for Economic, Scientific and Quality of Life Policies , April 2019, p. 7.

[78] Ibid, p. 9.

[79] Latency describes how long it takes data to travel between its source and destination and is measured in milliseconds.

[80] The 'Internet of Things' is how computers, sensors and objects interact with each other and process data. See the European Commission's Staff Working Document, "Advancing the Internet of Things in Europe", 19 April 2016: https://ec.europa.eu/digital-single-market/en/news/staff-working-document-advancinginternet-things-europe.

Open-RAN in combination with NFV and SDNs will allow different entities to share common network infrastructure while retaining independence in how network elements are deployed and services configured. Much of the RAN technology will become 'vanilla', with service differentiation layered on top through product features and software. SDN and NFV evolutions can deliver the phenomenon of "network slicing", which effectively creates separate networks that are housed within one physical infrastructure in a way that is tantamount to them being situated on separate physical infrastructures. In this way, each 'physical network' will also be able to host multiple service providers who provide specialist niche services over that network. The nature of network ownership and operation will likely evolve in a 5G environment, given that infrastructures will be able to adopt a multitenancy model.[81]

4.6 Gigabit Society objectives require converged network and policy strategies

A more general observation is that the advent of 5G promises to deliver connectivity in ways that go far beyond the telecommunications sector which will drive the broader European economy, with many parts of that economy, including transport, manufacturing, and health services, benefiting from the availability of these networks (or not operating optimally, as the case may be, in their absence)[82].

The deployment of 5G mobile networks cannot occur in isolation and must be accompanied by a comparable upgrade to the fixed network especially in an urban context. Thus, a 1Gbps wireless network is of little value to society if it is backhauled by a 100Mbps backhaul link[83]. This reality put the Commission's commitment to technological neutrality under pressure given its industrial policy imperative to achieve latency, bandwidth, jitter and other parameters above certain key thresholds in the fixed network. Hence, the Commission's identification of 'Very High Capacity'[84] limits under fixed technology which acknowledged the need for comparable capacity in the backhaul and radio access networks. Elsewhere studies have shown that a co-ordinated fixed and mobile network deployment can result in very significant network savings. Essentially if an FTTH/B network understands the likely location of 5G sites, those sites can be provisioned at a nominal cost compared to a subsequent build).[85]

New multi-tenant business models will require a reassessment of traditional access relationships. For example, the usual trade-off between the cost of network duplication versus the benefits of end-to-end competition will need to be reconsidered. Thanks to network slicing on 5G networks, most of the benefits of competing physical networks can potentially be delivered over one network with little loss of autonomy or independence on the part of the operators on the network. The current concerns about network sharing agreements and the point at which such sharing occurs in the network (RAN or otherwise) would occur in a very different context under 5G.

With multiple operators in urban areas but sharing a single physical network elsewhere, a priori, one could expect a level of competition equivalent to fully deployed networks throughout the Member State.

The commitment agreed among the Member States and the European Commission that 5G will be introduced throughout the European Union (EU) by 2025 at the latest[86] is ambitious. Specific

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[81] Refer to the European Commission supporting document of the 5G Public-Private Partnership, "5G Vision - The 5G Infrastructure Public Private Partnership: the next generation of communication networks and services" (available at: https://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf).

[82] COM(2016) 588 final 5G for Europe: An Action Plan

[83] "Backhaul" refers to the part of the network that connects local access to the core internet network (or backbone network) to carry and deliver data (see https://ec.europa.eu/digital-single-market/broadbandglossary).

[84] Refer to the European Commission's Proposal for a Directive, "establishing the European Electronic Communications Code (Recast)", COM(2016) 590 final 2016/0288 (COD) (http://eurlex.europa.eu/resource.html?uri=cellar:c5ee8d55-7a56-11e6-b07601aa75ed71a1.0001.02/DOC_1&format=PDF).

[85] See for instance 'White paper on FTTH-5G network convergence' at https://comsof.com

[86] The objective is set at having at least one major city in each Member State 5G enabled by the end of 2020 and uninterrupted 5G coverage in all urban areas and major terrestrial transport paths by 2025

objectives that have been established to have 5G deployed in at least one major city within the EU by 2020 after a commercial launch in 2018, with all urban areas and major terrestrial transport paths being covered by 2025.[87] A major revision to the 5G Action Plan is scheduled which will result in revised 5G/6G guidance. However, as with the BCRD in markets, concerns about progress and in the context of Covid-19 and the need for connectivity, the Commission brought forward measures to enable and accelerate 5G deployments as part of the Recommendation on Connectivity[88].

That Recommendation requires Member States report to the Commission by 20 December 2020 on measures taken to promote widespread network coverage. Specific measures that incentivise operator investment in 5G rollout are suggested which are listed below:

- promoting reserve prices that reflect the minimum levels of fees for rights of use of spectrum
- avoiding spectrum scarcity by assigning the full amount of harmonised radio spectrum at EU level
- Considering that the fees for rights of use of spectrum can be paid in instalments within the period of those rights
- giving preference to an individual authorisation regime for the 26 GHz frequency band, which promotes its timely use and is based, in particular, on fast-track administrative procedures when applied to geographically limited rights of use
- combining financial incentives with obligations or formal commitments to accelerate or to expand high-quality wireless coverage
- incentivising the sharing of passive and active infrastructure, as well as joint roll-out of infrastructure that relies on the use of radio spectrum

Essentially these measures amount to making spectrum available at reasonable prices and with various conditions to encourage deployment and importantly, measures to lower and facilitate deployment costs through network sharing both of passive and active deployments.

The European Commission acknowledges that network sharing is a widespread practice that can facilitate the roll out of electronic communications networks by reducing costs. While it notes that network sharing is a source of efficiencies it also states that in some circumstances it may have a negative impact on competition. While BEREC's common position on infrastructure sharing sets out how NRAs ought to assess such agreements, the main responsibility for assessing mobile network sharing lies with competition authorities.

When DG Competition set out its review of the Czech market where it found a negative impact on competition from active network sharing, it noted two key points in its public statement[89]:

- the Czech mobile communications market is highly concentrated with only three mobile network operators,
- the sharing parties O2 CZ/CETIN and T-Mobile CZ are the two largest operators, with their networks serving approximately three quarters of subscribers.

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[87] Refer to the European Commission's Communication, "Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society", COM(2016) 587 final (https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-587-EN-F1-1.PDF). See also the Commission's 5G Action Plan https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document

[88] C(2020) 6270 final: Recommendation on a common Union toolbox for reducing the cost of deploying very high capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union

[89] https://ec.europa.eu/commission/presscorner/detail/en/IP_19_5110

The Commission took a preliminary view that in this instance the network sharing agreement between the two main mobile operators in the Czech market restricts competition and thereby harms innovation in breach of EU antitrust rules saying that the network sharing agreement is likely to remove the incentives for the two mobile operators to improve their networks and services to the benefit of users.

One issue with this approach is that the number of MNOs in European markets is low (and in general decreasing) – as a consequence many European markets are concentrated. While the case involved many other aspects such as the geographic scope of the agreement and so on, simply applying the cumulative criteria of number of network operators and the industry concentration (as measured using the Herfindahl-Hirschman Index) what we can see in table 1 below is that there is nothing extraordinary about the Czech market. In fact, within EU 27 it lies exactly midway in terms of HHI (and of course all 13 Member States with a higher industry concentration had three MNOs operating in those markets). Therefore, more than half of European Member States would meet those headline criteria.

Table 1: EU Countries by number of operators and HHI[90]

3 MNOs	HHI	4 MNOs	HHI
BULGARIA	3370	POLAND	2551
FINLAND	3382	SPAIN	2676
NETHERLANDS	3386	ROMANIA	2811
GERMANY	3442	FRANCE	2831
CZECHIA	**3447**	DENMARK	2856
AUSTRIA	**3494**	SWEDEN	2952
HUNGARY	**3517**	SLOVAKIA	3023
ESTONIA	**3565**	ITALY	3036
PORTUGAL	**3583**	SLOVENIA	3167
LITHUANIA	**3603**		
BELGIUM	**3624**		
IRELAND	**3633**		
LATVIA	**3683**		
CROATIA	**3714**		
GREECE	**3761**		
CYPRUS	**3963**		
LUXEMBOURG	**3994**		
MALTA	**4040**		

The imperative to move to some form of spectrum/network sharing in a 5G context may therefore require an approach that recognises that the shift to 5G is desirable in a broader policy context. This is in addition to the technological change implicit in these networks and the way in which the technology to deploy them is changing.

According to BEREC's 2019 Common Position on Infrastructure Sharing, when considering the parameters to be considered by NRAs when assessing infrastructure sharing agreements the objective, "[t]he more a sharing agreement involves competitive technologies (4G, 5G) that still require substantial investment, the more this sharing is critical". This positive disposition towards network sharing can be seen in the European Commission's 2020 clearance of the Joint venture concerning passive sharing (site-sharing) in Italy in Case M.9675 INWIT/Telecom Italia/Vodafone,

[90] Own calculations based on GSMA and Company data.

where the Commission recognised the efficiencies that can result from network sharing. In commenting on the clearance decision, Competition Commissioner Margarethe Vestager has commented that:

"Fast roll-out of 5G technology in Italy will benefit consumers and businesses. Today we approve the creation of a joint venture between two mobile operators who are planning to combine their telecommunication towers to jointly achieve this objective, without compromising retail and wholesale competition."

However, the position on active sharing is less clear - on the one hand DG Connect has brought forward a Recommendation on Connectivity which is promoting the sharing of passive and active infrastructure (even on joint deployments) whilst on the other hand DG Competition's high level criteria suggest that active network sharing is likely to be problematic in most EU countries when viewed solely through the lens of competition law.

As noted above, the move to Open-RAN should mean that the hardware used in 5G is commoditised to some extent and that the technology choice is not as binding on services and service development as it once was. Together with the general move to SDN and NFV, this suggests that the area of competition is likely to move to the software that runs over the hardware and the services that are delivered. These same drivers ought to imply a high degree of decisional autonomy on the part of network participants, and may permit forms of network sharing that otherwise would previously have been problematic under competition law.

05

TELECOM POLICY AND COMPETITION LAW

5 Telecom policy and competition law

5.1 State Aid

Economic recovery plans for the COVID-19 pandemic include massive government investments in infrastructure. These investments are an extraordinary opportunity to advance the objectives of the Gigabit Society and the EECC, including deployment of VHCNs, but they will also run into state aid rules designed to ensure that government subsidies do not distort competition.

State aid is governed by article 107 of the TFEU, which prohibits any aid which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods. Services of general economic interest (SGEI) are not considered state aid, but the qualification as SGEI requires satisfaction of a number of tests which many broadband projects fail to satisfy. Among other things, SGEI implies a public service concession requiring service to be provided to all citizens, as well as an absence of investment by private operators thereby leaving a significant part of the population unconnected.

Even if a broadband project does not qualify as an SGEI, it can still receive state aid if the conditions of article 107(3)(c) TFEU are satisfied, i.e.: the aid must "facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest".

The Broadband State Aid Guidelines[91] (Guidelines) were published in 2013 and are currently under review with a consultation underway until January 2021. The 2013 Broadband State aid Guidelines give guidance to Member States on how Article 107 TFEU, and in particular the exception under Article 107(3)(c), would apply to deployment of broadband networks. In particular, they allow for public investments where a market failure exists and where these investments bring a significant improvement to the market in terms of service availability, capacity, speeds and competition (step change). This ensures that public interventions focus on areas that would otherwise be left behind due to the absence of commercial interest to invest and that support "state of the art" technologies. At the same time, the Guidelines also aim at protecting private investments by providing that no public intervention can take place where private operators have invested or credibly plan to invest and fostering fair competition through competitive selection procedures, technological neutrality and open access requirements for the benefit of all European citizens and businesses.

As explained in the Guidelines, to determine whether the conditions in article 107(3)(c) are satisfied, the Commission applies a balancing test. The Commission first verifies that seven cumulative conditions are satisfied:

1. Contribution to the achievement of objectives of common interest
2. Absence of market delivery due to market failures or important inequalities
3. Appropriateness of State aid as a policy instrument
4. Existence of incentive effect
5. Aid limited to the minimum necessary
6. Limited negative effects
7. Transparency

If all seven conditions are met, the Commission then balances the positive effects of the aid measure in reaching an objective of common interest against the potential negative effects.

[91] EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks (2013/C 25/01)

In order to satisfy the balancing test, the subsidized infrastructure must provide a "step-change" compared to existing broadband networks or compared to networks that are forecast in the concrete roll-out plans of operators.

The Commission's Guidelines make a distinction between white, grey and black areas, with different conditions applying to each.

'White areas' are those in which there is no broadband infrastructure and it is unlikely to be developed in the near future. 'Grey areas' are those in which one network operator is present and another network is unlikely to be developed in the near future. 'Black areas' are those in which there are or there will be in the near future at least two basic broadband networks of different operators and broadband services are provided under competitive conditions (infrastructure based competition).

State aid is easy to justify in white areas. In grey areas the balancing test is more difficult, and in black areas, state aid is generally forbidden. The Guidelines recognize an exception for "ultra-fast" broadband above 100Mbps, where subsidies may be granted exceptionally in black areas if it can be shown that private operators will not likely invest, and provided the subsidized network operates as a wholesale-only entity providing non-discriminatory access. For white and grey areas, the Guidelines do not impose a wholesale-only model but require that the operator benefiting from state aid provide effective wholesale access products to third party operators, including access to passive infrastructure.

The Guidelines distinguish basic broadband and NGA networks. "Basic broadband" is defined as speeds up to 30 Mbps by 2020. NGA networks include DOCSIS 3.0 upgraded cable networks, and fiber to the node or fiber to the curb.

The 2013 Guidelines are closely linked to the 2010 Digital Agenda for Europe (DAE), which restates the objective of the EU2020 to bring basic broadband to all Europeans by 2013 and seeks to ensure that, by 2020, (i) all Europeans have access to much higher Internet speeds of above 30 Mbps and (ii) 50 % or more of European households subscribe to Internet connections above 100 Mbps. The Broadband State Aid Guidelines were revised in 2013 after a process that started in 2011, to reflect these new targets and set the limits to the types of networks that public authorities could fund and be in line with the EU's State Aid rules. Pursuant to the Guidelines, broadband deployment that contribute to these DAE objectives will generally satisfy the first of the seven cumulative tests mentioned above: "contribution to the achievement of objectives of common interest". A recent example concerns state aid approved in Italy for network performance limited to 30Mbps[92]. While coherent under the DAE objectives, the project (approved in 2020) seems at odds with the Gigabit Society objectives.

[92] State Aid SA.57495 (2020/N) – Italy Broadband vouchers for certain categories of families.

Today the DAE objectives are obsolete, and have been replaced by the Gigabit Society objectives[93], defined as follows:

- Strategic objective for 2025: Gigabit connectivity for all main socio-economic drivers such as schools, transport hubs and main providers of public services as well as digitally intensive enterprises;
- Strategic objective for 2025: All European households, rural or urban, will have access to Internet connectivity offering a downlink of at least 100 Mbps, upgradable to Gigabit speed;
- Strategic objective for 2025: All urban areas and all major terrestrial transport paths to have uninterrupted 5G coverage;
- Intermediate objective for 2020: 5G connectivity to be available as a fully-fledged commercial service in at least one major city in each Member State, building on commercial introduction in 2018.

These Gigabit Society objectives will be the new benchmark against which state aid will be measured, and in particular its level of "contribution to the achievement of objectives of common interest". The "step-change" required by the Guidelines will also be measured against the new Gigabit Society bandwidth targets: 100Mbs upgradeable to 1 Gbps.

Adopted two years after the Gigabit Society communication, the EECC requires Member States to encourage the deployment of VHCNs. Studies have shown that dense fiber backhaul networks for 5G sites should be deployed at the same time as FTTH/FTTB to avoid duplication of costs.[94]

The EECC provides incentives for co-investment for fixed VHCN, and for wholesale-only business models for fixed VHCN, by providing relief from ex ante SMP regulation.

The COVID-19 crisis has triggered a new focus by the Council and the Commission on rapid investment in VHCNs and 5G networks, both of which provide pathways for both economic recovery and digital inclusion.[95] The COVID 19 crisis will have a strong influence on how the factors in the balancing test are evaluated. For example, the identification of a market failure or the existence of important inequalities will be easier to demonstrate in the context of home work and home schooling, where significant inequalities emerged during the COVID crisis.

Adopted in 2013, the Guidelines take no account of the new priorities set by the Commission in its 2016 Gigabit Society communication and by the European Union legislature in the EECC adopted in 2018. Similarly, the Guidelines do not reflect the new COVID-19 measures prioritizing VHCN and 5G deployment.

[93] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society COM/2016/0587 final

[94] See, for instance, https://www.siradel.com/research/ftth-council-europe/

[95] Council Conclusions on Shaping Europe's Digital Future, 9 June 2020, 8711/20; COMMISSION RECOMMENDATION of 18.9.2020 on a common Union toolbox for reducing the cost of deploying very high capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union, C(2020) 6270 final.

It is beyond the scope of this report to propose detailed modifications of the 2013 Guidelines, but it seems obvious that the Guidelines need to be synchronized with the new broadband priorities of the European Union, including:

- the Gigabit Society objectives;
- the EECC's emphasis on VHCN deployment, including encouragement of wholesale-only models;
- the need to coordinate VHCN deployment with 5G small cell backhaul;
- the emphasis on VHCN and 5G deployment to foster economic recovery from the COVID-19 crisis, as expressed recently by the Council Conclusions on Shaping Europe's Digital Future and the Commission's Recommendation on a common Union toolbox.

The state aid rules give significant weight to the achievement of objectives of common interest, and those objectives have now been updated and defined by the EECC, the 2020 Council Conclusions, the Commission's 2016 Gigabit Society Communication and its 2020 Toolbox Recommendation. The Guidelines should give examples of how broadband infrastructure projects receiving state aid can maximize their contribution to those new broadband objectives, and thereby maximize the probability of counterbalancing any potential negative effects flowing from the state aid.

Adopted after the Guidelines, the General Block Exemption Regulation[96] ("GBER") exempts Member States from having to notify aid measures where the criteria in the Guidelines clearly come out in favour of supporting state aid. This is the case where the deployment of broadband networks concerns areas where no infrastructure of the same category exists or is credibly planned in the near future, provided that certain conditions are met. The GBER represents a practical implementation of the Guidelines and currently reflects DAE, not Gigabit Society, objectives. As noted above, the Guidelines will have to be updated to reflect the new Gigabit Society objectives. Once that is done, the GBER would require similar modifications, defining projects that clearly pass the state aid criteria under the new approach, and therefore do not require notification to the European Commission. A recent revised draft for consultation of the GBER (closed July 2020) has made some effort to increase the performance of what constitutes an NGA/NGN network but there is no reference to VHCN anywhere or to the 100Mbps required to be universally available and upgradeable to 1Gb by 2025 in the Gigabit Society Communication. The revised draft of the GBER needs to be synchronized with the new broadband priorities of the European Union.

5.2 Horizontal cooperation agreements

Article 101(1) TFEU prohibits agreements that have as their object or effect the prevention, restriction or distortion of competition within the internal market. Article 101(3) allows however for an exemption where the restriction of competition is kept to the minimum necessary and is compensated by the promotion of technical or economic progress, while allowing consumers a fair share of the resulting benefit. The exemption under Article 101(3) translates into a multi-factor balancing test.

In 2011 the Commission published guidelines[97] (2011 Guidelines) on how to apply Article 101 to horizontal cooperation agreements. The provisions in the 2011 Guidelines on production agreements apply to network sharing agreements. In addition, the European Commission has issued a number of individual decisions on the permissible limits of network sharing for both fixed and mobile networks.[98] The 2011 Guidelines and the individual Commission decisions provide guidance on what forms of cooperation are likely to create a restriction on competition, thereby falling under the

[96] Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty
[97] COMMUNICATION FROM THE COMMISSION, Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (2011/C 11/01)
[98] See decision summaries in previous CERRE report.

prohibition of Article 101(1), and when such a restriction exists, whether it can be compensated by positive factors, and thereby qualify for an individual exemption under Article 101(3).

Each case of horizontal cooperation must be analyzed individually to determine whether the cooperation restricts competition, and if it does, whether it can qualify for an exemption based on the balancing test of Article 101(3). The factors taken into account on both questions include, among other things, the market shares of the parties, the geographic scope of cooperation, which parts of the network are shared, what information will be exchanged between the parties, etc. Sharing of the core network will inevitably lead to a high level of coordination between the parties since each party will have little or no latitude to differentiate its service. Sharing of the radio access network (RAN) may lead to different levels of coordination depending on whether the sharing involves only passive network elements such as towers and power supply, or active equipment, or even spectrum. Traditionally sharing active elements of the RAN creates a greater risk for anti-competitive coordination than sharing passive elements, and therefore a greater threat to competition. This is because each party's technical autonomy and capacity for differentiation were reduced when active elements were shared. Parties must coordinate upgrades, and exchange information on traffic forecasts. Sharing of passive elements, by contrast, preserves each party's independence in key network characteristics and upgrades. This has been the traditional analysis under Article 101 TFEU for network sharing.

However, this accepted wisdom will be challenged by SDN and NFV, technologies that permit operators to independently control network capacity and quality parameters even when active access network elements are shared with another operator. Because of this new technology, RAN sharing may no longer pose the same threat for an operator's independence and capacity to differentiate and upgrade. This may lead to a change in paradigm for network sharing under competition law, a change that would facilitate deployment of 5G access networks for very high capacity access (26GHz) where numerous new small cells with fiber backhaul will be needed in urban areas to meet the Gigabit Society objectives.

Under current Commission decisions, RAN sharing in urban areas is likely to create risks for competition, which creates considerable uncertainty for network investment in VHCN and 5G to meet the Gigabit Society targets. To reduce legal uncertainty, the Commission could update its 2011 Guidelines, or issue separate guidelines, to examine how Open-RAN and technologies such as SDN and NFV may affect the analysis and particularly the traditional "active versus passive" network sharing paradigm which drives many competition law decisions. While each cooperation case needs to be evaluated on its merits, operators would nevertheless have at their disposal the analytical tools needed to form a judgment as to whether RAN sharing for 5G deployment in urban areas can be pursued under Article 101 TFEU thanks to new technologies, and what measures should be implemented to ensure the competitive independence of the sharing parties. Because VHCN and 5G deployments are linked because of small site backhaul, the reduction of legal uncertainty on RAN sharing in dense areas will facilitate investment in both VHCN and 5G, thereby contributing to achievement of Gigabit Society objectives.

Because competition law is highly fact – and case – specific, it may be difficult for DG Competition to propose guidelines before it has had the opportunity to deal with several individual cases involving different forms of 5G RAN sharing. Nevertheless, given the Commission's recent Recommendation on Connectivity[99] which expressly encourages network sharing, DG Competition should consider giving preliminary guidance on how technological developments in 5G may or may not affect its analysis of competitive effects of RAN sharing under Article 101. While it may be too early to be

[99] C(2020) 6270 final: Recommendation on a common Union toolbox for reducing the cost of deploying very high capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union

definitive or overly specific about technologies, DG Competition could describe what their considerations will be, in terms of weighing up the trades offs when coming to their decision.

VHCN and 5G can raise more fundamental competition law questions, such as whether current competition concerns about network consolidation as a result of electronic communications sector mergers[100] should be tempered with the acknowledgement that there will be a different range of competition/innovation trade-off that will emerge in a future 5G environment where Open-RAN implies a break between services and equipment and where SDN and NFV enable a disintermediation between network services and the network itself. In such a concentrated environment, issues such as trust and security will become increasingly more important where it might be a single network infrastructure that hosts many service providers which emerges to deliver all services, both commercial and otherwise. However, it is far too early to even begin answering these bigger questions.

A closer alignment between DG Competition and DG Connect in bringing forward legislation and guidance either in the form of Recommendations and/or Guidelines which are consistent with each other, which use the same definitions and language and importantly, aspire to the same policy outcomes[101].

It is clear that DG Connect and DG Competition are seeking to work more closely together but this activity needs to reach much deeper into their services so that the Commission has a consistent approach across its services.

The conclusion of this analysis is that, owing to the effect of changing technologies in 5G (and even 4G), the way in which active network sharing is assessed in the future may change. The need for network sharing will not only be driven by cost in the future but also by technical necessity, especially in urban areas where some form of sharing will be required. The relationship between fixed and mobile network deployments and the efficiencies in a combined or co-ordinated deployment means that significant benefits can accrue, accelerating deployment. It is in this context that sharing being facilitated or assessed under ex-ante or ex-post regimes may lead to uncertainty. The recommendation is that DG Connect and DG Competition continue to work closely and that DG Competition consider giving preliminary guidance on how technological developments in 5G may or may not affect its analysis of competitive effects of RAN sharing under Article 101.

[100] See, most recently, Case M. 7758 *Hutchison 3G / WIND* in the European Commission Press Release on 1 September 2016: http://europa.eu/rapid/press-release_IP-16-2932_en.htm ; the European Commission Press Release, "Mergers: Commission prohibits Hutchison's proposed acquisition of Telefónica UK" (IP/16/1704), 11 May 2016. Refer to Case No COMP/M.7612 – *Hutchinson 3G UK / Telefonica* (2016); *Case No COMP/M.7419 - TeliaSonera/Telenor/JV* (abandoned by the parties on the 24 September 2015).

[101] For example, the GBER revision proposed after the first consultation would permit investment in FTTC to bring a network up to 30Mbps to qualify for funding under the block exemption. This is not consistent with the objective to promote VHCN under the EECC.

RECOMMENDATIONS

Recommendations

1. **Infrastructure based competition is the most powerful form of competition for network investment. Measures to lower entry barriers and promote infrastructure based competition should be enhanced, in particular by strengthening the Broadband Cost Reduction Directive.**

Network competition has not always been a policy priority but the importance of infrastructure based competition is now recognised clearly in the EECC. Instruments that stem from a period that pre-dates the shift in telecom policy to infrastructure based competition ought to be reviewed to ensure the measures contained therein are not counter-productive to that aim (cost-based virtual access products over VHCN for instance). There are already a number of mechanisms available to co-ordinate access and sharing of civil engineering infrastructure and these should be strengthened in the BCRD. The geographic scope of infrastructure based competition will be limited but if a large enough part of a market can support infrastructure competition that may move the whole market in the medium term; where a large enough part of the market cannot support infrastructure based competition other forms of regulated access will be needed even in the medium term.

2. **Competition law guidelines need to be updated to reflect a more unified policy perspective that covers both fixed and mobile networks sharing.**

Competition law's focus is narrower than that of telecom policy, which can lead to friction, particularly in the field of network sharing. This friction is healthy. Moreover, competition law is highly case specific, making it difficult to fix common rules. Nevertheless, several competition law guidelines – State Aid Guidelines, the Block Exemption Regulation for State Aid, and the Horizontal Cooperation Guidelines -- seem out of date compared to new technological developments in VHCN and 5G, and the new policy objectives expressed in the Commission's Gigabit Society Communication.

This inconsistency risks confusing market actors. We recommend that State Aid Guidelines and the Block Exemption Regulation be updated to reflect the policy objectives of the EECC and the Gigabit Society Communication, and that the Horizontal Cooperation Guidelines be supplemented with a section specifically addressing network sharing in the context of VHCN and 5G. The Horizontal Cooperation Guidelines should focus in particular on new technological developments such as Network Function Virtualisation (NFV) and Software Defined Networks (SDN) and their potential impact on the competition analysis of network sharing, particularly the traditional "active versus passive" network element dichotomy.

3. **There is a broad need to streamline regulatory provisions.**

Many aspects of the current framework were devised at a time when the policy objectives were quite different (NGA, NDCM Recommendations, BCRD, State Aid Guidelines, GBER) and a number of those instruments overlap (EECC, NGA and NDCM Recommendations, Connectivity Recommendation and the BCRD Directive). It would make sense to retire some instruments such as the NGA and NDCM Recommendations and include the advice still considered necessary in another instrument (such as the BCRD which is currently under review).

Streamlining the regulatory advice in this way would serve the dual function of ensuring that the overall objective remains clear whilst ensuring that when detailed guidance is offered it is fully aligned with those objectives.

4. **Entrant Wholesale-Only operators should be encouraged but with a caution that reflects the risks associated with such operators. Exemptions available for vertically integrated operators that choose to separate should be limited and this should be signalled in advance.**

It makes sense to continue to promote entrant Wholesale-Only operators. Their entry has created a new market dynamic in certain large moribund VHCN markets. However, there are clear risks associated with such operators concerning investment co-ordination and investment holdout and delay. In the short term, the presence of vertically integrated operators will act to mitigate the risks associated with investment coordination since those vertically integrated operators will be a source of competition. This situation may change over time, particularly where the competitive reaction for the whole market is to structurally separate. In this case, concerns about investment co-ordination, hold-out etc. will arise in the absence of other infrastructure based competitors, at least some of whom are vertically integrated. Regulators should signal ahead of time that exemptions available in a voluntary separation scenario will be limited.

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