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Draft BEREC Report on the regulatory treatment for fixed and mobile backhaul

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Contents

1 EXECUTIVE SUMMARY

The objectives of this report are to present the legal provisions applicable to mobile and fixed backhaul, the regulation in force and use of different types of backhaul networks and services in Europe, as well as views expressed by operators on their current and future needs for backhaul. The report is based on the responses received to a BEREC questionnaire for National Regulatory Authorities (35 NRAs respondents) and another questionnaire for operators, responded by 60 operators around Europe and two operators' associations.

Legal provisions applicable to mobile and fixed backhaul under the European Electronics Communications Code (hereinafter "EECC" or "Code")[1] allow for imposing *ex ante* obligations to grant regulated access to leased lines, dark fibre, ethernet services, as well as to physical infrastructures.

The European Commission (EC)'s Recommendation on Relevant Markets adopted in 2020[2] emphasizes that wholesale *ex ante* regulation should only be applied where demonstrable competition problems exist at the retail level. In particular, concerning mobile backhaul, the EC considers that mobile retail markets are in general competitive on a Union-wide level. This implies that asymmetric regulation of mobile backhaul is only possible if a prospective analysis presents additional, relevant elements which would justify its inclusion within a relevant market susceptible to *ex ante* regulation. Depending on the retail issues identified, backhaul can be integrated in the market analysis in different ways, including under market 1/2020[3], market 2/2020[4], or as a separate market for access to physical infrastructure (in this last case the fulfilment of the three criteria test[5] would need to be demonstrated). Prior to the imposition of additional remedies on the SMP operator[6], NRAs will need to examine whether the imposition of access to civil engineering alone may be a proportionate means to promote competition and the end-user's interest.

Regarding access to physical infrastructure which can be used for backhaul, the Broadband Cost Reduction Directive (BCRD)[7] is also aimed at facilitating access to the infrastructure of a large range of actors (not limited to electronic communication services), for the purposes of deploying elements of high-speed electronic communications networks.

[1] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code.

[2] European Commission Recommendation on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code, Published on 18.12.2020

[3] Market 1 of the EC 2020 Recommendation (see footnote 2): wholesale local access provided at a fixed location

[4] Market 2 of the EC 2020 Recommendation (see footnote 2): Wholesale dedicated capacity

[5] See 3.3.1.2

[6] Operators identified as enjoying Significant Market Power (SMP)

[7] 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

The responses provided by the operators on mobile backhaul suggest that there will be a significant shift from radio links to fibre connections driven by the rollout of 5G in the upcoming years. These fibre connections are expected to be to a large extent self-supplied, but there is also an expected increase of the demand for dark fibre and passive infrastructure from third parties.

Concerning fixed backhaul obtained from third parties, the responses show that most operators acquire connections with high bandwidth (≥ 1 Gbps) with a high use of third-party dark fibre and expect to continue to do so in the next years. On lower speeds (< 1Gbps), the input received from operators indicates a shift from Ethernet products to dark fibre use.

As regards fixed and mobile backhaul connections, the share of operators using regulated products is low, and is not expected to change in the future under the assumption that regulation remains unchanged. Nevertheless, the majority of alternative fixed and mobile operators consider that there is a present and future need for regulated access to inputs, including Ethernet products, dark fibre and/or access to passive infrastructure, most of them considering that the regulations should be nationwide. On the contrary, all incumbents are of the opinion that neither fixed, nor mobile backhaul regulation is necessary as alternative offers are available.

Concerning the regulatory treatment of backhaul, nearly half of BEREC members include backhaul in market 2/2020 or market 4/2014[8], and around a 25% of them find this market to be competitive. Part of the NRAs regulate backhaul as an ancillary service in market 1/2020 or market 3b/2014[9]. For those NRAs including backhaul in market 2/2020 or market 4/2014, the obligations are not differentiated based on its use (fixed or mobile).

Most NRAs regulating backhaul consider both traditional leased lines and Ethernet services as regulated active products. Apart from these regulated active wholesale products, access to passive infrastructure (ducts and poles) is also imposed by the majority of NRAs regulating inputs for backhaul and is considered as especially important by NRAs, as well as by operators.

BEREC would like to stress that backhaul contributes to ensure the effectiveness of the main remedies in both market 1/2020 and market 3b/2014 (copper LLU, fibre LLU, VULA) and/or to facilitate the deployment of mobile networks. When assessing backhaul in the different market reviews where this is particularly relevant, NRAs should therefore avoid not only false positive (Type I) errors, which might lead to excessive regulation or insufficient deregulation, but also avoid false negative (Type II) errors, which might result in insufficient regulation or excessive deregulation.

[8] Market 4 of the EC 2014 Recommendation on relevant markets: Wholesale high-quality access provided at a fixed location

[9] Market 3b of the EC 2014 Recommendation on relevant markets: Wholesale central access provided at a fixed location for mass-market products

BEREC will continue to monitor the evolution of backhaul use and needs, as well as the regulation by NRAs of wholesale inputs for backhaul, with a special focus on backhaul needs and use for 5G deployment and the application of the 2020 recommendation on relevant markets. Once a relevant number of NRAs decisions and corresponding EC input on the application of the recommendation will be available, BEREC may consider the preparation of a common position on the analysis (retail market analysis, wholesale market definition, SMP assessment) and remedies for fixed and mobile backhaul.

2 INTRODUCTION AND OBJECTIVES

The regulatory treatment of backhaul is particularly relevant in 5G deployment to connect to the core network the large number of base stations that are needed to ensure a comprehensive coverage by operators, as well as for deploying fixed very high capacity networks especially in non-densely populated and/or remote areas. This report continues and updates the work done by BEREC on the convergence of fixed and mobile networks, which focused on the role of regulation in the provision of mobile backhaul services and on the operators' mobile backhaul requirements.[10]

The objectives of the report are to present the legal provisions applicable to mobile and fixed backhaul – with a special focus on the recent EC recommendation on relevant markets[11] –, the regulation and use of different types of backhaul networks and services in Europe, as well as views expressed by operators on their current and future needs for backhaul.

In this line, this report presents a snapshot of the current regulatory treatment for both fixed and mobile backhaul among BEREC members, as well as an overview of how backhaul is being used and deployed by different operators.

The information provided in the report is based on the responses received to comprehensive questionnaires sent to NRAs and operators in April/May 2021. A total of 35 NRAs (all BEREC members and 8 BEREC observers), as well as 60 operators from 18 countries and two associations responded to the corresponding questionnaires (see annexes III to V). Additionally, BEREC organised a workshop in June 2021 with the main operators' associations to collect their input on current and future needs of backhaul in light of 5G deployment, their use of regulated products and their views on the regulatory treatment of backhaul.

The report is organised as follows. After the executive summary and the introduction, chapter 3 presents the legal provisions on backhaul under the EECC and related EC regulations. A

[10] "BEREC Report on the convergence of fixed and mobile networks" BoR (17) 187. October, 2017. See https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/7311-berec-report-on-the-convergence-of-fixed-and-mobile-networks

[11] Commission Recommendation of 18.12.2020 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code.

summary of data and views provided by stakeholders is provided in chapter 4, while chapter 5 gives an overview of how fixed and mobile backhaul networks are treated by NRAs in different countries: whether they are regulated or not, and if so, under which wholesale market, including details about market definition and the associated remedies. Chapter 6 presents BEREC conclusions with a special focus on future needs and regulation of backhaul, while chapter 7 briefly presents the potential future BEREC work in this area. Annexes I and II provide additional detail on input provided by operators. Annex III lists NRAs and stakeholders who responded to the questionnaires. The templates of the questionnaires sent to NRAs and operators are included in annexes IV and V.

3 EU LEGAL FRAMEWORK FOR BACKHAUL

3.1 Introduction

Backhaul is an important service in supporting the delivery of fixed and mobile electronic communication services at the retail market. However, not every service provider – either mobile or fixed – active on the electronic communications markets has a complete own backhaul network at its disposal. Such undertakings have to source inputs from wholesale electronic communications operators to meet their backhaul network requirements.

A commonly traded service for backhaul is dedicated capacity (leased lines) provided by other electronic communications operators. In this regard, service providers often purchase dedicated capacity in wholesale markets to connect their mobile base stations and/or their fixed access networks to their core network nodes. In its Explanatory Note to the Recommendation on Relevant Markets 2020[12], the EC notes that *"if the current trend of exponential growth in data consumption in mobile networks continues, fibre connections may become necessary for backhaul in mobile networks, especially in the most densely populated areas. This situation will be reinforced by 5G networks, which will require denser networks with smaller cells and thus more cell sites"*. [13] The progressive deployment of very high capacity networks, and the increase in upload and download speeds, will likewise probably make fixed backhaul services more prominent. As such, there is likely to be an increase in demand for backhaul services from MNOs and fixed operators in the future.

This section gives an overview of the legal provisions in the EECC as well as in Directive 2014/61/EU on measures to reduce the cost of deploying high-speed electronic

[12] SWD (2020) 337 final (hereinafter "Explanatory Note to the Recommendation on Relevant Markets 2020").

[13] Explanatory Note to the Recommendation on Relevant Markets 2020, p. 38. See also p. 33*: "Concerning general trends in infrastructure deployment, the Commission assumes a technological convergence as the need for fixed fibre networks for the transmission of mobile traffic will increase. Despite the use of microwave as well as sometimes fixed-line (e.g. copper, fibre) solutions as backhaul for the transmission of data between base stations and the core network, the Commission expects fibre connections to become necessary due to the current exponential growth in data consumption. The Commission presumes 5G networks to reinforce this situation even further".*

communications networks (BCRD) under which regulated access to backhaul or related physical infrastructure could be envisaged.

As it was already stressed in BEREC's report on the convergence of fixed and mobile networks[14], a different range of regulatory solutions are available to NRAs to address market failure(s) in backhaul or to overcome significant barriers to network expansion. These remedies can ensure that backhaul services are made available to meet the wholesale demand on a fair and reasonable basis. Examples of such remedies could include for instance the rental of leased lines, dark fibre, as well as access to physical infrastructure (e.g., ducts and poles). These access remedies may be available to alternative operators either via *ex ante* regulation or through legislation that indistinctly applies to all operators, namely the BCRD.

In the following sections, the rules on access to backhaul under SMP regulation (cf. section 3.2) as well as under the national rules implementing the BCRD (cf. section 3.3) are presented. It should be noted that in relation to bespoke SMP regulation, most of the considerations will gravitate around demand for mobile backhaul, as this is the topic that the Commission explicitly addresses in its Explanatory Note to the Recommendation on Relevant Markets 2020.[15]

3.2 Significant Market Power (SMP) regulation

In case that the requirements for SMP regulation of a potential wholesale market including backhaul are met (cf. section 3.2.1), the necessary inputs to provide backhaul and/or access to physical infrastructure are regulated via wholesale remedies (cf. section 3.2.2).

3.2.1 Requirements for SMP Regulation

The general legal framework for market definition and analysis is essentially set out in articles 64 and 67 of the EECC. These articles stipulate the core procedure and elements of the assessment, which are:

(1) Definition of the relevant product and geographical market;
(2) Assessment whether a market is susceptible to *ex ante* regulation; and
(3) Assessment whether an undertaking or several undertakings have SMP.

Since the EECC, as well as the 2020 Recommendation on Relevant Markets[16], are mostly silent regarding access to backhaul, the question whether or not access to backhaul needs to be regulated must be decided by each NRA through the application of these general provisions.

[14] BoR (17) 187. Ibid footnote 10
[15] Cf. Explanatory Note to the Recommendation on Relevant Markets 2020, p. 59.
[16] Commission Recommendation (EU) 2020/2245 of 18 December 2020, OJ L439/23 of 29 December 2020.

3.2.1.1 Market definition

Within the market definition, the relevant retail markets and wholesale markets have to be identified.

Retail market(s)

According to paragraph (6) of the 2020 Recommendation on Relevant Markets, the starting point for the identification of relevant markets should be the definition of retail markets in a forward-looking perspective over a given time horizon, guided by competition law[17]. Sustainable competition at retail level to the ultimate benefit of consumers and end-users remains the final objective of regulatory intervention. Therefore, SMP-based *ex ante* regulation should be applied only where needed in order to address, under the modified Greenfield approach, a lack of effective competition at the retail level.[18]

In order to assess whether or not there is a retail market where competition problems occur, as a first step the relevant retail market(s) need to be identified. Wholesale regulation is not a goal in itself but is only justified to resolve a demonstrable retail market failure. Thus, where retail markets are effectively competitive in the absence of wholesale regulation, regulation will not be needed on related wholesale markets. On the other hand, if the retail market concerned is not effectively competitive from a forward-looking perspective in the absence of *ex ante* regulation, the corresponding wholesale market(s) susceptible to *ex ante* regulation should be defined and analysed.

For the purposes of this report, the relevant downstream retail market(s) regarding the market for wholesale dedicated capacity (market 2/2020) would be the retail markets for high-quality products for business customers. Similarly, fixed telephony and broadband as well as mobile telephony and broadband would be the retail downstream markets of the wholesale fixed and mobile backhaul markets respectively. Besides these wholesale markets, relevant wholesale markets for retail fixed telephony and broadband are market 1 of the 2020 Recommendation on Relevant Markets (M1/2020 onwards) as well as market 3b of the 2014 Recommendation on Relevant Markets (M3b/2014). While, via input products from wholesale backhaul markets, connections to the core network are established, the input products from the wholesale markets 1/2020 and 3b/2014 serve to source fixed access lines to households as well as to business customers with mass market requirements.

[17] See also paragraphs (23) and (24) of the Recommendation on Relevant Markets 2020.
[18] See page 9 of the Explanatory Note 2020.

Table 1: Wholesale markets and related retail markets

Wholesale market	Related retail market
Local access provided at a fixed location (market 1/2020) and wholesale central access provided at a fixed location for mass-market products (market 3b/2014)	Fixed telephony and broadband
Dedicated capacity (market 2/2020)	High-quality products for business customers
Fixed backhaul (connection to the core network)	Fixed telephony and broadband
Mobile backhaul (connection to the core network)	Mobile telephony and broadband

Wholesale markets

Market 2/2020 (wholesale dedicated capacity) is one of the wholesale markets where, if there is evidence of a retail problem, *ex ante* regulation of backhaul might be considered. The Explanatory Note to the 2020 Recommendation on Relevant Markets also discusses the issue of mobile backhaul in the context of market 2/2020.

For the dedicated capacity market(s), NRAs are required to assess whether or not wholesale dedicated capacity products used in the provision of retail services form part of an overall wholesale market or constitute different segments of the wholesale market. This is done by performing a substitutability analysis within the conceptual framework of the SSNIP[19] test.

By definition, the dedicated capacity market mainly comprises the terminating segments of leased lines providing dedicated capacity in both the retail and wholesale markets. This could be specified as the portion of the Point to Point (PtP) line service between the end-user site and the closest exchange or alternately, based on the spilt between the trunk and terminating markets defined by the NRA. In general, the precise definition of the market should be determined by the characteristics of the service delivered rather than by technological details. Where upstream wholesale products for use in the different retail markets are substitutable, fixed and/or mobile backhaul may be part of the same wholesale market; backhaul may also be a segment of the wholesale market. However, the outcome may vary, depending on national circumstances.

In its Explanatory Note to the 2020 Recommendation on Relevant Markets, the Commission sets out its approach regarding the regulation of mobile backhaul (it does not, however, address fixed backhaul). The Commission does not in principle regard mobile backhaul as being part of the relevant product market for dedicated capacity but also acknowledges that this may be possible under specific national circumstances:

> *"However, with a view to delineating the boundaries of the market for dedicated capacity and other business access products NRAs should ensure that the*

[19] Small but Significant and Non-transitory Increase in Prices

> *relevant wholesale products correspond to the retail market problem identified. In particular, because currently retail mobile markets are in general competitive at EU level absent wholesale regulation, in the absence of additional elements relevant in a prospective analysis to include the mobile backhaul within the market for wholesale dedicated capacity."*[20]

Besides its consideration as part of market 2/2020, backhaul could be integrated in the wholesale market reviews through different means, which will be dependent on the way markets are identified and defined by each NRA on a national level. As noted, regardless of the precise way the market is defined, backhaul regulation would in any event require evidence of a related retail market problem.

First, the Explanatory Note to the 2014 Recommendation on Relevant Markets stressed that *"[a]n issue related to the definition of the wholesale high-quality access market is whether ex ante regulatory intervention is required in a market for access to backhaul (distinct from the market for access to fixed networks) in order to facilitate or enhance the competitive provision of services"*[21]. The Commission thus points out that, in the event of a generalised market failure, access to regulated backhaul services may lead NRAs to explore the definition of a separate wholesale market.

Second, the analysis of backhaul may also be part of the assessment that NRAs undertake of current market 1/2020 and (as already indicated) market 2/2020, in particular if the focus is on local connections (e.g. the last network segment to connect a 5G base station). Further back in the network, backhaul services could be deemed to constitute a segment or be part of the overall market for trunk segments of leased lines.

3.2.1.2 Market susceptible to ex ante regulation

A market is susceptible to ex ante regulation if all of the following criteria are met[22], cf. article 67 (1) subpara. 2 EECC:

(1) high and non-transitory structural, legal or regulatory barriers to entry are present;
(2) there is a market structure which does not tend towards effective competition within the relevant time horizon, having regard to the state of infrastructure-based competition and other sources of competition behind the barriers to entry;
(3) competition law alone is insufficient to adequately address the identified market failure(s).

Where a market is listed in the Recommendation on Relevant Markets, there is the (rebuttable) presumption that the market is susceptible to ex ante regulation, i.e., NRAs are obliged to

[20] Explanatory Note 2020, p. 59. Please note that the relevant sentence in the Explanatory Note is not complete. When comparing this version with the draft recommendation, it appears that the sentence should read: "…] *[it is not justified] to include the mobile backhaul within the market for wholesale dedicated capacity.*"
[21] cf. Explanatory Note to the Recommendation on Relevant Markets 2014, p. 51f.
[22] cf. article 67 (1) subpara. 2 EECC

analyse the market to ascertain if SMP regulation is warranted. Additionally, NRAs should also analyse markets that are not contained in the 2020 Recommendation on Relevant Markets if they have sufficient grounds to consider that the three-criteria-test is fulfilled.[23] Therefore, regulatory outcomes may vary between Member States.

In the event that – as detailed above – NRAs were to define a separate backhaul market or analyse backhaul in the context of the market for trunk segments of leased lines, the three criteria test would need to be satisfied, as these markets are not included in the 2020 Recommendation on Relevant Markets.

The Explanatory Note to the 2020 Recommendation on Relevant Markets contains further explicit guidance concerning mobile backhaul. When assessing whether mobile backhaul is susceptible to *ex ante* regulation, the following statement of the Commission is of relevance:

> *"Moreover, NRAs should consider whether access to physical infrastructure is already available upstream, which may improve Mobile Network Operators' potential reach and ability to deploy dedicated fibre connections with a high degree of flexibility to operate their networks."*[24]

On the other hand, the Commission indicates that incumbents may have a significant advantage (amongst others) in the speed of provisioning of 5G since they are generally strongly placed and have widespread infrastructure outside more densely populated areas. In order to leverage this advantage, incumbents would have limited incentives to offer wholesale access on a commercial basis.[25]

3.2.1.3 SMP assessment

An undertaking shall be deemed to have significant market power if, either individually or jointly with others, it enjoys a position equivalent to dominance, namely a position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers. When undertaking any market analysis, NRAs have to take into utmost account the SMP Guidelines.[26]

3.2.1.4 Conclusion

The imposition of remedies regarding access to backhaul infrastructure will be necessary in the event an NRA concludes that: (i) there is a lack of effective competition at the retail level

[23] Cf. recital (165) of the EECC.

[24] Explanatory Note 2020, p. 59, footnote 175.

[25] Explanatory Note 2020, p. 60. Similarly, the Explanatory Note also refers to results of the expert study issued for the revision of the Recommendation on Relevant Markets, cf. p. 85/86. In its report, WIK concludes that there are still significant areas where backhaul will not be viably duplicated. WIK attributes this to the lack of incentive of the owner of fibre backhaul connections in such areas to provide access to or share their assets in cases where this infrastructure confers an advantage for its own fixed and/or mobile retail business.

[26] Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services, OJEC C159/1 of 7 May 2018.

under the modified greenfield approach; (ii) the related wholesale market fulfils the three criteria test; (iii) SMP is deemed to exist in the relevant wholesale market.

3.2.2 Remedies under SMP regulation

Where an undertaking is designated as having SMP, NRAs shall impose any of the obligations specifically envisaged in the Code for those undertakings.

However, the remedies that may be necessary specifically for backhaul (such as access to leased lines, physical infrastructure, or dark fibre) may have already been mandated in the context of the market reviews undertaken by NRAs (e.g., in the context of market 1/2020 regarding fixed wholesale local access or market 2/2020 regarding wholesale dedicated capacity). The remedies imposed in these markets may in turn be made available for different uses, including fixed and/or mobile backhaul, provided that the competition problem(s) identified in the corresponding retail markets can be addressed by regulation of the same relevant wholesale market. In this regard, mandating access to regulated services such as ducts, dark fibre or leased lines for the backhaul segment, could solve or at least alleviate the competition problems that might have been identified by the NRA.

The EECC has changed the former market analysis process in regard to the imposition of any access regulation in a wholesale market. According to article 73 (2) of the Code, before imposing additional obligations, NRAs must examine whether the imposition of access to civil engineering (on the basis of article 72 of the Code) alone may be a proportionate means by which to promote competition and the end-user's interest.

In the context of *ex ante* regulation, access to the physical infrastructure of the SMP operator may thus be deemed as a self-standing remedy for the improvement of the competition conditions downstream, and not just as an ancillary remedy to other wholesale products or services or as a remedy limited to undertakings availing themselves of such other wholesale products of services.[27] The Explanatory Note to the 2020 Recommendation of Relevant Markets stresses at footnote (175) that the availability of access to physical infrastructure for mobile operators may be an important factor when determining whether further regulatory remedies should be available for the purposes of mobile backhaul.

EU legislation and non-binding (soft law) measures contain few references to other wholesale services that may be available to alternative operators for the purposes of backhaul. Regarding fixed backhaul, the Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA)[28] indicates at point (29) that a copper sub-loop unbundling remedy *"should be supplemented by backhaul measures, including fibre and Ethernet backhaul where appropriate, and by ancillary remedies ensuring its effectiveness and viability, such as non-discriminatory access to facilities for co-location, or in their absence, equivalent co-location"*. The NGA Recommendation also stresses at point

[27] See Recital (187) of the Code.

[28] OJEC L251/35 of 25 September 2010. The European Commission's access recommendations are currently under review.

(22) that, in the case that unbundled access to the fibre loop in the case of FTTH is required by NRAs, *"the imposition of unbundled access to the fibre loop should be accompanied by appropriate measures assuring co-location and backhaul. Access should be given at the most appropriate point in the network, which is normally the Metropolitan Point of Presence (MPoP)"*.

In the same vein, BEREC's Common Position on best practice in remedies on the market for wholesale (physical) network infrastructure access (including shared or fully unbundled access) at a fixed location[29] stresses at Best Practice 9 (access products to reach the access point) that *"the closer the access point is to the end-user the more essential the access product to reach the access point becomes. NRAs should impose an obligation for an access product to reach the access point from the MPoP such as duct access, dark fibre, leased lines including Ethernet access taking into account the economics of specific NGA scenarios"*. Best Practice 10 further notes that *"NRAs should impose an obligation to ensure that the MPoP can be connected to the operator's infrastructure with an appropriate remedy or set of remedies on regulated terms (although not necessarily covered by the same market review) unless the NRA is satisfied that such access products are available under competitive conditions on reasonable terms throughout the relevant geographic market*"[30].

3.3 Broadband Cost Reduction Directive (BCRD)

3.3.1 Scope of the BCRD

The Broadband Cost Reduction Directive (BCRD)[31] is a horizontal instrument[32] that provides several regulatory measures to lower the costs of broadband deployment in the EU. For the purposes of this report, articles 3 and 4 on access to physical infrastructure and transparency concerning physical infrastructure are particularly relevant.

Under article 3 of the BCRD, network operators have the obligation to meet all reasonable requests for access to its physical infrastructure under fair and reasonable terms and

[29] "Revised BEREC common position on best practice in remedies on the market for wholesale (physical) network infrastructure access (including shared or fully unbundled access) at a fixed location imposed as a consequence of a position of significant market power in the relevant market". BoR (12) 127. December, 2012. Available at https://berec.europa.eu/eng/document_register/subject_matter/berec/regulatory_best_practices/common_approaches_positions/1127-revised-berec-common-position-on-best-practice-in-remedies-on-the-market-for-wholesale-physical-network-infrastructure-access-including-shared-or-fully-unbundled-access-at-a-fixed-location-imposed-as-a-consequence-of-a-position-of-significant-market-power-in-the-relevant-market . See also "BEREC Report on access to physical infrastructure in the context of market analyses", BoR (19) 94. June, 2019. Available at https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/8597-berec-report-on-access-to-physical-infrastructure-in-the-context-of-market-analysis

[30] For fixed backhaul, see also Best Practice 13: *"where necessary NRAs should impose dark fibre/leased lines including Ethernet backhaul as an independent measure or as a subsidiary measure of duct access (i.e., in case there are no ducts, there is no space in the ducts or duct access is not viable) supplementing the FTTH and FTTN access remedies to connect the access point to a point higher in the network, e.g. MPoP"*.

[31] The BCRD is under review at the moment of preparing this report.

[32] That is, it is applicable to a wider range of economic agents than electronic communications operators and regardless of SMP consideration.

conditions, including price, with a view to deploying elements of high-speed electronic communications networks. Network operators are defined broadly and include among other (i) undertakings providing or authorised to provide public communications networks; (ii) undertakings providing a physical infrastructure intended to provide a service of production, transport or distribution of gas, electricity, heating or water; (iii) undertakings providing a physical infrastructure intended to provide transport services. Going beyond the BCRD, in some Member States, public administrations are also required to provide access to their physical infrastructure.

Under the BCRD, a high-speed electronic communications network is defined as an electronic communications network which is capable of delivering (fixed or mobile) broadband access services at speeds of at least 30 Mbps.

According to article 4 of the BCRD, network operators must also ensure that operators (that provide public communications networks) seeking access from an infrastructure owner are provided with the necessary information in order to progress its access request. This includes its location and route, the type and current use of the infrastructure, in addition to a contact point.

As noted in BEREC's response to the targeted consultation on the revision of the Commission's access recommendations[33], the BCRD and SMP regulation seek to achieve two objectives that are related but nevertheless differ significantly. The former is targeted at facilitating and incentivising the roll-out of high-speed electronic communications networks by promoting the joint use of existing physical infrastructure. The latter is concerned with safeguarding the conditions of competition in a given market via the imposition of regulatory obligations to the operator that holds SMP.

Both regimes of norms however aim to ensure that access to physical infrastructure, which is deemed as a key bottleneck for the development of high-speed broadband networks, is widely available to providers of electronic communications networks.

3.3.2 Obligations under the BCRD

As it has been seen, the BCRD aims to ensure that providers of electronic communications networks have access to the physical infrastructure of network operators[34], under reasonable conditions and prices, which are normally negotiated bilaterally. Physical infrastructure is defined as *"any element of a network which is intended to host other elements of a network without becoming itself an active element of the network, such as pipes, masts, ducts,*

[33] See "BEREC Response to the Targeted consultation on the revision of the Commission's access recommendations". BoR (20) 169. October, 2020. Available at https://berec.europa.eu/eng/document_register/subject_matter/berec/others/9444-berec-response-to-the-targeted-consultation-on-the-revision-of-the-commission8217s-access-recommendations

[34] As this term is defined in article 2 (1) of the BCRD and is described above.

inspection chambers, manholes, cabinets, buildings or entries to buildings, antenna installations, towers and poles".

Although this will be dependent on the specific way the BCRD has been transposed into national law, in general it can be said that the BCRD provides a general entitlement for access to physical infrastructures usable for (mobile and fixed) broadband deployment. However, unlike SMP regulation, access granted under the BCRD is generally considered to be based on a case-by-case assessment as several objective, transparent and proportionate reasons can be brought forward by the network operator to refuse access to its physical infrastructure.

4 STAKEHOLDERS' INPUT ON BACKHAUL

The questionnaire for operators was filled in by 60 operators and two associations from 18 countries (see Table 2). Among the operators, two are pure MNOs, 32 pure fixed network operators and 26 fixed-mobile converged operators. Five operators were identified as incumbent operators (i.e., previous fixed network monopoly operators) and all of these five operators also operate mobile networks. Since the number of operators that filled in the questionnaire is low compared to the total number of operators which use backhaul in the EU, and the distribution across countries is uneven, the results should be interpreted with caution.

The operator questionnaire covers questions about the current and future use of inputs for fixed and mobile backhaul as well as questions about the future need for regulation.

Table 2: Countries and number of operators

Country of origin	Number of operators / associations
Austria	1
Belgium	6
Croatia	2
Czech Republic	2
Estonia	1
France	2
Germany	6
Greece	2
Ireland	2
Italy	5
Lithuania	2
Luxembourg	1
Malta	2
Norway	7
Portugal	3
Slovakia	10
Slovenia	3
Spain	5
Total	**62**

The term backhaul is defined in the questionnaire as follows:

- Mobile backhaul: Connection of a base station or several base stations (including small cells) to the core network. Connections within the core network are not considered.
- Fixed backhaul: Connection of one or several fixed network elements (e.g., DSLAM, OLT, BNG, splitter, etc.) to operator's own core network and/or connection of the network to an internet exchange.

Section 4.1 discusses mobile backhaul and section 4.2 is focused on fixed backhaul.

4.1 Mobile backhaul

4.1.1 Operators' input on mobile backhaul

This chapter analyses the operators' answers to the mobile backhaul section of the operator questionnaire. 28 operators from 16 countries replied to the part of the questionnaire dealing with the inputs used for mobile backhaul (including self-supply).[35] These operators are significantly different in size, as shown by the number of base stations which varies between 30 and 25,000 with a mean of about 7,000.

First, the MNOs were asked which inputs (including self-supply) they currently use to connect their mobile base stations. This question was asked separately for bandwidths up to and including 1 Gbit/s and for bandwidths above 1 Gbit/s.

There are differences with regard to the inputs used by incumbents and alternative operators. Incumbents mainly self-supply the backhaul for their mobile base stations whereby the focus is on fibre links. But since only four responses of incumbents to those questions were received (and only two for future needs of mobile backhaul in three years), incumbents and entrants are not analysed separately in this report.

Table 3 and Table 4 show the average (mean) %-values of the different input types used by the MNOs. The means also include operators which do not use a certain input (with a value of zero). The number of operators who reported to use a certain input is shown in corresponding tables in Annex I. The Annex also contains boxplots, which include additional information on the distribution of the %-values of the entries.

For connections up to and including 1 Gbit/s (Table 3), almost all 28 operators who responded currently use self-supplied radio links. The mean share of base stations connected with self-supplied radio links is 58.3%, which is by far the highest value in Table 3. 18 operators also use self-supplied fibre links with a mean share of 19.3%.

With regard to inputs ≤ 1 Gbit/s from third parties, there is a clear use of Ethernet services and dark fibre. Ethernet services are mainly purchased from the incumbent operator on commercial terms (11 MNOs, mean 6.7%) and from alternative operators (seven MNOs, mean 3.5%), to a lower extent from the incumbent based on regulated products (six MNOs, mean

[35] 30 of the 62 operators declared themselves as MNOs, but two did not fill in this part of the questionnaire or reported implausible values.

0.4%). Dark fibre is mainly purchased from alternative providers (13 MNOs, mean 5.5%) while five MNOs buy dark fibre from the incumbent operator on commercial terms (mean 1.4%).

Table 3: Inputs used for mobile backhaul, present, ≤ 1 Gbit/s, mean % values

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					0.1%	19.3%	58.3%
From incumbent based on regulated products	0.7%	0.4%	0.0%	3.3%			
From incumbent commercial	0.1%	6.7%	1.4%	0.0%			
From other parties	0.0%	3.5%	5.5%	0.8%			

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc
Responses from 28 operators

For bandwidths above 1 Gbit/s (Table 4), all 25 operators who filled in the table use own fibre links. The mean share of own fibre links is 49.4%, significantly higher as for connections ≤1 Gbit/s. Only 16 operators also use own radio links in this bandwidth range and the mean share of 20.6% is considerably lower than for connections ≤1 Gbit/s. Also, regarding inputs from third parties, the focus is on fibre, mainly purchased as dark fibre from alternative providers (12 MNOs, mean 17.5%) and from the incumbent on commercial terms (seven MNOs, mean 8.9%). The importance of Ethernet Services is lower compared to the ≤ 1 Gbit/s segment with five MNOs buying from the incumbent on commercial terms (mean 0.3%) and only one MNO buying on regulated terms.

Table 4: Inputs used for mobile backhaul, present, > 1 Gbit/s, mean % values

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					0.0%	49.4%	20.6%
From incumbent based on regulated products	0.0%	0.0%	2.2%	0.3%			
From incumbent commercial	0.0%	0.3%	8.9%	0.0%			
From other parties	0.0%	0.0%	17.5%	0.4%			

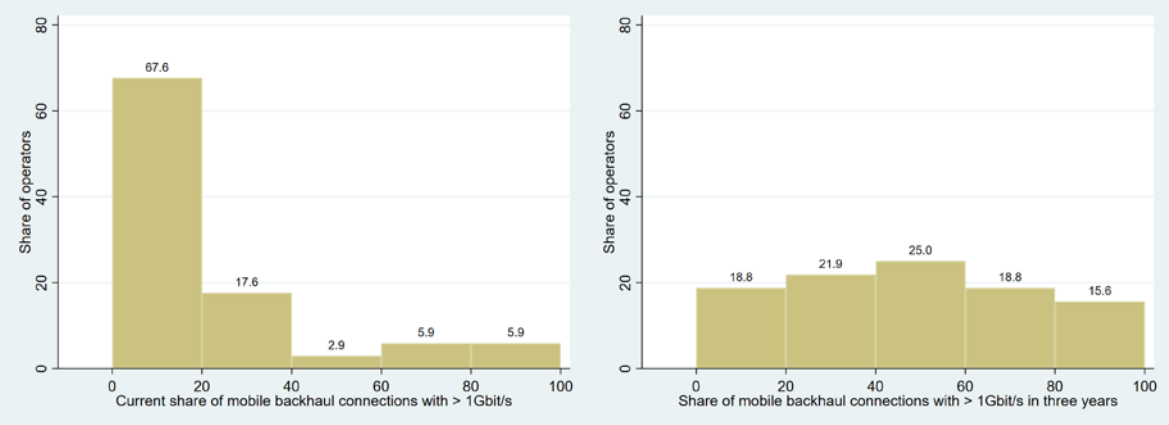
*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc
Responses from 28 operators

11 of the 28 MNOs state that they currently use regulated access to the passive infrastructure (e.g. duct or poles) from the incumbent, in order to establish own fibre links. The share of own fibre links established using such passive infrastructure ranges from 5% to 100% with a mean of 64%.

The current share of > 1 Gbit/s connections is very different across the 28 MNOs. The mean value of this distribution is about 20%. While four operators reported that they currently do not have any base stations connected with more the 1 Gbit/s, one operator said that all its base stations are connected with bandwidths in excess of 1 Gbit/s.

In a second step, MNOs were asked about their plans to connect their mobile base stations in the future (three years from now). Almost all operators said that the share of > 1 Gbit/s connections will increase significantly in this period. The mean value of such connections will increase by 32 percentage points to 52%. The histograms of the share of > 1 Gbit/s connections (present vs. in three years) are shown in Figure 1. The demand for > 1 Gbit/s connections will therefore increase significantly in the future. This development is likely driven by the rollout of 5G in the next years.

Figure 1: Histograms of the share of > 1 Gbit/s mobile backhaul connections, present vs. in three years



Responses from 28 operators

About half of the MNOs said that they intend to deploy small cells. However, the number will still be low compared to the number of base stations within the next three years.[36]

The projected demand for mobile backhaul in the next three years is shown in Table 5 and Table 6. The results are similar to the situation at present as shown in Table 3 and Table 4 indicating that the operators by and large will stick to their actual sourcing strategies in the bandwidth ranges ≤ 1Gbit/s and > 1 Gbit/s. However, the role of regulated inputs from the incumbent appears to decrease in the ≤ 1 Gbit/s-segment, while assuming that the current regulation remains unchanged, and it is expected to remain low for bandwidths above 1 Gbit/s.

[36] 21 MNOs responded to the question "What will be the approximate number of small cells in your network within three years?". The mean value of the figures provided is 350.

Table 5: Inputs used for mobile backhaul, in three years, ≤ 1 Gbit/s, mean % values

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					0.3%	18.7%	57.6%
From incumbent based on regulated products	0.3%	0.1%	0.0%	3.4%			
From incumbent commercial	0.0%	8.2%	1.8%	0.0%			
From other parties	0.0%	3.1%	5.6%	0.4%			

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc
Responses from 28 operators

Table 6: Inputs used for mobile backhaul, in three years, > 1 Gbit/s, mean % values

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					0.0%	47.5%	20.5%
From incumbent based on regulated products	0.0%	0.0%	2.7%	0.6%			
From incumbent commercial	0.0%	3.9%	6.8%	0.1%			
From other parties	0.0%	3.0%	18.2%	0.4%			

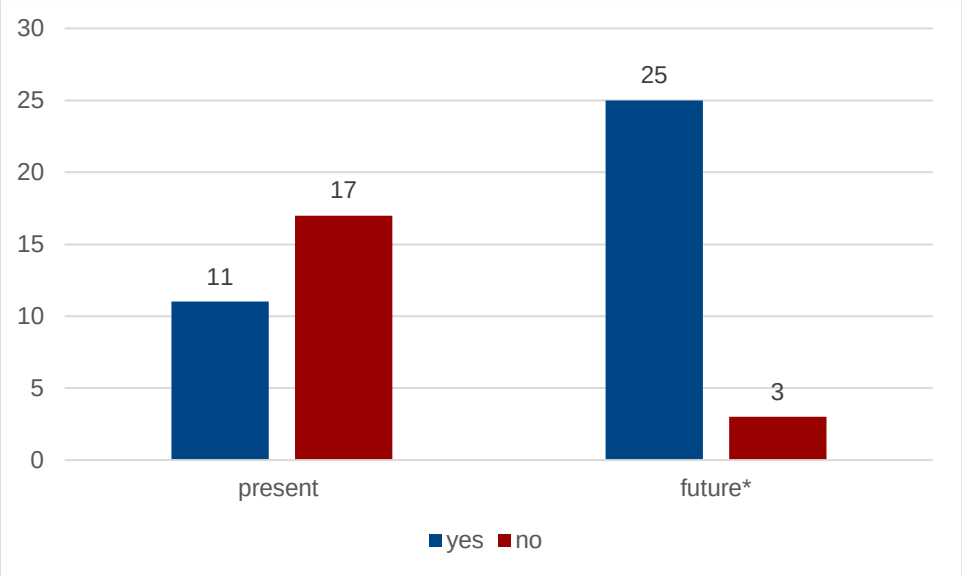
*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc
Responses from 28 operators

25 of the 28 MNOs state that they want to use regulated access to passive infrastructure (e.g., duct or poles) from the incumbent to deploy their own fibre links in the future.[37] This is a significant increase compared to 11 MNOs as today (Figure 2). However, only 15 MNOs also report that they actually will or can use ducts if the current regulation remains unchanged. This indicates that there is a significant number of MNOs who want to use the incumbent's ducts

[37] Responses to the question "If possible, will you use access to the passive infrastructure (e.g. duct) from the incumbent operator to establish own fibre links?"

but do not expect to get (viable) access to them if current regulation remains unchanged. The planned share of own fibre links established using the incumbent's passive infrastructure by the 15 MNOs ranges from 1% to 100% with a mean of 65% under the assumption that the current regulation remains unchanged. The importance of regulation of passive infrastructure for the use of mobile backhaul can therefore be expected to increase in the next years.

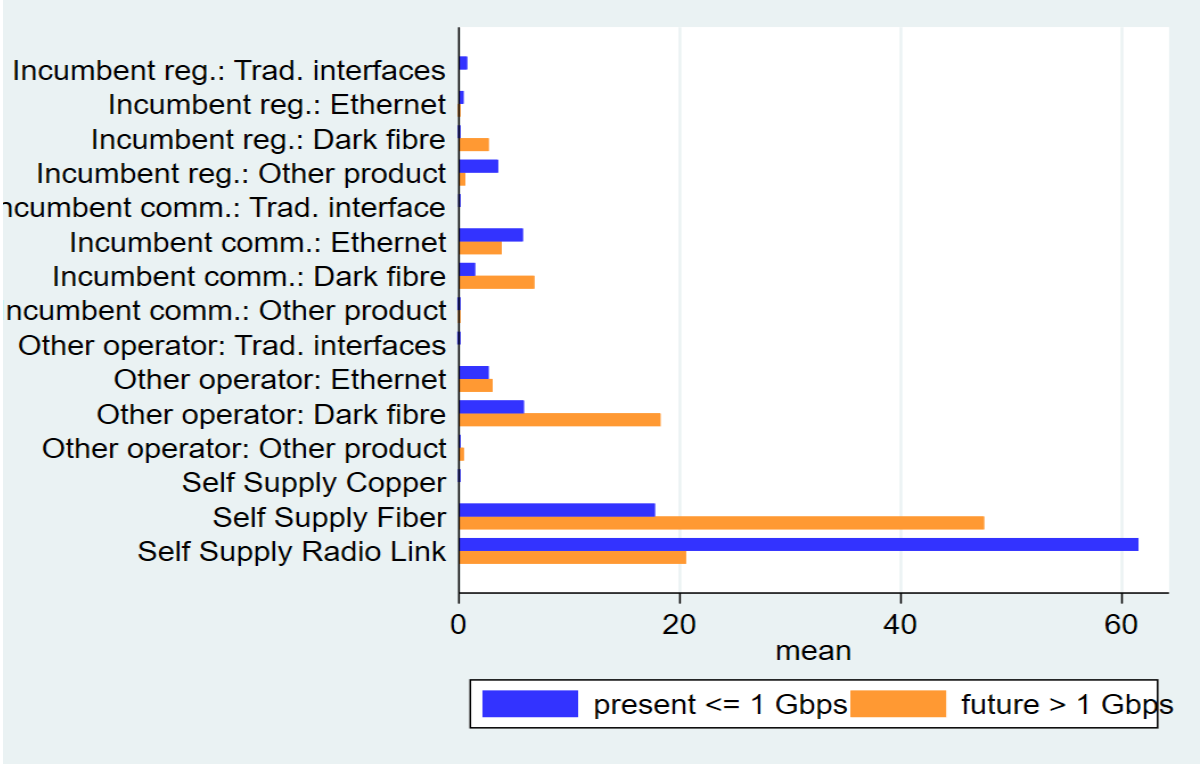
Figure 2: Current and future intended use of physical infrastructure access for mobile backhaul



(*): if available

Given that there will be a significant shift of connections from ≤ 1Gbit/s to > 1 Gbit/s, it is interesting to compare the current inputs for ≤ 1Gbit/s connections to the prospective inputs for > 1 Gbit/s connections. Figure 3 shows that there will be a significant shift from self-supplied radio links to dark fibre. The largest increase is in self-supplied dark fibre followed by dark fibre from alterative operators and dark fibre obtained from the incumbent operator on commercial terms.

Figure 3: Comparison of mean shares of input types – inputs ≤ 1 Gbit/s present vs inputs > 1 Gbit/s in the future[38]



Abbreviations: Trad. = traditional, reg. = regulated, comm. = commercial

Summing up, it can be concluded that, driven by the rollout of 5G in the next years, there will be a significant shift from radio links to fibre connections. Fibre connections will mainly be self-supplied, but there is also an increase in demand for dark fibre from the incumbent and alternative providers. In general, the share of operators who buy regulated products is low and seems to be decreasing in the future. But alternative MNOs emphasise the need for (more effective) future regulation of mobile backhaul (Ethernet Services of very high bandwidth or dark fibre) and/or access to passive infrastructure (where available) to allow the deployment of own fibre links (see Section 4.1.2 below).

4.1.2 Views on future regulation of mobile backhaul

The questionnaire asked respondents for their views on the need, or otherwise, of requiring regulation for the provision of mobile backhaul in the future, specifically for the next three years.

[38] The figures may deviate from those in Table 3 and Table 6 since not all operators included in the tables filled in both present and future values.

Views of incumbent operators

The responses from the five incumbent operators responding to the questionnaire, each of which also owns a mobile arm, were practically identical. All stated that there were many alternative sources for mobile backhaul available to operators and that, therefore there was no need for regulatory intervention in the provision of this service, see Table 7 below. This position was supported by "other reasons" by four of these respondents, one citing that physical infrastructure access (PIA) and publicly funded open access networks were available to operators. Another stated that as the trunk terminating market for leased lines had been removed from the Recommend markets by the EU Commission as far back as 2007 and had not been included in the 2020 Recommendation, the market for this service was competitive. A further response, restating the position of the EU Commission, said that there was no need for any regulatory intervention in mobile backhaul services because the retail markets for mobile telephony were deemed competitive.

Table 7: Incumbents Responses: Reasons against regulation of fixed backhaul in the future

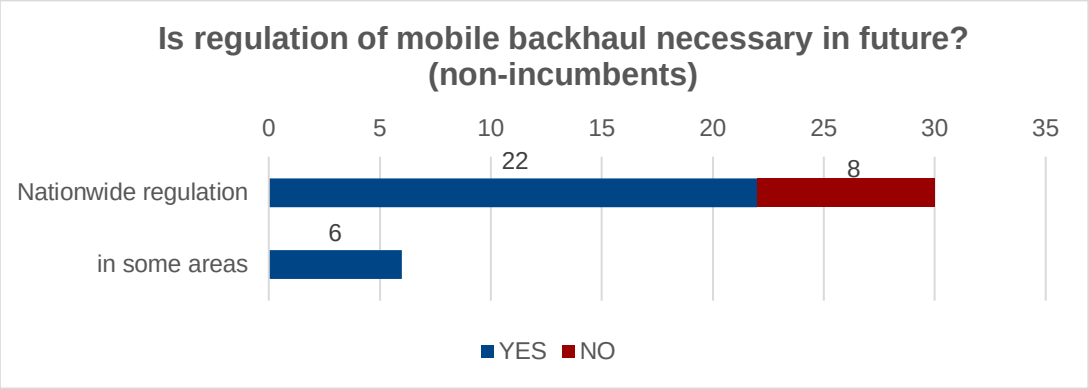
Offers from alternative operators are available	There is a commercial agreement with the incumbent operator	Backhaul can be self-supplied with radio links	Backhaul can be self-supplied with own fibre connections	Other reason
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	

Views of non-incumbent operators

The majority of non-incumbent[39] operators who responded indicated that they considered that future national regulation would be necessary to ensure that mobile backhaul would be available to operators in all areas (22 of a total of 36 respondents), while six others thought that it would be necessary in "some areas", as shown in Figure 4 below.

[39] The 5 incumbents' responses are not included here.

Figure 4: Non-incumbent respondents' views on the need for future mobile backhaul regulation



Both cohorts of respondents in favour of future regulation for each case (national and some areas) were further asked which type of remedies would be required in the future. The choices offered included Ethernet, Dark Fibre and PIA. Respondents were permitted to choose any number of these options offered and also an "other" category. The results for both cases are shown in Figure 5 and Figure 6 below. This broadly agrees with the responses of operators made to projected future uses of PIA and dark fibre to meet the expected increase in bandwidth demands as shown above in Section 4.1.1.

Figure 5: Preferred type of nationwide remedies needed for mobile backhaul in future

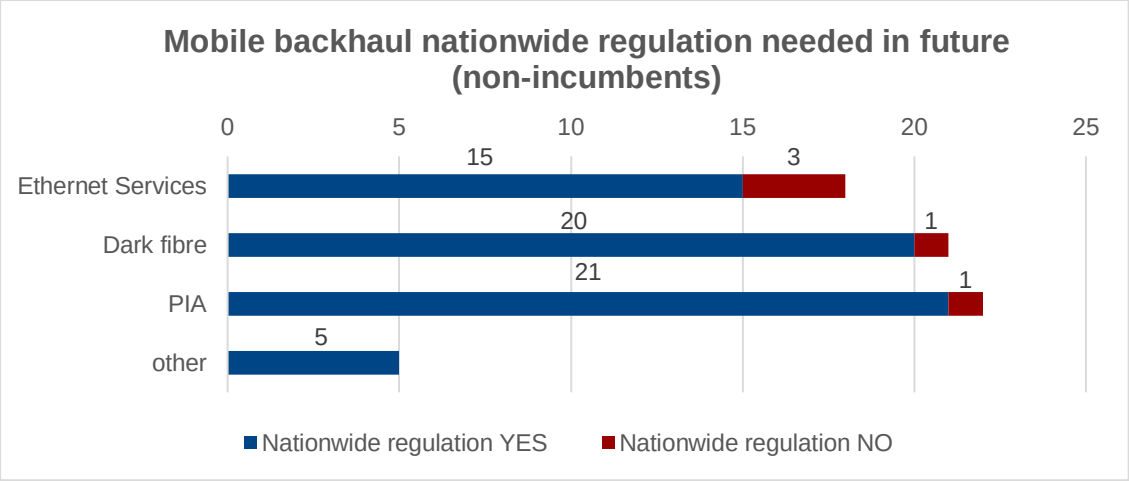
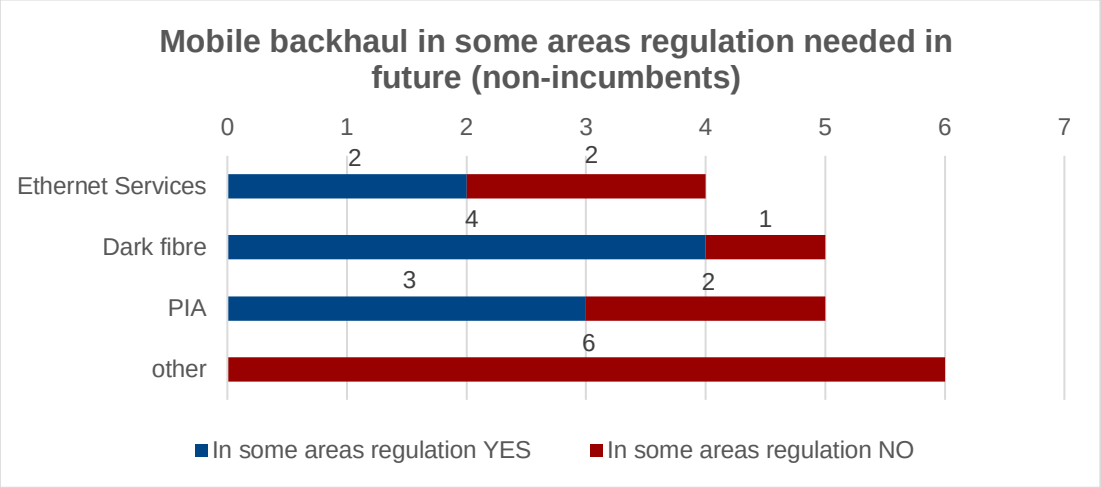


Figure 6: Preferred type of sub-national remedies needed for mobile backhaul in future

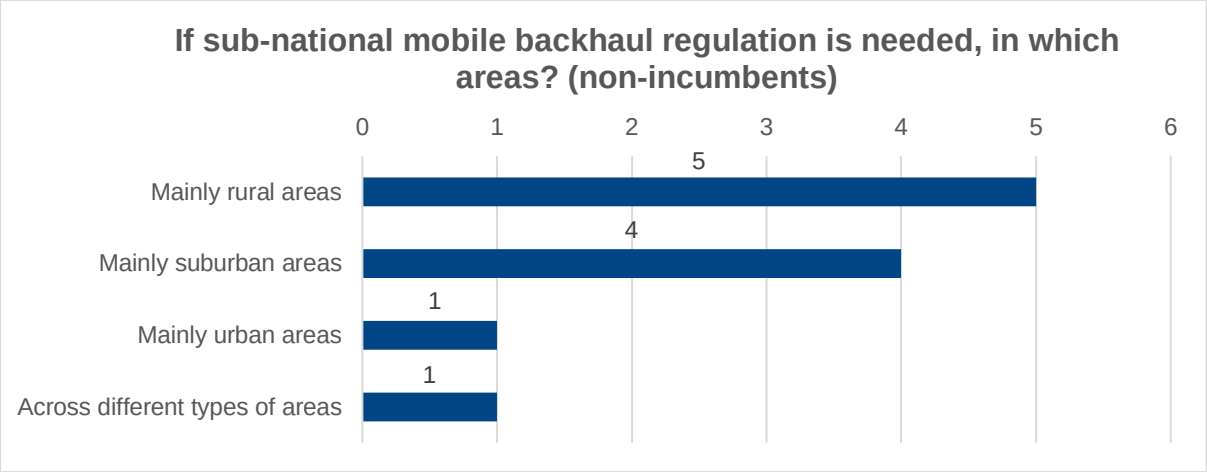


The 22 respondents who favoured national regulation were almost unanimous in the view that dark fibre and PIA would be required, (20 and 21) respectively, while those in favour of regulation in some areas were less emphatic in this view, being four and three out of six respondents.

The “other” category for those who chose national regulation was mainly for xWDM services while some mentioned the use of traffic control, lighting poles and electrical distribution infrastructure. There were zero respondents to this other category for “some areas”. Half of the 22 respondents also provided commentary in support of their view of the necessity of national regulation, six of which said that it was essential to assist in the rollout of 5G services while others said it was necessary to reach non-urban areas while one stated that the BCRD was not sufficient.

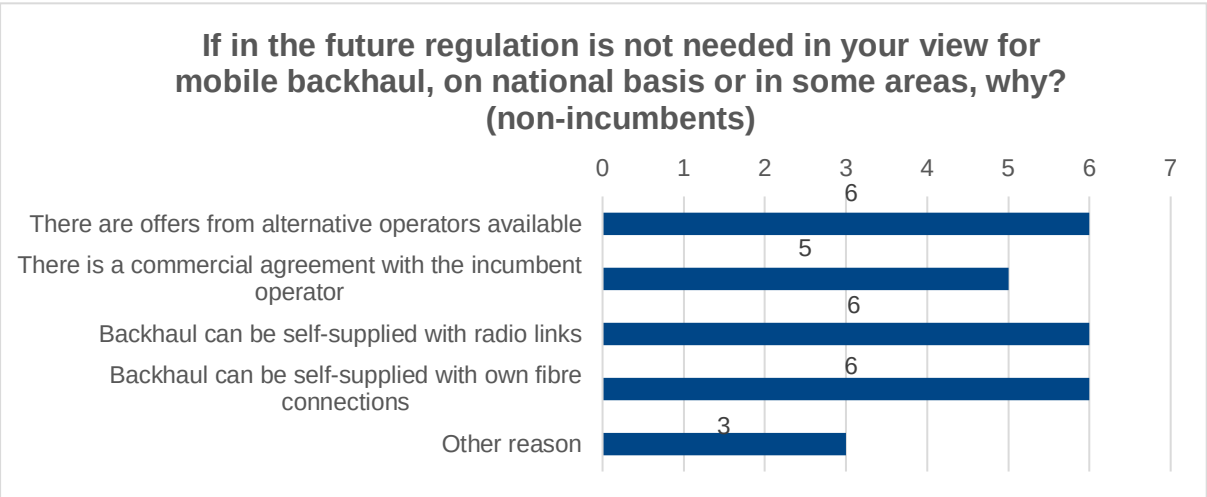
The six respondents who said that regulation was required in some areas rather than being national in scope, were further asked to nominate the type of sub-national geographic markets which needed regulation from four suggested types: urban, suburban, rural and other. The responses are shown in Figure 7 below. This indicates that in order to meet their anticipated demand, this cohort of operators considered that regulatory intervention should increase, as requirements move outward from urban to rural areas. One such respondent, in the comments section, cited the need for regulated backhaul in order to be able to connect to islands, as a specific geographic requirement in its territory.

Figure 7: Suggested type of sub-national markets which require regulation in future



Finally, non-incumbent respondents who considered that no regulation would be required for mobile backhaul in the future, were asked to provide reasons to support this view from a choice of a possible five. The results are shown in Figure 8 below (the views of the incumbent operators were already considered in Table 7 above). All unanimously said that alternative offers were available to meet any requirements or that operators could self-supply or use radio links to meet their requirements. Most of these respondents also expressed the view that commercial arrangements could be obtained from the incumbent. The main "other reason" offered were that they concurred with the EC's view that there was no requirement for upstream regulation for mobile backhaul as the downstream retail mobile telephony market(s) is considered as competitive.

Figure 8: Reasons for not requiring regulation of mobile backhaul in the future



The main conclusion BEREC has drawn from these responses is that due to the future expected demand for higher bandwidth mobile backhaul services, operators are looking to employ greater use of inputs such as dark fibre and PIA. This allows them to more easily drive higher bandwidths at less cost. Hence, they see the necessity for regulation to meet the demand for such services in areas where they perceive there will be an absence of competitive offerings to fulfil this anticipated demand.

4.2 Fixed backhaul

4.2.1 Operators' input on fixed backhaul

This section gives an overview of the current and future realisation of fixed backhaul connections in different European countries and summarizes operators' and stakeholders' associations' views on the need for regulation.

The number of operators who provided answers to the fixed backhaul section of the questionnaire varies significantly between questions, ranging from 11 to 51 operators. Almost all incumbent operators in the sample stated that they do not use any fixed backhaul connections from third parties and therefore did not answer most of the questions.

On average, an operator currently buys 1,665 fixed backhaul connections from third parties.[40] While there are operators who realize all of their fixed backhaul connections on their own, the maximum number of connections bought from other operators is 63,000. The standard deviation of 8,886 also demonstrates the great variation in the number of lines bought from third parties.

The wholesale products used for connecting fixed network elements to the operators' core networks differ depending on the bandwidths needed for the connection. Table 8 shows the current average share of each input type used for ≤ 1Gbit/s connections. The number of operators taken into account is the same for all input types so that the average values also include operators who do not use a certain input type (with a value of zero).

[40] All non-missing answers taken into account (including zeros) - number of responses: 50 present; 41 future.

Table 8: Average shares of input types for connections bought by third parties ≤ 1Gbit/s as today[41]

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	9.47%	13.16%	1.58%	0.00%
From incumbent commercial	8.21%	16.00%	11.61%	8.34%
From other parties	3.11%	17.58%	9.89%	0.37%

(*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

Ethernet products –whether they are bought from the incumbent commercially, on a regulated basis or from other operators – are the most used inputs for fixed backhaul connections with bandwidths lower than 1Gbit/s. The distribution of the shares reported by each operator for each input type and the number of operators using a certain input type are shown in the box plots and tables in annex II.

While Ethernet products play a big role for the realization of fixed backhaul connections with bandwidths lower than 1Gbit/s, dark fibre is the most commonly used input product for connections with > 1Gbit/s at the moment, which is illustrated by Table 9. It is mostly bought from other operators (on average 29.05% of the lines), but also from the incumbent on a regulated or commercial basis (11.33% and 16.28% respectively). Ethernet products from other operators are also used quite often to realize fixed backhaul connections with more than 1 Gbit/s (13.57%).

Interestingly, only 22-24% of fixed backhaul connections bought from third parties are realized via regulated products from the incumbent. Besides, of the 16 operators who use regulated

[41] Number of plausible responses:
present ≤ 1Gbit/s: 19
present > 1Gbit/s: 35
future ≤ 1Gbit/s: 11
future > 1Gbit/s: 29
(Operators who reported percentages which summed up to less than 80% were dropped; when operators reported a sum of percentages > 100%, the given values were rescaled.)

products from the incumbent, seven also buy the exact same product from other operators commercially.

Table 9: Average shares of input types for connections bought by third parties > 1 Gbit/s as today[42]

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	3.69%	6.33%	11.33%	0.29%
From incumbent commercial	3.29%	4.71%	16.28%	4.48%
From other parties	2.91%	13.57%	29.05%	2.93%

**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.*

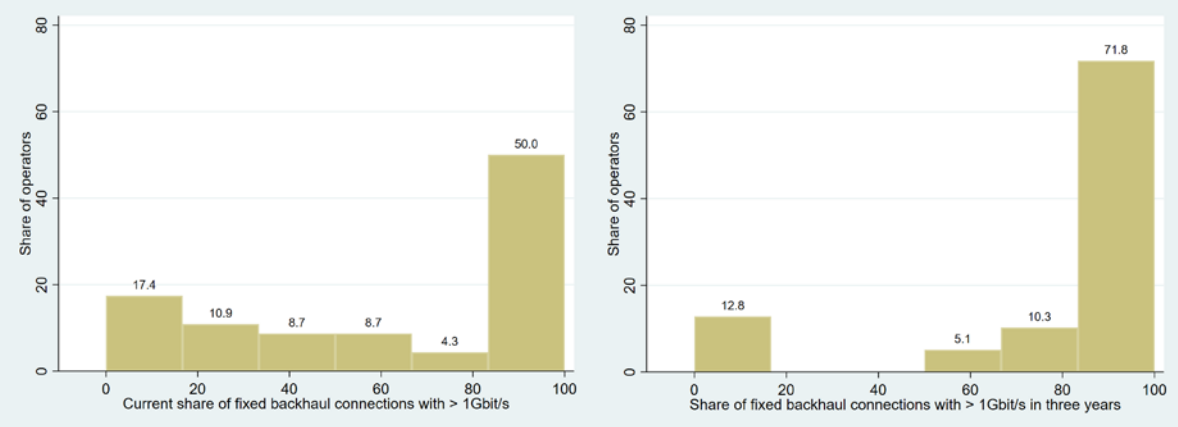
At present, on average 63% of the operators' fixed backhaul lines have bandwidths higher than 1Gbit/s.[43] The distribution of this share is shown on the left of Figure 9.

Regarding future use of backhaul, operators were also asked about the expected share of fixed backhaul connections with > 1Gbit/s in three years which is displayed on the right of Figure 9. The share of 80-100% is indicated even more often than today, leading to an increase of the expected share of connections with > 1Gbit/s to be on average 81% in three years.

[42] Ibid.

[43] All non-missing answers taken into account (including zeros) - number of responses: 46 present; 39 future.

Figure 9: Histograms of the share of fixed backhaul connections bought by third parties > 1 Gbit/s, present vs. in three years

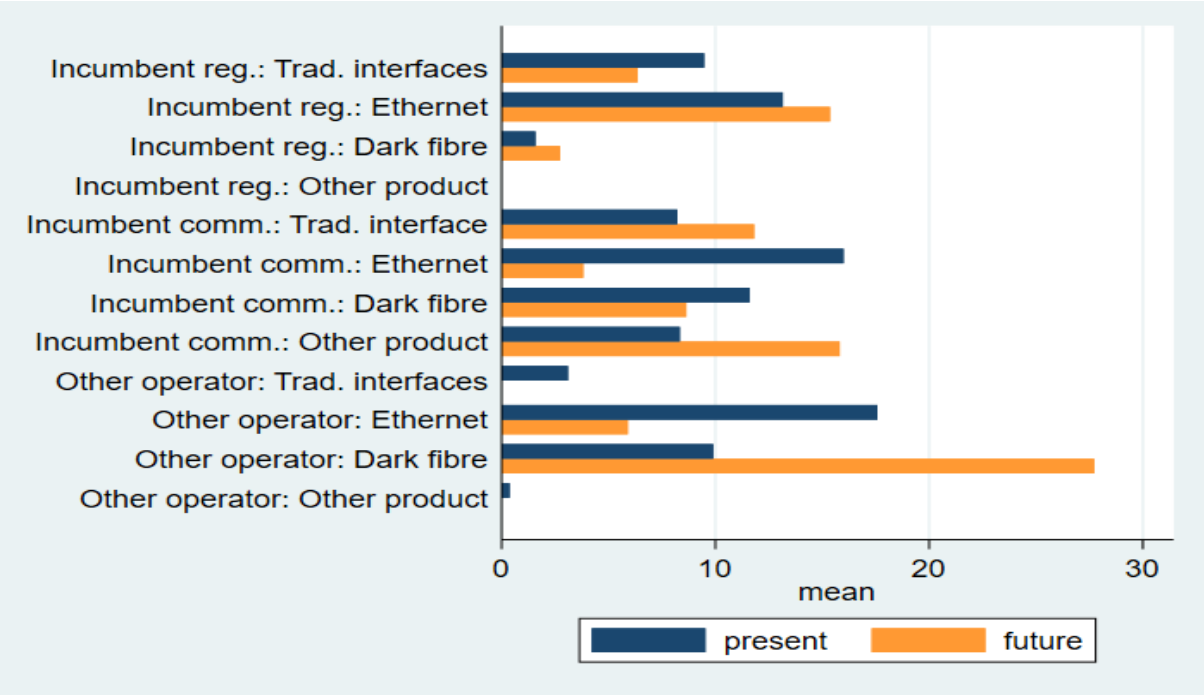


The average absolute number of fixed backhaul connections bought from third parties is expected to rise from 1,665 to 2,362 within the next three years, ranging from operators who still do not buy any connections from third parties to operators who do so for 81,000 connections. Again, the variation is quite high (standard deviation of 12,614).[44]

Figure 10 shows that for the realization of ≤ 1Gbit/s connections a shift from Ethernet products (bought from the incumbent commercially or from other operators) to dark fibre bought from other operators is expected. The latter is used on average for 27.73% of fixed backhaul connections as can be seen in Table 9. With regard to regulated inputs, Ethernet products continue to be important wholesale products for fixed backhaul connections (15.36%) whereas the use of products with traditional interfaces is expected to fall (from 9.47% to 6.36%).

[44] All non-missing answers taken into account (including zeros) - number of responses: 50 present; 41 future.

Figure 10: Comparison of average shares of input types for connections bought by third parties ≤ 1Gbit/s today and in three years[45]



Abbreviations: reg: regulated; comm: commercial; trad: traditional

[45] Number of plausible responses:
present ≤ 1Gbit/s: 19
present > 1Gbit/s: 35
future ≤ 1Gbit/s: 11
future > 1Gbit/s: 29
(Operators who reported percentages which summed up to less than 80% were dropped; when operators reported a sum of percentages > 100%, the given values were rescaled).

Table 10: Average shares of input types for connections bought by third parties ≤ 1Gbit/s in three years[46]

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	6.36%	15.36%	2.73%	0.00%
From incumbent commercial	11.82%	3.82%	8.64%	15.82%
From other parties	0.00%	5.91%	27.73%	0.00%

**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.*

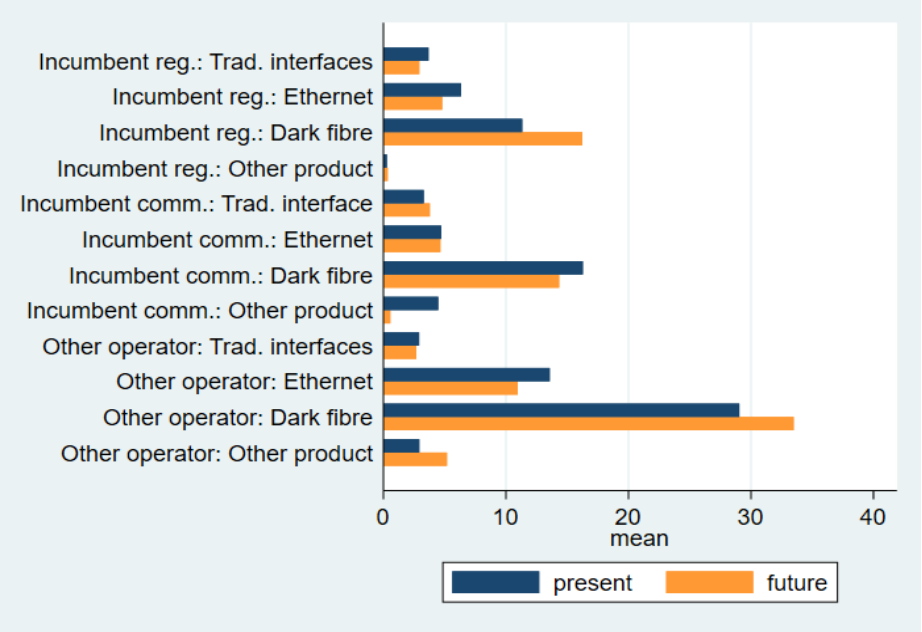
As the majority of fixed backhaul connections have bandwidths above 1Gbit/s, the evolvement of input types for the realization of these bandwidths is even more interesting.

Dark fibre is expected to remain the most commonly used input type for these connections and it is expected to be bought most often from other operators – just as today (see Figure 11 and Table 11: dark fibre bought from other parties on average for 33.49% of lines). Also, in terms of regulated wholesale products, dark fibre remains the most important input for fixed backhaul connections (average use of 16.24%).

Independent from the bandwidths, the use of regulated products from the incumbent is expected to make up on average only 24% of inputs used for the connection of fixed backhaul (under the assumption that regulation is the same as today).

[46] Ibid.

Figure 11: Comparison of average shares of input types for connections bought by third parties > 1Gbit/s today and in three years[47]



Abbreviations: reg: regulated; comm: commercial; trad: traditional

Table 11: Average shares of input types for connections bought by third parties > 1 Gbit/s in three years[48]

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	2.93%	4.79%	16.24%	0.34%
From incumbent commercial	3.79%	4.66%	14.34%	0.56%
From other parties	2.69%	10.97%	33.49%	5.19%

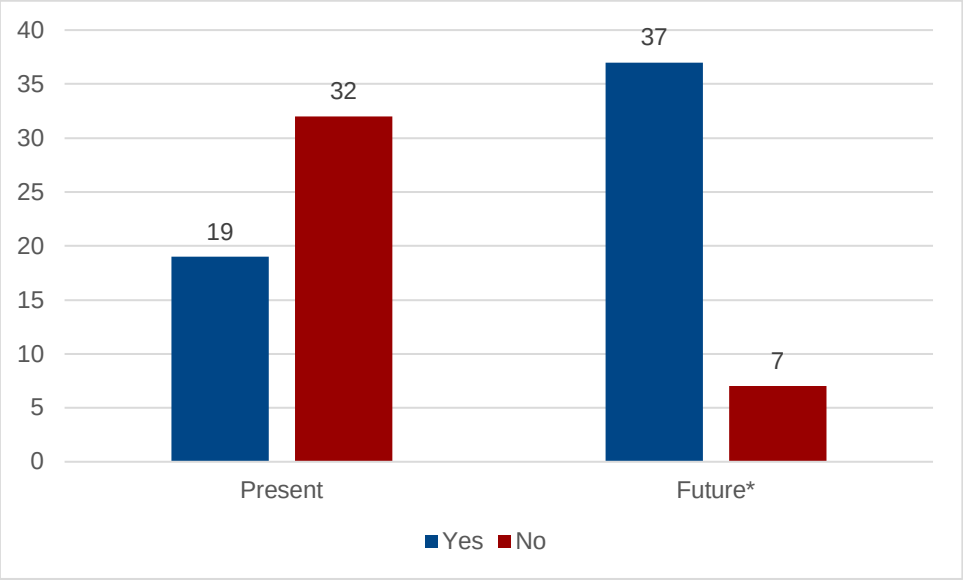
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.*

[47] Ibid.
[48] Ibid.

Use of passive infrastructure for the deployment of own fibre links

Operators were also asked whether they use regulated access to the passive infrastructure (e.g., ducts) from the incumbent operator to establish own fibre links. 19 out of 51 operators do so at present (37.25%, see Figure 12). The median number of fibre links deployed by using regulated passive infrastructure of these operators is 100.[49]

Figure 12: Current and future intended use of passive physical infrastructure from incumbent for fixed backhaul



(*): if available

Figure 12 shows that when being asked whether they would use regulated passive infrastructure from the incumbent in the future, 37 out of 44 operators agreed. If current regulation remains unchanged, the expected median number of fibre links deployed via these passive products in three years is 100 as well.[50] Some operators also utter, however, that they cannot provide forecasts for more than one year as deployment plans change quickly.

[49] Number of plausible answers taken into account: 15.
As there are some extreme outliers, the median is reported in the main text.
Average: 1,429; Standard deviation: 3,695.
A few operators, who use regulated passive infrastructure, reported percentage values (8 operators from France, Spain, Portugal, Slovakia, Estonia and Croatia.). Taking only these percentages into account, the average share of fibre links deployed by using regulated passive infrastructure is 98.5%.
(When operators reported "100" or "98", it is unclear whether they reported percentages or absolute numbers, so these values were taken into account in the absolute and in the percentage average).

[50] Number of plausible answers taken into account: 22.
As there are some extreme outliers, the median is reported in the main text.
Average: 5,254; Standard deviation: 19,784.

As the number of companies stating that they would use regulated passive infrastructure in the future if possible is almost twice as high as the number of companies who currently use it, it can be concluded that – independent from regulation - the demand for regulated passive products[51] is going to be quite high in the future.

Out of the 37 operators who would like to use these products in the future, 32 provided information on the expected scope of use of these passive products when assuming that the current regulation remains unchanged. 10 of them said that under this assumption the use would be zero. Considering the expected use of the remaining 22 operators with a use greater than zero, the expected use of the passive products is similar to the current use (median number of fibre links is 100 today and in three years). Consequently, it can be concluded that the number of operators who would like to use regulated passive products in the future is higher than those who actually expect to use it if current regulation remains unchanged.

4.2.2 Views on future regulation of fixed backhaul

Same as with the questions on the future of mobile backhaul regulation (see Section 4.1.2 above). the questionnaire sought respondents' views on future regulation for the provision of fixed backhaul in the next three years. It should be noted the responses received were broadly in concert with those expressed by respondents in relation to mobile backhaul, though with slight variations in the actual number of specific responses registered.

Views of incumbent operators

Again, the responses received from the five incumbent operators (each of which also operates a mobile as stated earlier) to the fixed backhaul portion of the questionnaire, were in broad agreement. They all considered that regulation of fixed backhaul was not required in the future and were unanimous in the view that alternative suppliers were available and, and that additionally, the option of self-provision will also be possible.

All but one of the incumbents stated that point-to-point wireless backhaul could be employed as a substitute for fixed backhaul while four appeared to indicate that they offered commercial products in their respective territories. Narrative was provided supporting "other reasons" which included statements that both publicly funded networks and PIA were available, but the main point registered was that there is a dynamic and long-established competitive market(s) for fixed fibre-based products, including backhaul. One further operator stated that this was the reason why the Commission had not included any form of backhaul in its 2020 Recommendation. See Table 12 below.

Considering only operators who expect to use passive infrastructure and who reported percentage values instead (6 operators from Spain, Malta, Portugal, Croatia and Slovenia), the average share of fibre links deployed using regulated passive infrastructure is expected to be 91% in three years under the assumption that current regulation remains unchanged.

[51] The type of regulation (e.g. SMP regulation or symmetrical regimes) was not specified in the operators' questionnaire.

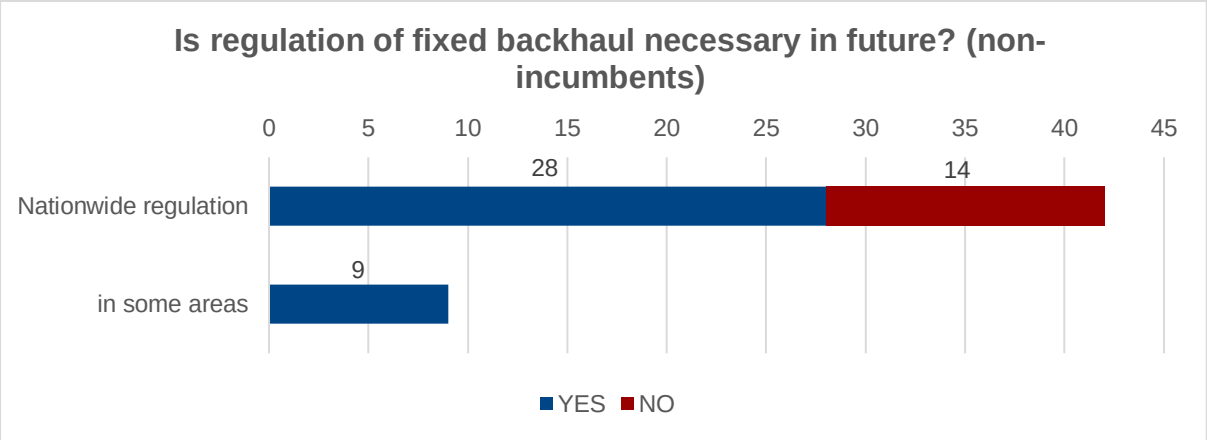
Table 12: Incumbents Responses: Reasons against regulation of fixed backhaul in the future

Offers from alternative operators available	There is a commercial agreement with the incumbent operator	Backhaul can be self-supplied with radio links	Backhaul can be self-supplied with own fibre connections	Other reason
Yes	Yes	Yes	Yes	
Yes		Yes	Yes	Yes
Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	

Views of non-incumbent operators

The majority of non-incumbent operators who responded indicated that they considered that some form of future regulation would be necessary to ensure that backhaul was available to operators in all geographies across each territory (28 of a total of 51 respondents), while nine others thought that it would be necessary in "some areas" as shown in Figure 13 below.

Figure 13: Non-incumbents respondent views on necessity of future of fixed backhaul regulation in the future



Again, both sets of respondents in favour of regulation of fixed backhaul (national and some areas) were asked to choose which type of remedies would be required in the future and the results are shown in Figure 14 and Figure 15 below. Once again, as with the mobile backhaul case, this broadly agreed with the respondents projected uses of passive infrastructure access and dark fibre to meet expected increased bandwidth demand, as outlined in Section 4.2.1 above.

Figure 14: Preferred type of nationwide remedies need for fixed backhaul in future

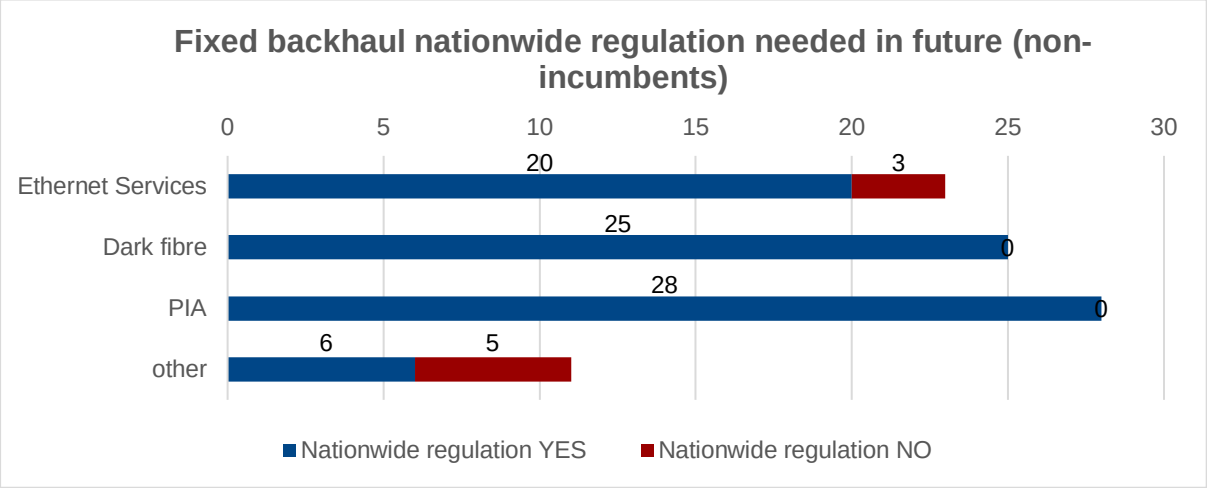
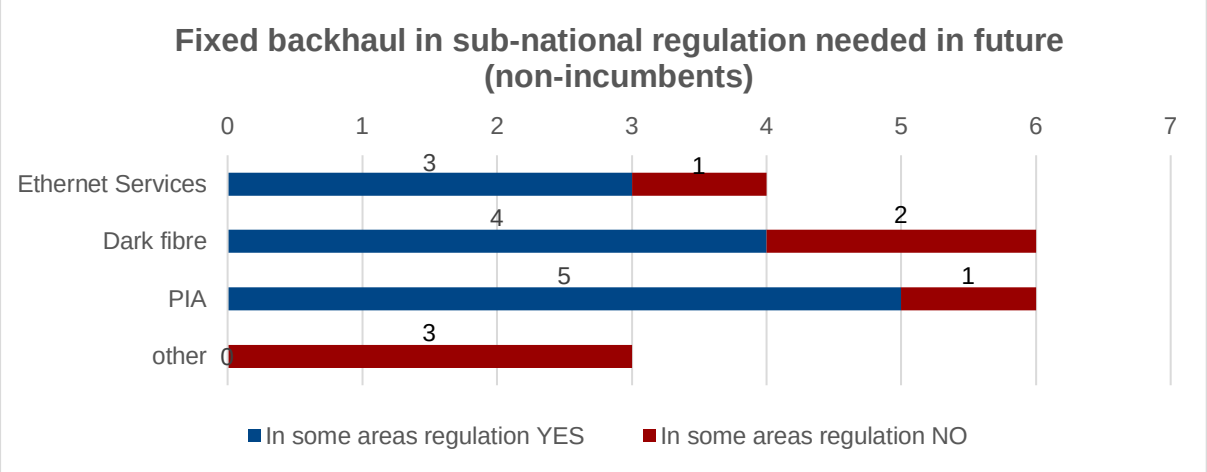


Figure 15: Preferred type of sub-national remedies need for fixed backhaul in future



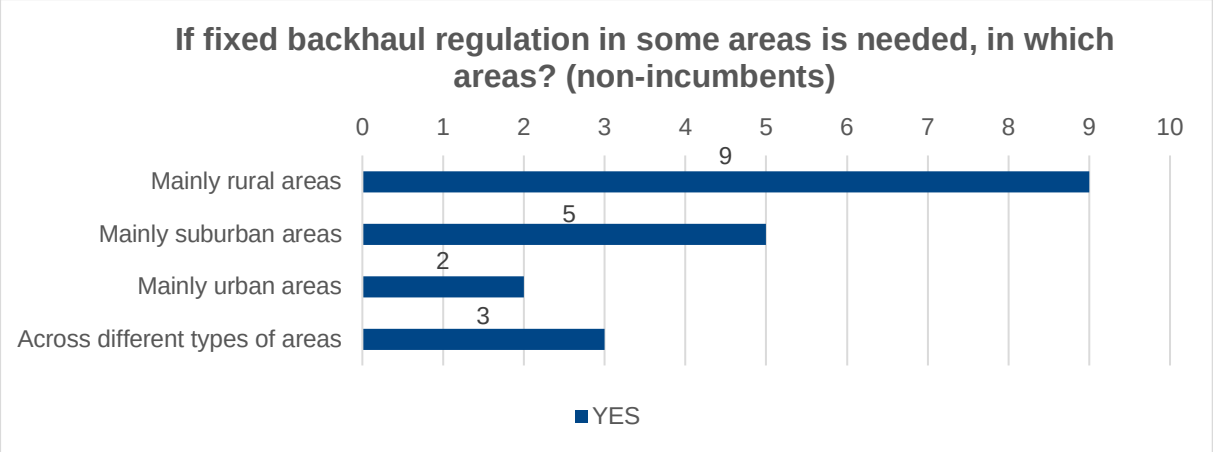
The 28 respondents who favoured national regulation were unanimous on that that PIA would be required while a large majority (25) chose dark fibre. The cohort of respondents (nine) who favoured "some areas" regulation was less definite in this regard but considered at least one or other of the forms of suggested remedies. There were no suggestions in the "other" category of this latter group and three provided commentaries, two of which considered that their respective NRA's should ensure that backhaul was available in areas in which it was required. Those in favour of national regulation broadly suggested xDWM services as a suitable remedy. 16 of the 28 respondents provided commentaries which largely concentrated on the pricing issues. Many maintained that both the regulated and market prices of managed backhaul services (leased lines), dark fibre and PIA were prohibitive while other said that it was needed to reach rural areas in particular, and another that it was important to have a remedy to enable alternate operators climb the ladder of investment.

Both responses broadly corresponds to the projected technology use indicated in Figure 10 and Table 5 for mobile backhaul: dark fibre is expected to be mainly used for connections > 1 Gbit/s which explains why 29 operators say that regulation of dark fibre is needed in the future.

But although Ethernet services are not expected to be used on a large scale for these high bandwidth connections in three years (under the assumption in Figure 11 and Table 11 that regulation remains unchanged), operators say that regulation for Ethernet Services is needed anyways. As explained above, 37 operators said that they would like to use passive infrastructure in the future which is illustrated in Figure 12, which shows that many operators would like passive infrastructure to be regulated for fixed backhaul in the future.

The 9 respondents who indicated that regulation was required in "some areas" i.e., sub-national areas or markets, rather than being national in scope were further asked to choose what type of sub-national markets would be appropriate, given a choice of four. The responses are shown in Figure 16 below. In a similar manner to the mobile backhaul case, the responses of these operators indicate that they want regulation to increase progressively from urban, to suburban and to rural areas. In fact, all were unanimously in favour of future regulation in rural areas.

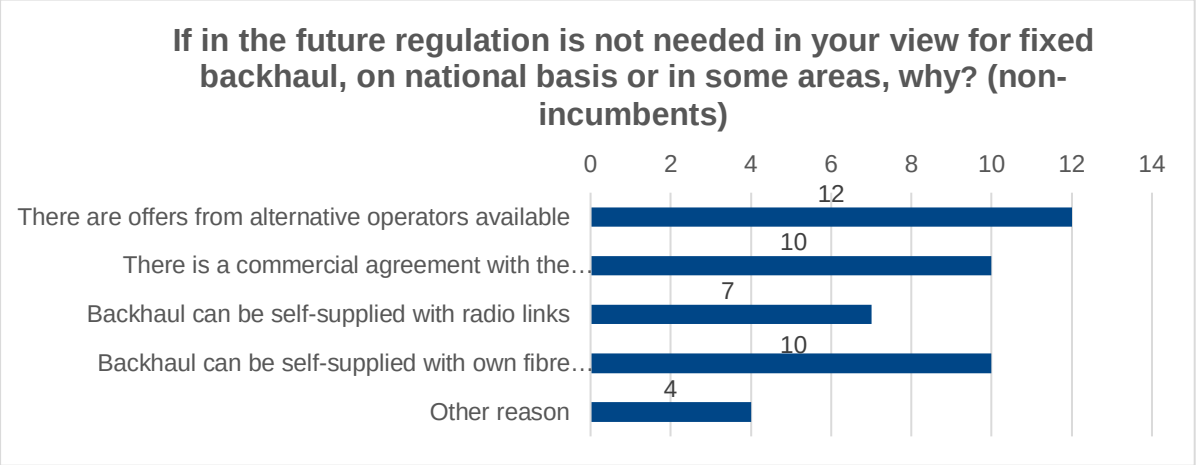
Figure 16: Respondents view of regulation of sub-national market type for fixed backhaul



The final question posed was to those non-incumbents who considered that national or some areas regulation was not required[52] for fixed backhaul in the future. They had to choose the reasons in support of this view from the choices offered as shown in Figure 17 below. The majority nominated two or more reasons, though two did not pick any supporting reasons. The four operators who chose "other reason" stated that the market was competitive and that the EC had not specified a fixed backhaul market in its 2020 Recommendation on relevant markets. These views were similar to those of the two respondents who provided additional supporting comments.

[52] There were 14 operators who said that nationwide regulation was not required and 0 operators who thought that regulation in some areas was not necessary.

Figure 17: Reasons for not requiring regulation of fixed backhaul in the future



Overall, one can conclude that the share of fixed backhaul lines with more than 1 Gbit/s is expected to increase even further. For these lines, dark fibre is and is expected to be the most used input product which the incumbents' competitors would like to buy on a regulated basis. This can probably be explained by the fact that dark fibre facilitates the provision of higher bandwidths as bandwidth can easily be increased at a much lower cost per Gbit/s than by purchasing managed bandwidth services. Although some operators already use regulated passive infrastructure (e.g. ducts) for fixed backhaul connections, the number of operators who would like to buy it on a regulated basis is much higher. Contrary to the competitors' opinions, the incumbents think that one reason why regulation is not necessary is that there are competitive offers available. Dark fibre bought from other parties is expected to be the most used input product in three years under the assumption that regulation remains unchanged. Nevertheless, it is unclear whether these alternative offers will satisfy the entire demand for fixed backhaul connections. Especially in rural areas, this may not be the case.

5 REGULATORY TREATMENT OF FIXED AND MOBILE BACKHAUL BY NRAs

Fixed and mobile backhaul (connectivity of mobile radio stations and fixed access nodes) are not only assessed in market 2/2020 or market 4/2014, but are also in other markets such as the wholesale markets for local (market 1/2020 or market 3a/2014) and central access provided at a fixed location (market 3b/2014) as well as the wholesale PIA market. Section 5.1 and section 5.2 assess the latter markets and market 2/2020 or 4/2014, respectively, based on the replies of the NRAs to BEREC questionnaire.[53]

[53] All the NRAs in in the EU, Iceland, Kosovo, Liechtenstein, Montenegro, Republic of North Macedonia, Norway, Republic of Serbia and Turkey replied to the questionnaire. In total 35 respondents. See annex III for the list of NRAs who responded to the questionnaire.

5.1 Backhaul regulation in M1/2020 or M3a/2014

5.1.1 Ducts and poles access for mobile and fixed backhaul

In 19[54] of the 23 countries where access to ducts and poles is imposed as an *ex ante* remedy in market 1/2020 or market 3a/2014, the use of this passive infrastructure for deploying mobile backhaul is allowed. Regarding fixed backhaul, in almost all the countries where access to ducts and poles is imposed as a remedy in market 1/2020 or market 3a/2014 (in 22[55] out of 23) the use for fixed backhaul is allowed.

Likewise, in the two countries where access to ducts and poles has been imposed as a remedy in a separate PIA market (France and Liechtenstein[56]), the use of such infrastructure is permitted for providing both mobile and fixed backhaul services.[57,58]

Therefore, in 21 and 24 countries (of the 25 countries where access to ducts and poles is regulated on an ex-ante basis on either market 1/2020 or market 3a/2014 or a PIA market) mobile and fixed backhaul can be implemented by means of the access to ducts and poles, respectively.

Twelve of the 21 NRAs are of the view that access to ducts and poles is important for mobile backhaul whereas 13 of the 24 NRAs share that view as regards fixed backhaul.[59] Only four and five NRAs do not find access to ducts and poles to be important for mobile and fixed backhaul, respectively.[60]

[54] Belgium, Croatia, Cyprus, Estonia, Ireland, Iceland, Italy, Latvia, Lithuania, Montenegro, Norway, Portugal, Republic of North Macedonia, Republic of Serbia, Slovakia, Spain, Sweden and Turkey. It is also currently available in Slovenia but the market review, which was submitted to public consultation at the moment of preparing this report, foresees the withdrawal of the use for mobile backhaul and the application of symmetric regulation.

[55] The same 19 countries as mentioned in footnote 54 plus Germany, Greece and Hungary.

[56] The remedy only concerns ducts in Liechtenstein

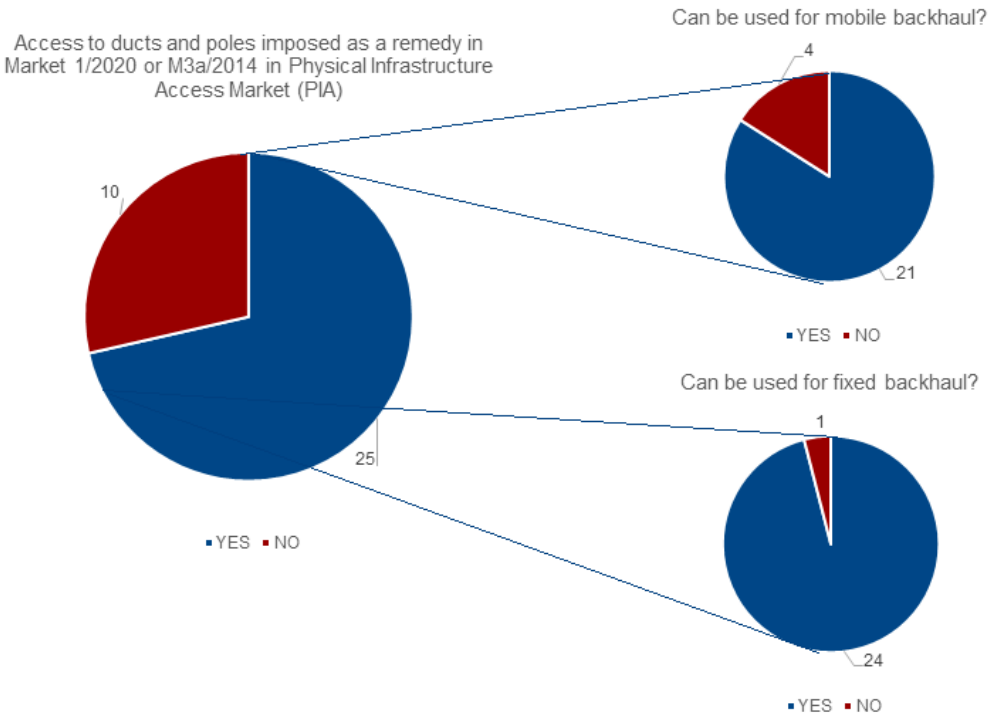
[57] In Iceland a separate PIA market is also defined and the obligation of access to ducts and poles (allowing its use for mobile and fixed backhaul) is imposed. However, since the same remedy is also imposed in market 1, the availability of ducts and poles for backhaul purposes is considered to be ensured within market 1.

[58] In the separate PIA market defined by ARCEP, the access obligation includes all infrastructure regardless of whether it is being used to deploy access or backhaul network segments. In addition to this access obligation, ARCEP imposes to the SMP operator, as an ancillary service within the separate PIA market, to provide access to alternative operators to its fixed backhaul network via a passive dark fibre offer.

[59] The NRAs of Croatia, Estonia, France, Iceland, Latvia, Lithuania, Montenegro, Portugal, Republic of Serbia, Slovakia, Slovenia and Spain consider that access to ducts and poles is important for both mobile and fixed backhaul. The NRA of Cyprus finds access to ducts and poles to be important only for fixed backhaul.

[60] The NRAs of Belgium, Hungary, Liechtenstein and Norway do not find this wholesale access service to be important for either mobile or fixed backhaul. ComReg (Ireland) does not consider it to be important for mobile backhaul while BNetzA (Germany) does not consider it to be important for fixed backhaul.

Figure 18: Regulation of access to ducts and poles for backhaul



5.1.2 Other market 1/2020 or market 3a/2014 remedies for mobile and fixed backhaul

Other wholesale products, which have been imposed as remedies in market 1/2020 or market 3a/2014, can be used for mobile or fixed backhaul in some countries. Nonetheless, NRA do not perceive these alternatives to be especially important, except for fibre LLU. The latter is relevant for some NRAs as set out below.

Copper LLU can be used for mobile backhaul in 15 of the 32 countries where it is imposed as a remedy in market 1/2020 or market 3a/2014. Despite the role that copper LLU might have played in the past in the context of backhaul for 2G mobile networks, none of the NRAs consider it to have relevance at the current stage. Copper LLU can be also used for fixed backhaul in 16 of those 32 countries. However, except for Norway, NRAs do not consider it to be especially important for fixed backhaul purposes.

As to VULA, the opinion concerning its relevance is similar. VULA is imposed as a remedy in market 1/2020 or market 3a/2014 in 23 countries, but none of the 13 NRA where VULA can be used as mobile or fixed backhaul find it to be especially relevant or important. Only for the Norwegian NRA VULA seems to be relevant for fixed backhaul.

Fibre LLU is imposed in 18 countries as a remedy in market 1/2020 or market 3a/2014. In 8[61] of those countries, fibre LLU can be used for both mobile and fixed backhaul purposes. Opinions as to the relevance of fibre LLU vary among the NRAs of these countries. RRT (Lithuania), AK (Liechtenstein), Teleoff (Slovakia) and PTS (Sweden) consider it to be important whereas PFS (Iceland) and EKIP (Montenegro) have the opposite view and CTU (Czech Republic) and ILR (Luxembourg) do not express any opinion.

Finally, in 19 of 32[62] countries where market 1/2020 or market 3a/2014 is regulated, an ancillary backhaul service is available. Although the use and/or availability of the ancillary backhaul services may be subject to the fulfilment of specific conditions regarding the related regulated wholesale product, they can be considered as a regulated fixed backhaul product and to some extent as substitutes for leased lines products.

5.1.3 Market 3b/2014 remedies for mobile and fixed backhaul

The use of wholesale access products, which are imposed as a remedy in market 3b/2014, for mobile or fixed backhaul purposes is also allowed in some countries, or at least not explicitly prohibited. Nevertheless, similarly to the wholesale products in market 1/2020 or market 3a/2014, most of the NRAs do not consider it to be especially important.

VULA product is imposed as a remedy in market 3b/2014 in seven countries. In four[63] and five[64] countries, VULA product can be used for mobile and fixed backhaul, respectively. Only DBA (Denmark) considers that it is important for fixed backhaul to some extent.

Bitstream products are imposed as a remedy in 29 countries and can be used for mobile and fixed backhaul in 14 and 15 countries respectively. RRT (Lithuania) considers it to be important for both mobile and fixed backhaul. DBA (Denmark), to some extent, and NKOM (Norway) also find that bitstream products are important but only for fixed backhaul.

Finally, 16 of 29 countries where some remedy is imposed in market 3b/2014 also imposed an ancillary backhaul service related to the market.

5.2 Backhaul regulation in Market 2/2020 or Market 4/2014

5.2.1 Regulation for backhaul in M2/2020 or M4/2014

Market 2/2020 or market 4/2014 are subject to *ex ante* regulation in 22 countries (out of the 35 respondents). As regards the EU, market 2/2020 or market 4/2014 are regulated in 18 countries; they are not regulated in Bulgaria (2019), Denmark (2016), Estonia (2015), Latvia (2019), Poland (2021), Romania (2018), Slovakia (2019), Sweden (2017) and Finland

[61] Czech Republic, Iceland, Lithuania, Liechtenstein, Luxembourg, Montenegro, Slovakia and Sweden.
[62] Only the NRAs of Bulgaria, the Netherlands and Romania have not imposed any remedy in market 1/2020 nor market 3a/2014.
[63] Austria, Iceland, Republic of North Macedonia and Turkey.
[64] The same as previous footnote 63 plus Denmark.

(2021).[65] As regards the non-EU regulators these markets are not regulated in Liechtenstein (2012), North Macedonia (2015), Norway (2018), and Kosovo[66] (2012).

Figure 19: Summary of regulation of backhaul in M2/2020 or M4/2014

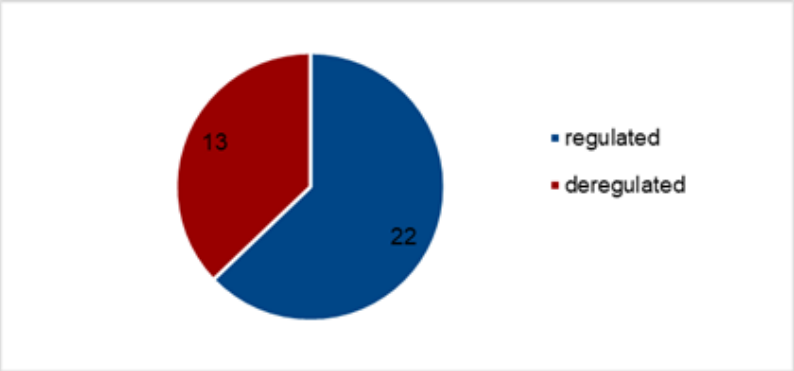


Table 13: Detail on regulation of backhaul in Market 2/2020 or market 4/2014

	EU	Non-EU
Non-regulated market 2/2020 nor market 4/2014	CRC (Bulgaria), **DBA (Denmark)**, **Traficom (Finland**), **TTJA (Estonia) SPRK (Latvia)**, **UKE (Poland)**, ANCOM (Romania), Teleoff (Slovakia) and **PTS (Sweden)**	ARKEP (Kosovo), AK (Liechtenstein), **NKOM (Norway)** and RATEL (Republic of Serbia)
Regulated market 2/2020 or market 4/2014 where the use for backhaul is not included	CTU (Czech Republic), **NMHH (Hungary)**, **AGCOM (Italy)**, RRT (Lithuania), **MCA (Malta)** and ACM (the Netherlands)	
Regulated market 2/2020 or market 4/2014 where regulated products can be used for mobile and fixed backhaul purposes	RTR (Austria), **BIPT (Belgium)**, **HAKOM (Croatia)**, **OCECPR (Cyprus)**, **ARCEP (France)**, **EETT (Greece)**, **COMREG (Ireland)**, **ILR (Luxembourg)**, **ANACOM (Portugal)**, **AKOS (Slovenia)**, **CNMC (Spain)** and BNetzA (Germany)[67] (*)	PFS (Iceland), **EKIP (Montenegro)**, AEC (Republic of North Macedonia) and BTK (Turkey)

[65] In Finland the market is currently non-regulated due to the Finnish Supreme Administrative court's ruling on Traficom's latest market analysis

[66] This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence. This footnote applies throughout the report

*

[67] In Germany regulated wholesale products can be used for mobile and fixed backhaul but only to limited binary rates of 155 Mbit/s.

Irrespective of whether backhaul products are included in a regulated market 2/2020 or market 4/2014, there are some NRAs which impose the obligation to provide backhaul as an ancillary service in either market 1/2020 or market 3a/2014 or market 3b/2014 or both on the SMP operator. These NRAs are shown in bold letters.

5.2.2 Market definition: Boundaries between trunk and terminating

In 18 out of 31 countries whose NRAs provide information in this regard, the terminating segments of leased lines are defined as a portion between the end user site (or the network element for ARCEP)[68] and the closest exchange. Eleven NRAs in the EU define the terminating segments in this way, specifically: Cyprus, Czech Republic, France, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Portugal, and Poland.

The remaining NRAs in the EU use alternative definitions, according to which the terminating segment could encompass network elements beyond the closest exchange, as set out in the following table.

Table 14: Delineation of trunk and terminating segments by NRAs

NRA (Country)	Delineation of trunk and terminating segments
RTR (Austria)	Trunk segments are defined as connections between a number of defined cities and all other connections are considered as terminating segments
Traficom (Finland)	Since there are several sub-national geographical markets and SMP operators a terminating segment is defined as a connection that begins and ends within the same SMP geographical area. The connections that begin and end in different SMP areas are considered as trunk segments
BNetzA (Germany)	The backbone network of the incumbent Telekom (with its 76 net transfer nodes at the time of the last market definition) is considered as the dividing line between the trunk and terminating segment. All other connections belong to the terminating segment; i.e. connections within the local networks as well as connections to, between and within other local networks.
ComReg (Ireland)	A set of competitive nodes are identified and the connections among would constitute the trunk segments
CRC (Bulgaria)	Wholesale terminating segments are defined as wholesale leased lines that comprise: (i) local lines where both endpoints specified by the access seeker are located in the same village; (ii) long distance lines within the administrative area where one of the endpoints is situated in the administrative centre69 and (iii) long distance lines where the two end points are located in different municipalities within the same administrative area. Trunk segments are defined as wholesale leased lines connecting two endpoints that are located in two different regional centres.
AKOS (Slovenia)	The terminating segment is defined as the portion of the Point to Point line service between the end-user site and either the closest exchange

[68] In France the definition is slightly different compared to the other 17 countries since it relates to the portion between the end user site or the network element (ex. a mobile base station) and the closest exchange.

[69] For example, Sofia would be the administrative centre of the Sofia region, which is one of the 27 regions of Bulgaria.

	node or node at core edge. The trunk segments would be the connections in the core network.
HAKOM (Croatia)	The terminating segment are defined as a connection between end user site and aggregation node at the highest level while the portion of the circuit that connects such aggregation node (at the highest level) with core network nodes is considered to belong to trunk segment
ANCOM (Romania)	The terminating segment is defined as the segment of the leased line (full circuit) up to the interconnection point for leased lines that is located at the level of the regional transmission network while the trunk segment is the segment of the leased line (full circuit) between two points of interconnection for leased lines located at the level of the transmission network.
Teleoff (Slovakia)	Trunk segments are defined as connections between two network interconnection points. All other connections are considered as terminating segments of leased lines, which include the network termination points
CNMC (Spain)	The terminating segment is defined as a leased line service that will belong to the access network of the operator requesting such wholesale service. It typically connects an end-user service or an access node in a fixed location to the operator's exchange or premises. Trunk segments are those leased lines used to connect operators network nodes as switching or interconnection exchanges, therefore related to transport networks.
ILR (Luxembourg)	The terminating segment is defined as the connection between the end-user and the regional Point of Presence (PoP).
PTS (Sweden)	The terminating segment is defined as the connection between the end-user site and the exchange of the operator using the wholesale service.
BIPT (Belgium)	A separate market for either trunk or terminating segments of leased lines is not identified. The wholesale leased lines, which are part of market 2, might or might not include the trunk segments alongside the terminating segments.

5.2.3 Market definition: Services

Both leased lines with traditional and Ethernet interfaces are part of market 2/2020 or market 4/2014 in 31 out of 35 countries. Among the 22 countries where these markets are regulated, only RTR (Austria) and AEC (Republic of North Macedonia) do not include the traditional and Ethernet leased lines, respectively[70]. Wavelength services are included in 11 countries (eight of them are subject to ex-ante regulation)

RTR (Austria), PFS (Iceland) and ACM (the Netherlands) are the only NRAs that consider the dark fibre to be part of these markets. On the other hand, BNetzA (Germany)[71], AKOS (Slovenia), SPRK (Latvia) and CNMC (Spain) include high quality bitstream services. To some

[70] The only NRAs that include the leased lines with Ethernet interface and exclude the Ethernet services are OCECPR (Cyprus), AGCOM (Italy), AK (Liechtenstein), UKE (Poland) and PTS (Sweden).

[71] BNetzA (Germany) defines the high-quality bitstream products as layer 2-bitstream products with a guaranteed data transmission rate, de facto no overbooking as well as symmetrical down and upload speeds and explain that such wholesale products were not offered when the market analysis was carried but were nevertheless included in the market in an abstract and forward-looking manner.

extent, Greece and Turkey, where Layer 2 Wholesale Access Products and PON based leased lines are respectively included in market 2/2020 or market 4/2014, are similar to those countries where high quality bitstream is part of such markets.

5.2.4 Market definition: Product and geographical dimensions

In general, NRAs do not identify separate markets on the basis on the type of products, the bandwidth and/or the geographical dimension. Only PFS (Iceland) identifies a separate market for traditional leased lines while RTR (Austria), CTU (Czech Republic), BNetzA (Germany) and ANACOM (Portugal) identify different markets based on the bandwidth. The only NRAs that find the geographical scope of market 2/2020 or market 4/2014 not to be national are RTR (Austria) (for bandwidths above 10 Mbit/s), Traficom (Finland) and ANACOM (Portugal).

5.2.5 Market definition: Type of uses

Most NRAs consider fixed and mobile backhaul to be part of market 2/2020 or market 4/2014. This is the case of all the NRAs in the EU, except for CTU (Czech Republic), NMHH (Hungary), SPRK (Latvia), RRT (Lithuania), MCA (Malta), and ACM (the Netherlands). NRAs do not make any difference between fixed and mobile backhaul either; if included, both are included whereas if excluded both are excluded.

At the stage of market definition, CTU (Czech Republic), NMHH (Hungary), RRT (Lithuania), MCA (Malta) and ACM (the Netherlands) are the NRAs that do not include the use for backhaul from these markets

- CTU (Czech Republic) indicates that terminating segments of leased lines can only connect to an end-user site and cannot terminate at the premises of an Electronic Communications Services provider (network node).
- NMHH (Hungary) explains that market 2 is defined in a narrow way because it comprises the wholesale services for access to the terminating segments that operators require to provide leased line services in the retail market.
- ACM (the Netherlands) points out that the market for high quality wholesale access to the copper network of KPN (i.e. former Market 4/2014) is the only market that is currently subject to *ex ante* regulation[72]. ACM explains that the analysis of this market is limited to connections between the access point and the termination point on the premises of (business) end users. Therefore, the backhaul to network locations such as mobile base stations or street cabinets is not regulated. ACM adds that backhaul was never regulated but it was, in practice, available on the basis of commercially negotiated contracts. This is the reason why regulation was not deemed to be necessary, except for the regulation of the backhaul connection from Area Point of Presence (PoP) up to the City PoP. This

[72] Either because ACM concluded that markets are competitive or because the regulation of ACM is annulled by the competent Dutch court.

type for fixed backhaul was regulated until March 2020 in the context of the regulation of KPN's FttH network at the Optical Distribution Frame (ODF)[73].

As regards the EU NRAs that do not include backhaul in a non-regulated market, SPRK (Latvia) explains that the scope of the regulation of market 2 never foresaw the regulation for the provision of mobile or fixed backhaul to other operators, i.e., mobile and fixed backhaul were not included in the relevant market, they did not form a separate relevant market and they were not part of any other relevant market. This approach is justified on the strong competition among operators (including the incumbent operator) providing wholesale leased lines based on commercial offers to other fixed and mobile operators.

5.2.6 Regulated and commercial offers treatment

In ten countries, the incumbent operator provides specific wholesale product for backhaul: Croatia, Czech Republic, Italy, Finland, France, Germany, Latvia, the Netherlands, Norway, and Slovenia. In all of them specific products for mobile backhaul (either commercial or regulated or both) are offered by the incumbent operators. This is not the case for fixed backhaul[74]. The main differences are set out in the following table.

Table 15: Regulated and commercial offers for fixed and mobile backhaul in market 2/2020 or M4/2014

	Regulated specific offers		**Commercial specific offers**	
	Mobile backhaul	Fixed backhaul	Mobile backhaul	Fixed backhaul
Germany	No	No	Yes	No
Finland	No	No	Yes	No
Czech Republic, Italy, Latvia the Netherlands and Norway	No	No	Yes	Yes
France	Yes	Yes	Yes	No
Croatia and Slovenia	Yes	Yes	Yes	Yes

In Croatia, Finland, France, and Norway the specific wholesale products are included in market 2/2020 or market 4/2014, while in Czech Republic, Latvia, the Netherlands and Slovenia they are not part of any relevant market.[75]

[73] Within KPN's FTTH Point to Point (PtP) network, the ODFs are located in the area PoP which gives typically access to about 2000 households. Several area Pop are normally grouped together and connected to the so-called city PoP. Since access to the area PoP was not economically viable for most access seekers, a regulated backhaul connection from the area PoPs to the City PoP was available. Beyond the City PoP access seekers had to rely on commercial backhaul offers.

[74] NKOM (Norway) and NMHH (Hungary) indicate that regulated fixed backhaul offers are available. However, those offers are related to backhaul services products imposed in the context of markets 3a/2014 and 3b/2014 and not market 2/2020 nor market 4/2014 that is unregulated in Norway and is limited to retail leased lines in Hungary.

[75] BNetzA (Germany) does not indicate whether these specific offers are included in market 2/2020, they form a separate market or they are not part of any relevant market as the SMP operator does not offer specific regulated wholesale products for mobile and fixed backhaul (if a company wants to use a regulated product of market 2/2020

5.2.7 Remedies imposition

The obligations on the SMP operator to provide traditional leased lines, Ethernet leased lines and Ethernet services are imposed respectively by 17, 18 and 16 of the 22 NRAs that regulate these markets. RTR (Austria), HAKOM (Croatia)[76], NMHH (Hungary), ARKEP (Kosovo), UKE (Poland), ACM (the Netherlands), and RATEL (Republic of Serbia), do not regulate traditional leased lines.

Dark fibre is regulated in the three (Austria, Montenegro and Iceland) of the four countries that include this technology in market 2/2020 or market 4/2014. In the Netherlands it is not regulated.

5.2.8 Remedies differentiation depending on the type of uses

The lack of availability of a regulated backhaul service is not determined at the stage of imposing remedies but at the product market definition. Neither do NRAs introduce any difference in remedies for the provision of backhaul. Only ARCEP (France) indicates that some obligations (such as publishing a reference offer or practicing an Economic Replicability Test) are not required for the specific mobile backhaul products.

In none of the four countries (Belgium, France, Italy and Portugal) where remedies are geographically differentiated, this differentiation is driven by any issue concerning mobile or fixed backhaul.

5.2.9 Relevance of M2/2020 or M4/2014 regulated products for mobile and fixed backhaul

Only in four of the 17 countries where access to traditional leased lines is imposed as a remedy, NRAs indicate that they play an important role for mobile backhaul. The situation is similar for fixed backhaul; only three NRA consider traditional leased lines to play a significant role. The number of NRAs stating that traditional leased lines are not important for mobile and fixed backhaul are higher: five and seven NRAs, respectively.

With regards to Ethernet technology (either leased lines with Ethernet interfaces or Ethernet services), eight of the 14 NRAs which regulate them are of the view that the Ethernet products are important for mobile and fixed backhaul. As shown in next table, they are not the same NRAs for each type for backhaul. There are significantly less NRAs which consider that Ethernet is not important for backhaul; three and five for mobile and fixed backhaul, respectively.

for mobile or fixed backhaul, then it can do so) and AGCOM (Italy) replies that none of those three options apply, since fixed backhaul is a service regulated in market 3a/2014 (as a passive service), while mobile backhaul was a service of market 4/2014 that is no longer regulated.

[76] In Croatia the obligation to provide access to traditional SDH/PDH lines is not in place in general, since network was switched off but it still applies on traditional low capacity lines based on SHDSL over the copper access network.

Table 16: Relevance of different M2/2020 or M4/2014 regulated products for backhaul

	Mobile backhaul		Fixed backhaul	
	YES	NO	YES	NO
Traditional leased lines	OCECPR (Cyprus), CNMC (Spain), ANACOM (Portugal) and AKOS (Slovenia)	MCA (Malta), ARCEP (France) CTU (Czech Republic), AGCOM (Italy) and COMREG (Ireland)	OCECPR (Cyprus), BNetzA (Germany) and AKOS (Slovenia)	BIPT (Belgium), CNMC (Spain), CTU (Czech Republic), ARCEP (France), MCA (Malta), AGCOM (Italy) and COMREG (Ireland)
Ethernet (either leased lines or Ethernet services)	RTR (Austria)[77], OCECPR (Cyprus),, ARCEP (France)[78], PFS (Iceland), COMREG (Ireland), ANACOM (Portugal)[79], (AKOS) Slovenia and (CNMC) Spain	CTU (Czech Republic), MCA (Malta) and AGCOM (Italy)	RTR (Austria), BIPT (Belgium) BNetzA (Germany OCECPR (Cyprus), PFS (Iceland), COMREG (Ireland), (AKOS) Slovenia and (CNMC) Spain	CTU (Czech Republic), MCA (Malta), ARCEP (France), ANACOM (Portugal) and AGCOM (Italy)

Two of the three NRAS that impose dark fibre a remedy in market 2 (PFS Iceland and EKIP Montenegro) stress its importance for both mobile and fixed backhaul. RTR (Austria) does not share this view.

On the other hand, ComReg (Ireland) is the only NRA (of the five countries[80] where wavelength services/xWDM is imposed as an access remedy) that highlights the importance of wavelength services/xWDM for mobile and fixed backhaul in M2/2020 or M4/2014.

[77] RTR (Austria) finds the Ethernet services, not the leased lines with Ethernet interface, to be important for both fixed and mobile backhaul.

[78] ARCEP (France) finds the Ethernet services, not the leased lines with Ethernet interface, to be important for mobile backhaul

[79] ANACOM (Portugal) finds the leased lines with Ethernet interface, not the Ethernet services, to be important for mobile backhaul.

[80] MCA (Malta) also imposes this remedy but it is not available for backhaul purposes.

6 CONCLUSIONS

6.1 Conclusions on legal treatment of backhaul

NRAs have at their disposal different regulatory tools to address potential issues in the provision of backhaul (fixed or mobile). These tools include the imposition of obligations to grant access to leased lines, dark fibre, Ethernet services, as well as access to physical infrastructures. Such access remedies may be available to alternative operators either via *ex ante* regulation (as laid down in the EECC) or through other legal instruments, namely the national legislation transposing the BCRD.

Regarding *ex ante* regulation, in order to be able to impose access obligations, NRAs must identify a relevant product and geographic market, and assess whether such market is susceptible to *ex ante* regulation, due in particular to the existence of one or several undertakings holding SMP.

The EC 2020 Recommendation on Relevant Markets emphasizes that wholesale *ex ante* regulation should only be applied where demonstrable competition problems exist at the retail level. Specifically with regard to mobile backhaul, the EC expresses the view that mobile retail markets are in general competitive on a Union-wide level. From this follows that SMP regulation of mobile backhaul is only possible if additional elements relevant in a prospective analysis justify its inclusion within a relevant market susceptible to *ex ante* regulation.

Depending on the retail issues identified, fixed and/or mobile backhaul could be integrated in the wholesale market reviews through different means, including markets 1/2020 (local access provided at a fixed location) and 3b/2014 (wholesale central access provided at a fixed location for mass-market products); market 2/2020 (dedicated capacity); or even via the identification of a separate infrastructure market not expressly included in the 2020 Recommendation on Relevant Markets, in which case the three criteria test would need to be undertaken.

As set out in the EECC, prior to the imposition of additional remedies on the SMP operator, NRAs will need to examine whether the imposition of access to civil engineering alone may be a proportionate means to promote competition and the end-user's interest.

Regarding access to physical infrastructure, the BCRD is also aimed at facilitating access to the infrastructure of a large range of actors not limited to those providing electronic communication services (defined in the BCRD as “network operators”), for the purposes of deploying elements of high-speed electronic communications networks. In this regard, the BCRD provides a general entitlement for access to physical infrastructures usable for mobile and fixed broadband deployment, including backhaul.

6.2 Conclusions on stakeholders’ input on mobile backhaul

28 operators from 16 countries replied to the part of the questionnaire dealing with the inputs used for mobile backhaul (including self-supply).

Their responses suggest that, driven by the rollout of 5G in the next years, there will be a significant shift from radio links to fibre connections. Fibre connections will to a large extent

be self-supplied (partly by using access to physical infrastructure such as ducts and poles). However, there is also an increase in demand for dark fibre from the incumbent and alternative providers.

In general, the share of operators who buy regulated products is low and, under the assumption that regulation remains unchanged, seems to be decreasing in the future. But However, alternative MNOs emphasise the need for (more effective) future regulation of mobile backhaul (Ethernet Services of very high bandwidth or dark fibre) and/or access to passive infrastructure (where available) to allow the deployment of own fibre links to connect mobile base stations. Regarding the geographic scope, the majority of these operators want a nationwide regulation in the future, while some of them are of the opinion that regulation will only be required in mainly rural or sub-urban areas. There are also several operators (including incumbent operators) who are of the view that there is no need for future regulation because sufficient alternatives to regulated inputs will be available.

6.3 Conclusions on stakeholders' input on fixed backhaul

The questions concerning fixed backhaul connections were answered by up to 55 operators (depending on the question) from 18 countries.

The majority of fixed backhaul connections bought by third parties have bandwidths higher than 1 Gbit/s and are realised most often via dark fibre (mostly bought from other operators). Operators do not expect this to change in the upcoming years under the assumption that regulation remains unchanged.

For connections bought by third parties with less than 1 Gbit/s, the answers suggest a shift from Ethernet products – which are currently the most used input products for these connections – to dark fibre. Under the assumption that current regulation remains unchanged, dark fibre is expected to be bought most often from other operators as well (not from the incumbent).

With regard to self-supplied fixed backhaul connections, around one third of operators currently use regulated passive infrastructure[81] for establishing their own fixed backhaul connections, but the number of operators who would like to do so in the future is significantly higher (84%).

Whereas the incumbent operators are of the opinion that fixed backhaul should not be regulated, as there are sufficient alternatives available, other operators think that regulation is needed either nationwide or in some areas (mostly rural areas). The input products which should be regulated in their view in the future for fixed backhaul connections are passive infrastructure, dark fibre and Ethernet services.

[81] Used either under SMP regime or BCRD regime

6.4 Conclusions on NRAs' regulatory treatment for backhaul

Nearly half of the 35 BEREC members and observers that replied to the questionnaire include the use of backhaul within a regulated market 2/2020 or market 4/2014. As regards EU countries, 12 NRAs consider backhaul services to be part of a regulated market 2/2020 or market 4/2014. As to the remaining 15 NRAs, eight of them find market 2/2020 or market 4/2014 to be effectively competitive while the other six NRAs regulate market 2/2020 or market 4/2014 but exclude backhaul from such market (or it is excluded from the uses that are subject to ex-ante regulation). In Finland the market is currently non-regulated due to the Finnish Supreme Administrative court's ruling on Traficom's latest market analysis.

The NRAs which ensure the provision of backhaul on a regulated basis in market 2/2020 or market 4/2014 do not differentiate remedies as regards backhaul and therefore both, mobile and fixed backhaul, are available on same terms.

When looking more into details at the regulation imposed by the EU NRAs in market 2/2020 or M4/2014, it is found that:

- The wholesale services that can be used for backhaul are mainly traditional leased lines and Ethernet services (including leased lines with Ethernet interface).
- The majority of NRAs (910 NRAs) which regulate either leased lines with Ethernet interface or Ethernet services (Ethernet) consider them to be important for backhaul. The relevance of leased lines with traditional interface is significantly lower; no more than four NRAs consider them to be important for backhaul.

As regards the non-EU NRAs, PFS (Iceland), EKIP (Montenegro), AEC (the Republic of North Macedonia) and BTK (Turkey) allow backhaul to be provided over the regulated wholesale access services of market 2/2020 or market 4/2014. The latter comprise leased lines with traditional and Ethernet interface, except for AEC (the Republic of North Macedonia), which does not find Ethernet based leased lines to be part of market 2/2020 or market 4/2014.

Apart from remedies that fall within the scope of market 2/2020 or market 4/2014, the access to ducts and poles is the most important wholesale access service for backhaul purposes. A majority of the NRAs that regulate and allow the access to ducts and poles to be used for backhaul[82] consider it to be important. Other wholesale access services such as copper LLU, fibre LLU, VULA or bitstream services do not seem to play the same relevant role, with the exception of Liechtenstein.

Finally, the need for fixed backhaul can be further addressed by the obligation that NRAs impose on the SMP operator to provide it as an ancillary service related to the primary regulated wholesale access service in market 1/2020 or market 3a/2014 and/or 3b/2014.

[82] 12 of 21 NRAs and 13 of 24 NRAs for mobile and fixed backhaul, respectively.

In fact, there are NRAs that do not regulate fixed backhaul in market 2/2020 or market 4/2014 but do so, not necessarily with the same scope, via ancillary services. This is the case of DBA (Denmark), TTJA (Estonia), NMHH (Hungary), AGCOM (Italy), SPRK (Latvia), UKE (Poland) where ancillary services are imposed in both markets 1/2020 or market 3a/2014 and 3b/2014. MCA (Malta) and PTS (Sweden) impose such ancillary services in market 1/2020 or market 3a/2014 but not in market 3b/2014.

Outside the EU, NKOM (Norway) is the only NRA that follows this approach, i.e., it does not regulate market 2 but ensures the provision of fixed backhaul on a regulated basis as ancillary services.

Among the 12 NRA that include backhaul in a regulated market 2/2020 or market 4/2014, BIPT (Belgium), CNMC (Spain), OCECPR (Cyprus), HAKOM (Croatia), EETT (Greece), ILR (Luxembourg) and ANACOM (Portugal)[83] oblige the SMP operator to provide fixed backhaul as an ancillary service in markets 1/2020 or market 3a/2014 and 3b/2014. AKOS (Slovenia) imposes such obligation only in market 1/2020 or market 3a/2014, while ComReg (Ireland) does it in market 3b/2014. Finally, ARCEP (France) imposes to the SMP operator to provide a dark fibre offer for fixed backhaul use[84], as an ancillary service both in market 3a/2014 and in the separate PIA market defined in 2020.[85]

EKIP (Montenegro) is the only non-EU NRA that regulates backhaul in market 2/2020 or market 4/2014 as well as an ancillary service (in both markets 1/2020 or market 3a/2014 and 3b/2014).

In sum, except for CRC (Bulgaria), CTU (Czech Republic), RRT (Lithuania), ANCOM (Romania), Teleoff (Slovakia) and ACM (the Netherlands), NRAs of the EU find it appropriate and justified to ensure that fixed backhaul is provided over a wholesale leased line on a regulated basis. ARKEP (Kosovo), AK (Liechtenstein) and the RATEL (Republic of Serbia) are the non-EU NRAs that do not impose any *ex ante* remedy on wholesale leased lines for fixed backhaul.

The *ex ante* regulation of mobile backhaul is not as prominent as the regulation of fixed backhaul, but it is still very widespread across the EU. As already shown, nearly half of the NRAs regulate it in the context of market 2/2020 or market 4/2014. Moreover, other non-regulating NRAs such as TTJA (Estonia), RRT (Lithuania), SPRK (Latvia) and Teleoff (Slovakia) find the obligation for access to the ducts and poles to be important for mobile backhaul purposes.

BEREC observes that an important number of NRAs allows the use of backhaul in the provision of regulated wholesale leased lines in the context of market 2/2020 or market 4/2014

[83] In the case of ANACOM, the ancillary backhaul services comprises collocation services.
[84] ARCEP obliges the SMP operator to provide access to alternative fixed operators to its fixed backhaul network *via* a passive dark fibre offer for backhaul use, which is called "LFO" (*Liens en Fibre Optique*).
[85] Access to ducts and poles has also been imposed as a remedy in the separate PIA market. The use of such infrastructure is thus permitted to deploy backhaul networks.

(or market 1/2020 or market 3a/2014 and 3b/2014 as ancillary remedies). ARCEP (France) identifies dark fibre as the main used product for backhaul, be it via the SMP regulated offers or via third parties' offers. Many NRAs must therefore assess whether the withdrawal of the existing use of leased lines for backhaul is justified rather than whether the introduction of backhaul is required.

In this regard, BEREC would like to stress that backhaul contributes to ensure the effectiveness of the main remedies in both market 1/2020 or market 3a/2014 and market 3b/2014 (copper LLU, fibre LLU, VULA) and/or to facilitate the deployment of mobile networks.

NRAs should therefore avoid not only false positive (Type I) errors, which might lead to excessive regulation or insufficient deregulation, but also avoid false negative (Type II) errors, which might result in insufficient regulation or excessive deregulation, when assessing backhaul in the different market reviews where this issue arises.

7 FUTURE WORK

BEREC will continue monitoring the evolution of backhaul use and needs, as well as its regulation by NRAs of wholesale inputs for backhaul, with a special focus on backhaul needs and use for 5G deployment and the application of the new recommendation on relevant markets that entered into force in December 2020.

Decisions by NRAs on markets where backhaul or relevant inputs for backhaul are regulated, further workshops to be organised with the stakeholders, as well as the EC input on the application of the new recommendation on relevant markets will provide valuable information to complete the current analysis. On this basis, and once a relevant number of NRAs decisions and corresponding EC input on the application of the recommendation will be available, BEREC may consider the preparation of a common position on the analysis (retail market analysis, wholesale market definition, SMP assessment) and remedies for fixed and mobile backhaul.

ANNEX I: ADDITIONAL CHARTS ON MOBILE BACKHAUL

The following tables show the number of operators using a certain input.

Table 17: Inputs used for mobile backhaul, present, ≤ 1 Gbit/s, number of operators using a certain input

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					3	19	27
From incumbent based on regulated products	4	6	1	3			
From incumbent commercial	4	11	5	1			
From other parties	1	7	13	2			

*) Including network sharing (shared backhaul)

**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc

responses from 28 operators

Table 18: Inputs used for mobile backhaul, present, > 1 Gbit/s, number of operators using a certain input

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					0	25	16
From incumbent based on regulated products	0	1	2	1			
From incumbent commercial	0	5	7	0			
From other parties	0	0	12	1			

*) Including network sharing (shared backhaul)

**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc

responses from 28 operators

Table 19: Inputs used for mobile backhaul, in three years, ≤ 1 Gbit/s, number of operators using a certain input

	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					2	16	24
From incumbent based on regulated products	2	4	0	3			
From incumbent commercial	0	9	5	2			
From other parties	0	7	10	1			

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc
responses from 28 operators

Table 20: Inputs used for mobile backhaul, in three years, > 1 Gbit/s, number of operators using a certain input

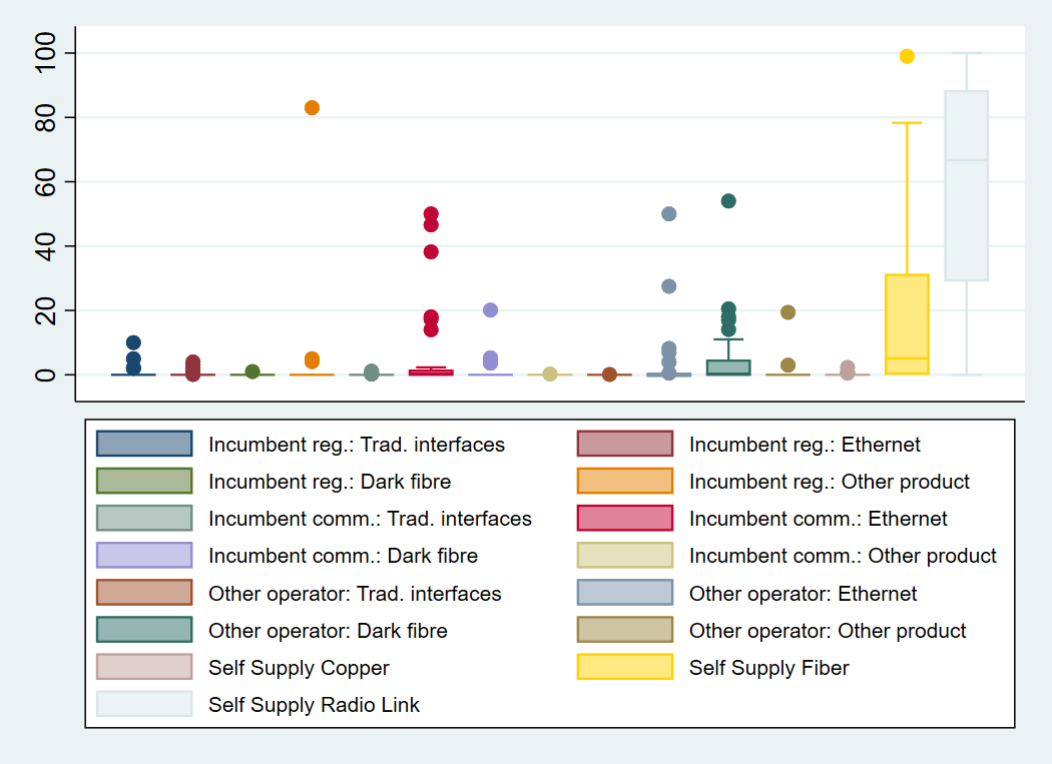
	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply					0	25	22
From incumbent based on regulated products	0	1	2	1			
From incumbent commercial	0	9	10	2			
From other parties	0	5	15	2			

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc
responses from 28 operators

In the following charts, the distributions of the percentages given for each wholesale product (and self-supply of mobile backhaul) are illustrated by box plots. The line in the middle of each

box indicates the median[86], the lower and upper bound of each box represent the 25th and 75th percentile, accordingly. The end points of the adjacent lines show the upper and lower adjacent values[87] and the dots indicate outliers.

Figure 20: Distribution of input types used for mobile backhaul ≤ 1 Gbit/s, present (responses from 27 operators)



[86] Median = 50th percentile (the score below which 50% of the scores in the distribution may be found)
[87] The upper (lower) adjacent value is the highest (lowest) value within a distance to the "box" of maximum 1.5 times the height of the box.

Figure 21: Distribution of input types used for mobile backhaul > 1 Gbit/s, present (responses from 24 operators)

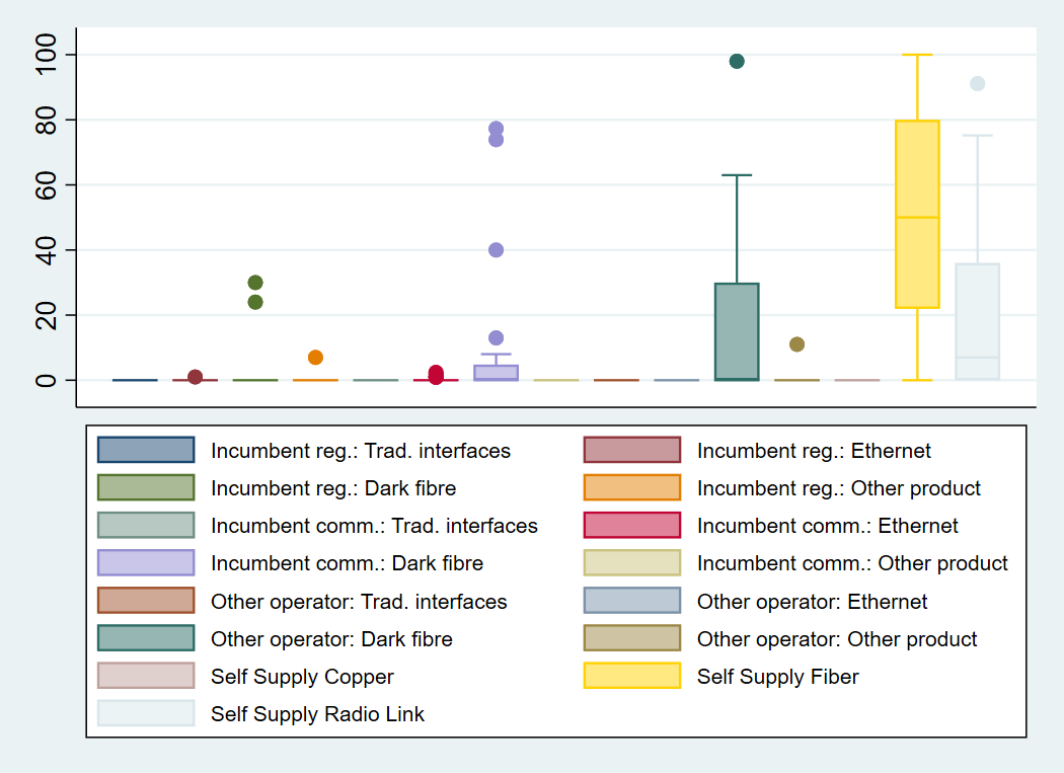


Figure 22: Distribution of input types used for mobile backhaul ≤ 1 Gbit/s, in three years (responses from 25 operators)

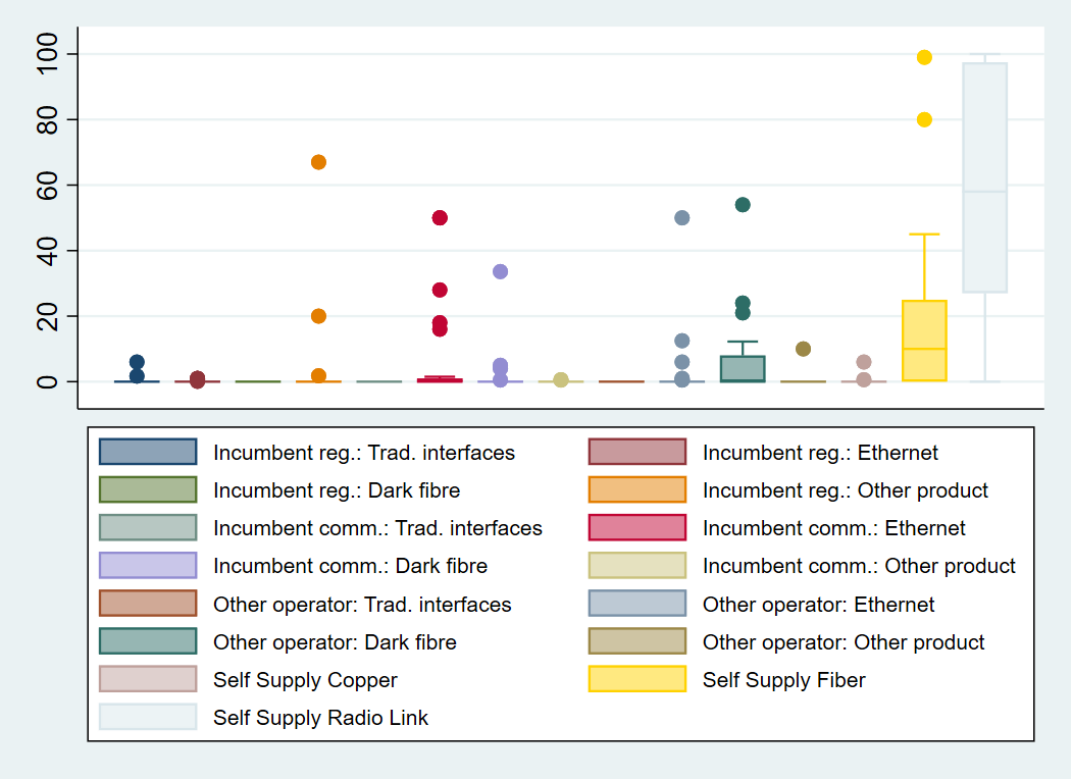
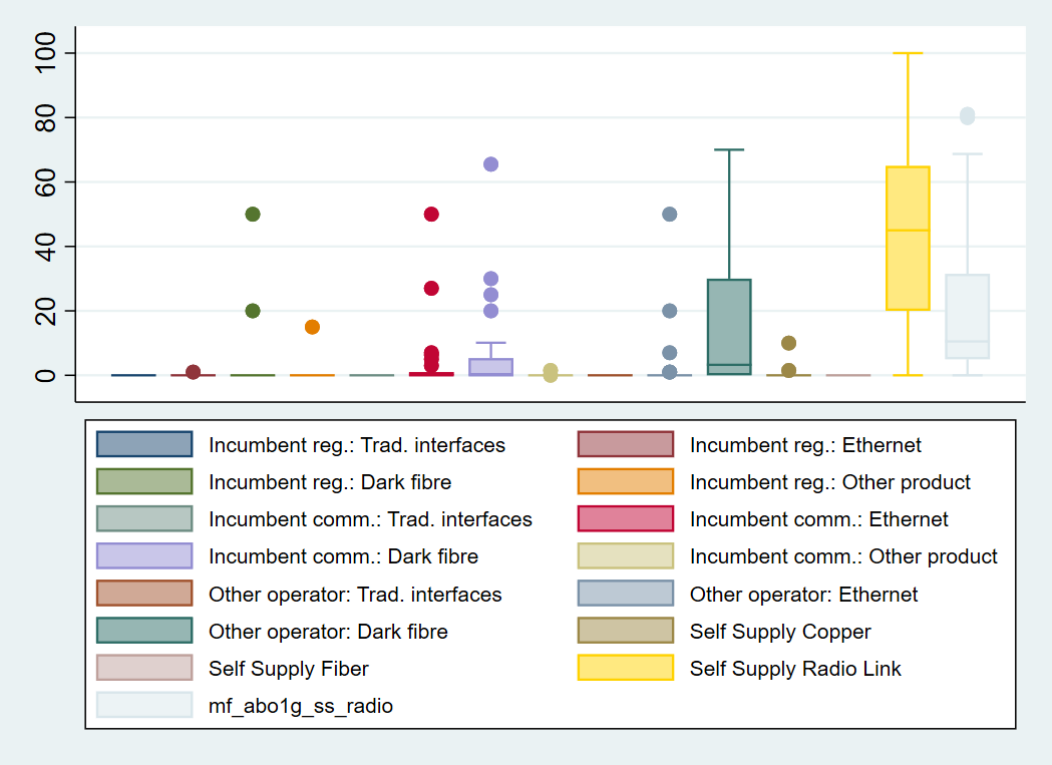


Figure 23: Distribution of input types used for mobile backhaul > 1 Gbit/s, in three years (responses from 25 operators)



ANNEX II: ADDITIONAL CHARTS ON FIXED BACKHAUL

The following tables show the number of operators using a certain input.

Table 21: Inputs used for fixed backhaul, present, ≤ 1 Gbit/s, number of operators using a certain input

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	2	3	1	0
From incumbent commercial	3	6	5	6
From other parties	1	6	5	1

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

Table 22: Inputs used for fixed backhaul, present, > 1 Gbit/s, number of operators using a certain input

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	3	7	7	1
From incumbent commercial	4	4	10	4
From other parties	3	11	19	6

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

Table 23: Inputs used for fixed backhaul, in three years, ≤ 1 Gbit/s, number of operators using a certain input

	Inputs used for fixed backhaul

	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	1	2	1	0
From incumbent commercial	2	2	3	4
From other parties	0	3	4	0

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

Table 24: Inputs used for fixed backhaul, in three years, > 1 Gbit/s, number of operators using a certain input

	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products	2	5	7	1
From incumbent commercial	3	3	7	2
From other parties	2	9	19	6

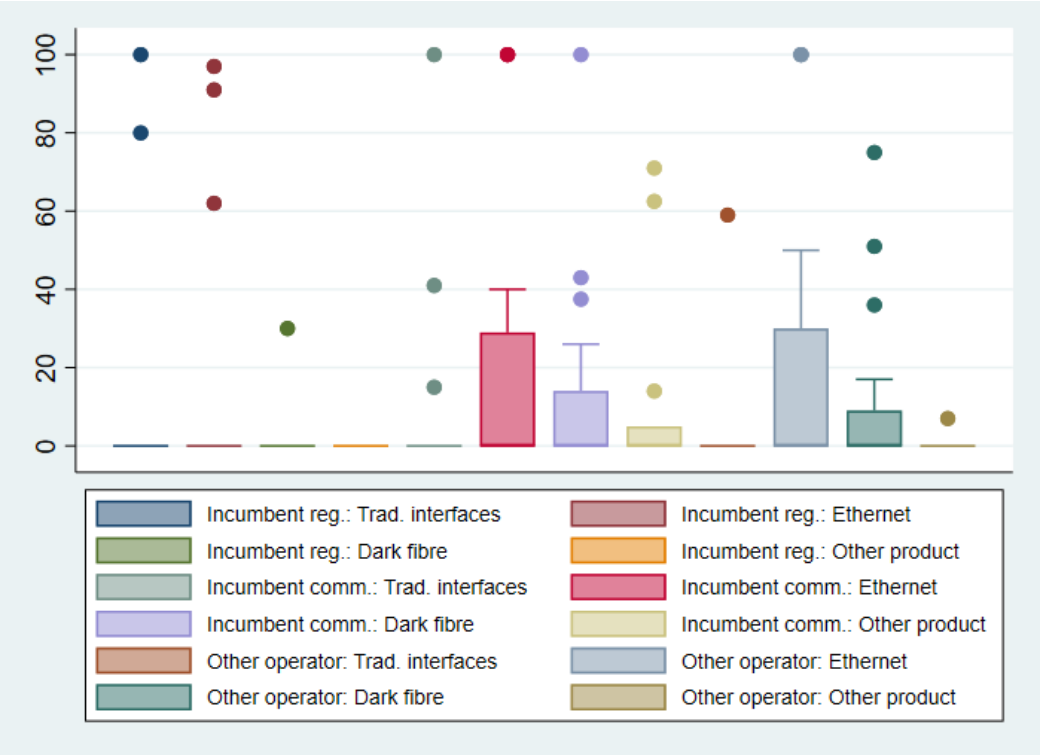
*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

In the following charts, the distributions of the percentages given for each wholesale product are illustrated by box plots. The line in the middle of each box indicates the median[88], the lower and upper bound of each box represent the 25th and 75th percentile, accordingly. The end

[88] Median = 50th percentile (the score below which 50% of the scores in the distribution may be found)

points of the adjacent lines show the upper and lower adjacent values[89] and the dots indicate outliers.

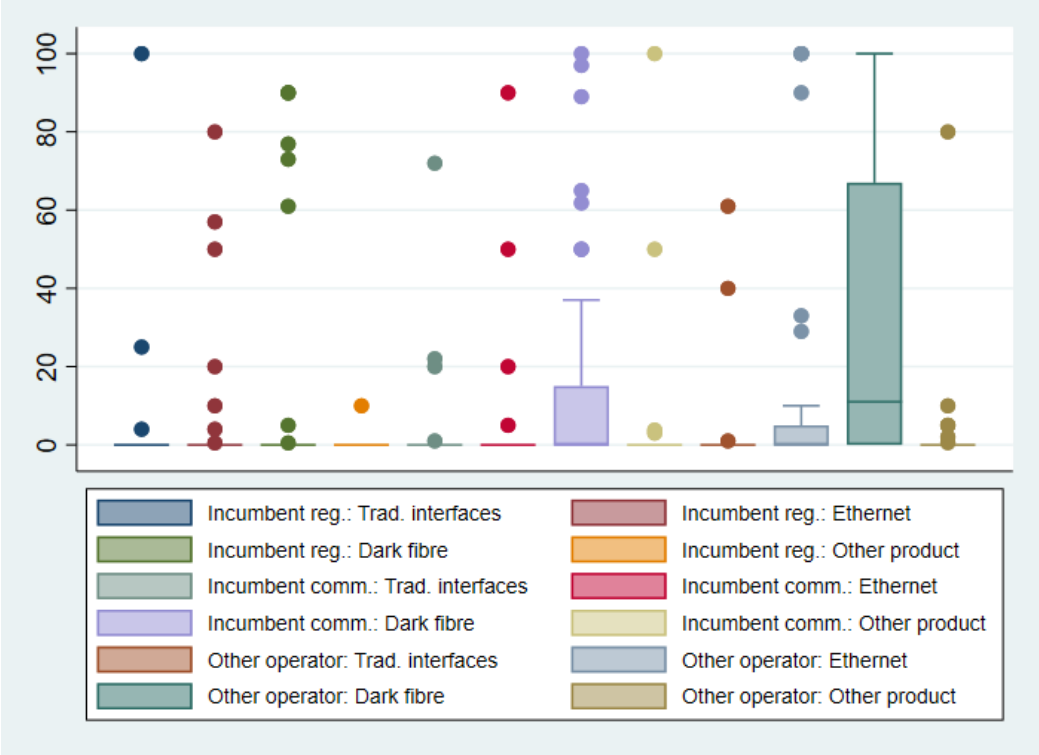
Figure 24: Box plot of percentages usage of each input type for connections ≤ 1Gbit/s, present[90]



[89] The upper (lower) adjacent value is the highest (lowest) value within a distance to the "box" of maximum 1.5 times the height of the box.

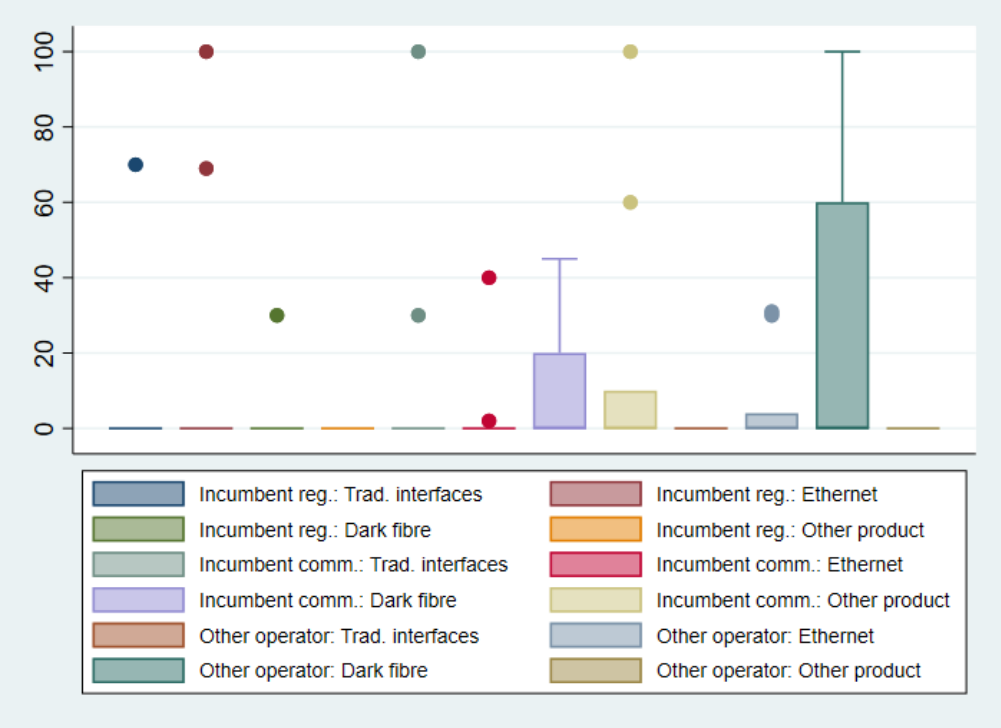
[90] Number of plausible responses:
present <= 1Gbit/s: 19
present > 1Gbit/s: 35
future <= 1Gbit/s: 11
future > 1Gbit/s: 29
(Operators who reported percentages which summed up to less than 80% were dropped; when operators reported a sum of percentages > 100%, the given values were rescaled.)

Figure 25: Box plot of percentages usage of each input type for connections > 1Gbit/s, present[91]



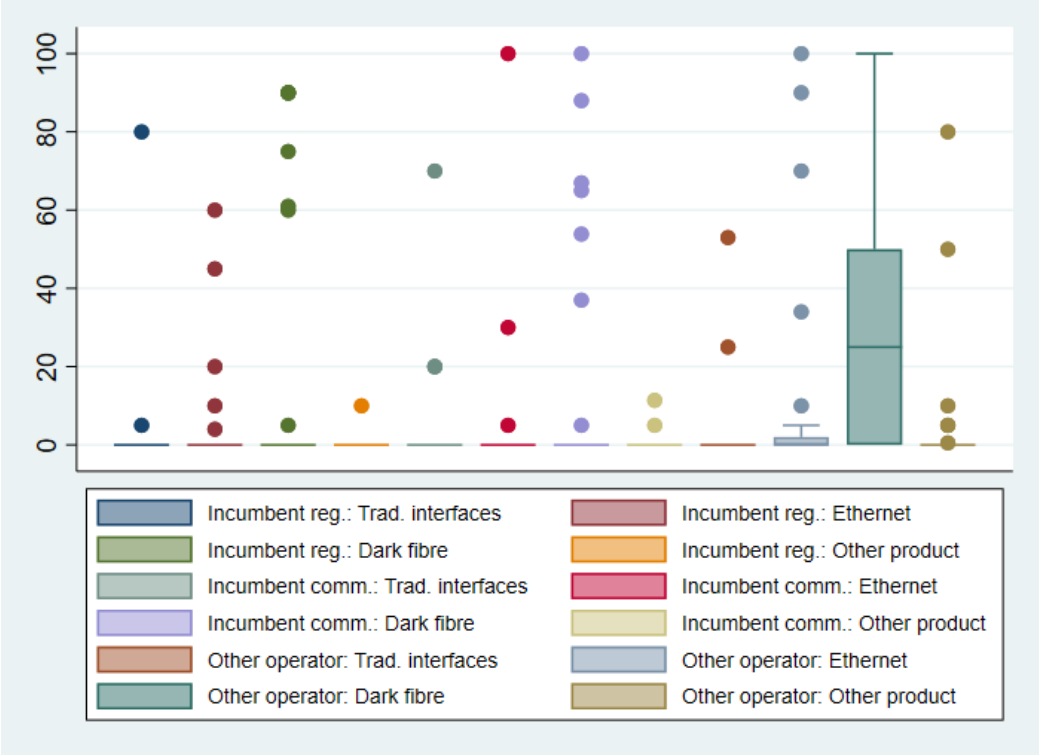
[91] Ibid.

Figure 26: Box plot of percentages usage of each input type for connections ≤ 1 Gbit/s, future[92]



[92] Ibid.

Figure 27: Box plot of percentages usage of each input type for connections > 1Gbit/s, future[93]



[93] Ibid.

ANNEX III: NRAS AND STAKEHOLDERS RESPONDING TO THE QUESTIONNAIRES

Table 25: List of NRAs having answered to the questionnaire for regulatory authorities

Organisation
RTR (Austria)
BIPT(Belgium)
CRC (Bulgaria)
HAKOM (Croatia)
OCECPR (Cyprus)
CTU (Czech Republic)
DBA (Denmark)
ECPTRA (Estonia)
TRAFICOM (Finland)
ARCEP (France)
BNetzA (Germany)
EETT (Greece)
NMHH (Hungary)
PTA (Iceland)
COMREG (Ireland)
AGCOM (Italy)
ARKEP (Kosovo)
SPRK (Latvia)
AK (Liechtenstein)
RRT (Lithuania)
ILR (Luxembourg)
MCA (Malta)
EKIP (Montenegro)
AEC (North Macedonia)
NKOM (Norway)
UKE (Poland)
ANACOM (Portugal)
ANCOM (Romania)
RATEL (Serbia)
RU (Slovak Republic)
AKOS (Slovenia)
CNMC (Spain)
PTS (Sweden)
ACM (The Netherlands)
BTK (Turkey)

Table 26: List of operators and associations having answered to the questionnaire for stakeholders

Company	Country
T-Mobile Austria GmbH	Austria
Sofico	Belgium
Telenet	Belgium
Scarlet Belgium NV	Belgium
Orange Belgium	Belgium
Eurofiber NV	Belgium
United Telecom N.v.	Belgium
Telemach Hrvatska d.o.o.	Croatia
A1 Hrvatska d.o.o.	Croatia
Poda a.s.	Czech Republic
Vodafone Czech Republic	Czech Republic
Tele2 Eesti AS	Estonia
Iliad	France
Bouygues Telecom	France
BREKO, German Broadband Association	Germany
Bundesverband Glasfaseranschluss e.V. (BUGLAS) Association	Germany
United Internet AG	Germany
Vodafone GmbH	Germany
Telefónica Germany	Germany
Deutsche Telekom AG	Germany
Wind Hellas	Greece
Vodafone Greece	Greece
National Broadband Ireland	Ireland
BT Communications Ireland Limited	Ireland
WINDTRE S.p.A.	Italy
TIM Spa	Italy
Fastweb	Italy
Iliad Italia S.p.A	Italy
Open Fiber SpA	Italy
PE Placiajuostis internetas	Lithuania
JSC Cgates	Lithuania
Canal+ Luxembourg s.à r.l. (M7 Group)	Luxembourg
Melita Limited	Malta
GO PLC.	Malta
Luostejok Bredbånd AS	Norway
Sola Bredbånd	Norway
GIG Networks AS	Norway
Ice	Norway
Sognenett AS	Norway
Telenor	Norway
Telia Norge AS	Norway

Company	Country
Fibroglobal Comunicações Electrónicas S.A.	Portugal
Nowo Communications, S.A.	Portugal
NOS Comunicações, S.A.	Portugal
RadioLAN, spol. s r.o.	Slovak Republic
Železničné telekomunikácie	Slovak Republic
Alternet, s.r.o.	Slovak Republic
Fibris, s.r.o.	Slovak Republic
ELKVANT	Slovak Republic
SURANY.NET s.r.o.	Slovak Republic
RKnet s,r,o,	Slovak Republic
SGnet s.r.o.	Slovak Republic
UPC Broadband Slovakia, s.r.o.	Slovak Republic
JUKO s. r. o. Prešov	Slovak Republic
A1 Slovenija,	Slovenia
T-2 d.o.o.	Slovenia
Telemach d.o.o.	Slovenia
Xfera Móviles, S.A.U.	Spain
Vodafone España, S.A.U.	Spain
Cellnex/nexLoop	Spain
Orange España	Spain
Telefónica de España	Spain

ANNEX IV: QUESTIONNAIRE SENT TO NRAS

Definition of mobile and fixed backhaul:

Mobile backhaul: Connection of a base station or several base stations (including small cells) to the core network. Connections within the core network are not considered.

Fixed backhaul: Connection of one or several fixed network elements (e.g. DSLAM, OLT, BNG, splitter, etc.) to the core network.

Overview (markets other than Market 2/2020 (M4/2014))

Summary of backhaul in other regulated markets

Market*	Imposed as remedy [94]	Can be used for mobile backhaul [95]	Can be used for fixed backhaul[2]	Is it important as a use for mobile backhaul[96]	Is it important as a use for fixed backhaul[3]
Market 1/2020 (Market 3a/2014)					
Access to ducts and poles	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
copper LLU	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
Fibre LLU	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
VULA	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
Ancillary backhaul service	Y/N	-	-	-	-
Market 3b/2014					
VULA	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
Bitstream	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
Ancillary backhaul service	Y/N	-	-	-	-
Market for physical infrastructure					
Access to ducts and poles	Y/N	Y/N	Y/N	Y/N/don't know	Y/N/don't know
Ancillary backhaul service	Y/N	-	-	-	-

*) for Market 2/2020 (M4/2014) see questions below

[94] Independent of the use for backhaul.
[95] Use for or as part of mobile/fixed backhaul is not prohibited by the regulatory obligation.
[96] Based on currently available information.

Market 2/2020 (M4/2014)

Year of last decision: _____

Market definition

1. How are trunk and terminating segments defined?
    a. The terminating segment is defined as the portion of the PtP line service between the end-user site and the closest exchange, all other connections are trunk segments. (Y/N)
    b. Trunk segments are defined as connections between a number of defined cities, all other connections are terminating segments. (Y/N)
    c. Other definition (please explain) _____
2. Which services/products are included in the market:
    a. Leased lines with traditional interfaces (Y/N)
    b. Leased Lines with Ethernet interfaces (Y/N)
    c. Ethernet Services (Y/N)
    d. Wavelength services / xWDM (Y/N)
    e. Dark fibre (Y/N)
    f. Other (please explain) (Y/N) _____
3. Are there separate markets for Leased lines with traditional interfaces and other services such as Ethernet Services / Wavelength services, xWDM / dark fibre? (Y/N)
4. What is the geographic scope of the market?
    a. National (Y/N)
    b. Sub-national (please explain) (Y/N) _____
5. Is/Are the market(s) differentiated by bandwidths or other QoS criteria? (Y/N)
    a. If yes, please explain _____
6. Does the market definition differentiate between different types of use of a specific wholesale products:
    a. Use for mobile backhaul (Y/N)
    b. Use for fixed backhaul (Y/N)
    c. Use for fixed or mobile backhaul (Y/N)
    d. Other (please explain) _____
7. If the answer to one of the questions 6a-c is yes: What does this mean for the market definition:
    a. Use for mobile backhaul is not included in the market (true/false)
    b. There is a separate market for the use for mobile backhaul (true/false)
    c. Use for fixed backhaul is not included in the market (true/false)
    d. There is a separate market for the use for fixed backhaul (true/false)
    e. Use for backhaul (mobile or fixed) is not included in the market (true/false)
    f. There is a separate market for the use for backhaul (mobile or fixed) (true/false)
    g. Other (please explain) (true/false) _____
8. If the answer to one of the points 7a-e is yes, please explain the main reasons for each of the 'yes' reply:

    _____
9. Does the SMP operator offer specific wholesale products for
    a. Mobile backhaul – regulated (Y/N)
    b. Mobile backhaul – commercial offer (Y/N)

c. Fixed backhaul – regulated (Y/N)
d. Fixed backhaul – commercial offer (Y/N)

10. If such products exist: How are they treated in the market definition?
    a. They are included in the relevant market (Y/N)
    b. They form a separate relevant market (Y/N)
    c. They are not part of any relevant market (Y/N)
11. If the answer to one of the points 10b-c is yes, please explain the main reasons _____

Remedies

12. For which products did you impose an access obligation?
    a. Leased lines with traditional interfaces (Y/N)
    b. Leased Lines with Ethernet interfaces (Y/N)
    c. Ethernet Services (Y/N)
    d. Wavelength services / xWDM (Y/N)
    e. Dark fibre (Y/N)
    f. Other (please explain) (Y/N) _____
13. Do the remedies differentiate between the use of the wholesale product(s) (i.e. whether the same product is used for different purposes)?
    a. Use for mobile backhaul (Y/N)
    b. Use for fixed backhaul (Y/N)
    c. Other (please explain) (Y/N) _____
14. If the answer to one of the question 13a-c is yes, please explain how the remedies differ and why. _____
15. If the answer to all of the question 13a-c is no, does this mean that all wholesale products can be bought at the same conditions irrespective of the specific use (including fixed and/or mobile backhaul)? (Y/N)
16. Are there specific regulated wholesale products for
    a. Mobile backhaul (Y/N)
    b. Fixed backhaul (Y/N)
17. Do the remedies differentiate between wholesale products specifically for backhaul and other wholesale products (if such products exist)? (Y/N)
18. If the answer to question 17 is yes, please explain how the remedies differ and why. _____
19. If different remedies/regulation apply to mobile backhaul, can an intermediary fixed operator purchase any type of regulated backhaul (to base stations or any other premises) and resell this connectivity to MNOs? (Y/N)
20. Geographic differentiation of remedies:
    a. Is there a geographic differentiation of the remedies? (Y/N)
    b. If yes, is the geographic differentiation driven by considerations on mobile and fixed backhaul? (Y/N)
    c. If yes, please explain _____
21. If regulated products can be used for mobile backhaul: Is the particular remedy important as a use for mobile backhaul?
    a. Leased lines with traditional interfaces (Y/N/don't know)
    b. Leased Lines with Ethernet interfaces (Y/N/don't know)
    c. Ethernet Services (Y/N/don't know)

d. Wavelength services / xWDM (Y/N/don't know)
e. Dark fibre (Y/N/don't know)
f. Other (please explain) (Y/N/don't know) _____

22. If regulated products can be used for fixed backhaul: Is the particular remedy important as a use for fixed backhaul?
    a. Leased lines with traditional interfaces (Y/N/don't know)
    b. Leased Lines with Ethernet interfaces (Y/N/don't know)
    c. Ethernet Services (Y/N/don't know)
    d. Wavelength services / xWDM (Y/N/don't know)
    e. Dark fibre (Y/N/don't know)
    f. Other (please explain) (Y/N/don't know) _____

ANNEX V: QUESTIONNAIRE SENT TO OPERATORS

COMPANY DATA

Company name, country, contact name, contact E-Mail address

Company profile

1. Does your company offer (Table with (Y/N) and approximate number of active lines/SIM-cards per category by end of 2020)
    a. Mobile Services based on an own network (MNO)
    b. Fixed broadband services based on FTTB/H (own network or co-invested network)
    c. Fixed broadband services based on a copper access network (own network)
    d. Fixed broadband services based on a coaxial cable access network (own network)
    e. Fixed broadband services based on wholesale physical unbundling
    f. Fixed broadband services based on wholesale virtual unbundling
    g. Fixed broadband services based on wholesale bitstream services
    h. Fixed Business Services (Leased Lines, Ethernet Services, etc.)
    i. Other (please explain) _____

MOBILE BACKHAUL

Definition mobile backhaul: Connection of a base station or several base stations (including small cells) to the core network. Connections within the core network are not considered.

Current demand for / realisation of <u>mobile backhaul</u>

2. What is the approximate number of base stations in your network? _____
3. Table: Backhaul ≤ 1 Gbit/s: Please provide % values which add up to 100% across the table [grey cells not to be filled in].

≤ 1Gbit/s	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply							
From incumbent based on regulated products							
From incumbent commercial							
From other parties							

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

4. Table: Backhaul > 1 Gbit/s: Please provide % values which add up to 100% across the table

>1 Gbit/s	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply							
From incumbent based on regulated products							
From incumbent commercial							
From other parties							

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

5. What is the current share of backhaul connections with >1 Gbit/s? __%
6. Do you use regulated access to the passive infrastructure (e.g. duct) from the incumbent (SMP)[97] operator to establish own fibre links? (Y/N)
7. What % of your own fibre links were deployed using regulated passive infrastructure access (e.g. duct or pole access)? __%

Future demand for / realisation of <u>mobile backhaul</u> in three years

8. What will the approximate number of base stations (macrocells) in your network in three years? _____
9. What will be the approximate number of small cells in your network within three years? _____
10. Table: Backhaul ≤ 1 Gbit/s: Please provide % values which add up to 100% across the table (under the assumption that regulation is the same as today).

[97] Operator designated with a status of significant market power (SMP)

≤ 1Gbit/s	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply							
From incumbent based on regulated products							
From incumbent commercial							
From other parties							

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

11. Table: Backhaul > 1 Gbit/s: Please provide % values which add up to 100% across the table (under the assumption that regulation is the same as today).

>1 Gbit/s	Inputs used for mobile backhaul				Self-supply* used for mobile backhaul		
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services**	Own copper link	Own fibre link	Own radio link
Self-supply							
From incumbent based on regulated products							
From incumbent commercial							
From other parties							

*) Including network sharing (shared backhaul)
**) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

12. What will be the share of backhaul connections with >1 Gbit/s in three years? __%
13. If possible, will you use access to the passive infrastructure (e.g. duct) from the incumbent operator to establish own fibre links? (Y/N)
14. What will be the % of your own fibre links deployed using regulated passive infrastructure access (e.g. duct or pole access) in three years if the current regulation remains unchanged? __%

Future regulation of <u>mobile backhaul</u>

15. Is regulation of mobile backhaul necessary in future?
    a. Yes, nationwide regulation (Y/N); If yes, which wholesale products (for mobile backhaul)?

   i. Ethernet Services
   ii. Dark fibre
   iii. Passive infrastructure access (e.g. duct or pole access)
   iv. Other _____

b. Yes, in some areas (Y/N), If yes, which wholesale products (for mobile backhaul)?
   i. Ethernet Services
   ii. Dark fibre
   iii. Passive infrastructure access (e.g. duct or pole access)
   iv. Other _____

c. If your answer to point b) is yes, in which areas?
   i. Mainly rural areas
   ii. Mainly suburban areas
   iii. Mainly urban areas
   iv. Across different types of areas

d. If in the future regulation is not needed in your view, on national basis or in some areas, why?
   i. There are offers from alternative operators available. (Y/N)
   ii. There is a commercial agreement with the incumbent operator. (Y/N)
   iii. Backhaul can be self-supplied with radio links. (Y/N)
   iv. Backhaul can be self-supplied with own fibre connections. (Y/N)
   v. Other reason (please explain) _____

e. Room for further comments about the need for future regulation of mobile backhaul: _____

FIXED BACKHAUL

Definition fixed backhaul: Connection of one or several fixed network elements (e.g. DSLAM, OLT, BNG, splitter, etc.) to your core network and/or connection of the network to an internet exchange.

Current demand for <u>fixed backhaul</u> from third parties

1. What is the approximate number fixed backhaul connections bought from third parties? _____
2. Table: Backhaul ≤ 1 Gbit/s: Please provide % values which add up to 100% across the table

≤ 1Gbit/s	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products				
From incumbent commercial				
From other parties				

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

3. Table: Backhaul > 1 Gbit/s: Please provide % values which add up to 100% across the table

> 1Gbit/s	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products				
From incumbent commercial				
From other parties				

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

4. What is the current share of backhaul connections with >1 Gbit/s? __%

5. Do you use regulated access to the passive infrastructure (e.g. duct) from the incumbent (SMP)[98] operator to establish own fibre links? (Y/N)
6. What is the approximate number of own fibre links deployed using regulated passive infrastructure access (e.g. duct or pole access)? _____

Future demand for <u>fixed backhaul</u> from third parties

1. What will be the approximate number fixed backhaul connections bought from third parties in three years? _____
2. Table: Backhaul ≤ 1 Gbit/s: Please provide % values which add up to 100% across the table (under the assumption that regulation is the same as today).

≤ 1Gbit/s	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products				
From incumbent commercial				
From other parties				

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

3. Table: Backhaul > 1 Gbit/s: Please provide % values which add up to 100% across the table (under the assumption that regulation is the same as today).

> 1Gbit/s	Inputs used for fixed backhaul			
	Leased lines with traditional interfaces	Ethernet Services	Dark fibre (rented)	Other wholesale services*
From incumbent based on regulated products				
From incumbent commercial				
From other parties				

*) physical unbundling, virtual unbundling, bitstream services, xWDM, etc.

4. What will be the share of backhaul connections with >1 Gbit/s in three years? __%

[98] Operator designated with a status of significant market power (SMP)

5. If possible, will you use access to the passive infrastructure (e.g. duct) from the incumbent operator to establish own fibre links? (Y/N)
6. What will be the approximate number of own fibre links deployed using regulated passive infrastructure access (e.g. duct or pole access) in three years (provided the current regulation remains unchanged)? _____

Future regulation of <u>fixed backhaul</u>

1. Is regulation of fixed backhaul necessary in future?
    a. Yes, nationwide regulation (Y/N); If yes, which wholesale products (for fixed backhaul)?
        i. Ethernet Services
        ii. Dark fibre
        iii. Passive infrastructure access (e.g. duct or pole access)
        iv. Other _____
    b. Yes, in some areas (Y/N), If yes, which wholesale products (for fixed backhaul)?
        i. Ethernet Services
        ii. Dark fibre
        iii. Passive infrastructure access (e.g. duct or pole access)
        iv. Other _____
    c. If your answer to point b) is yes, in which areas?
        i. Mainly rural areas
        ii. Mainly suburban areas
        iii. Mainly urban areas
        iv. Across different types of areas
    d. If in the future regulation is not needed in your view, on national basis or in some areas, why?
        i. There are offers from alternative operators available. (Y/N)
        ii. There is a commercial agreement with the incumbent operator. (Y/N)
        iii. Backhaul can be self-supplied with radio links. (Y/N)
        iv. Backhaul can be self-supplied with own fibre connections. (Y/N)
        v. Other reason (please explain) _____
    e. Room for further comments about the need for future regulation of mobile backhaul: _____