Another Look at the Debate on the "Fair Share" Proposal

A document for Telefonica

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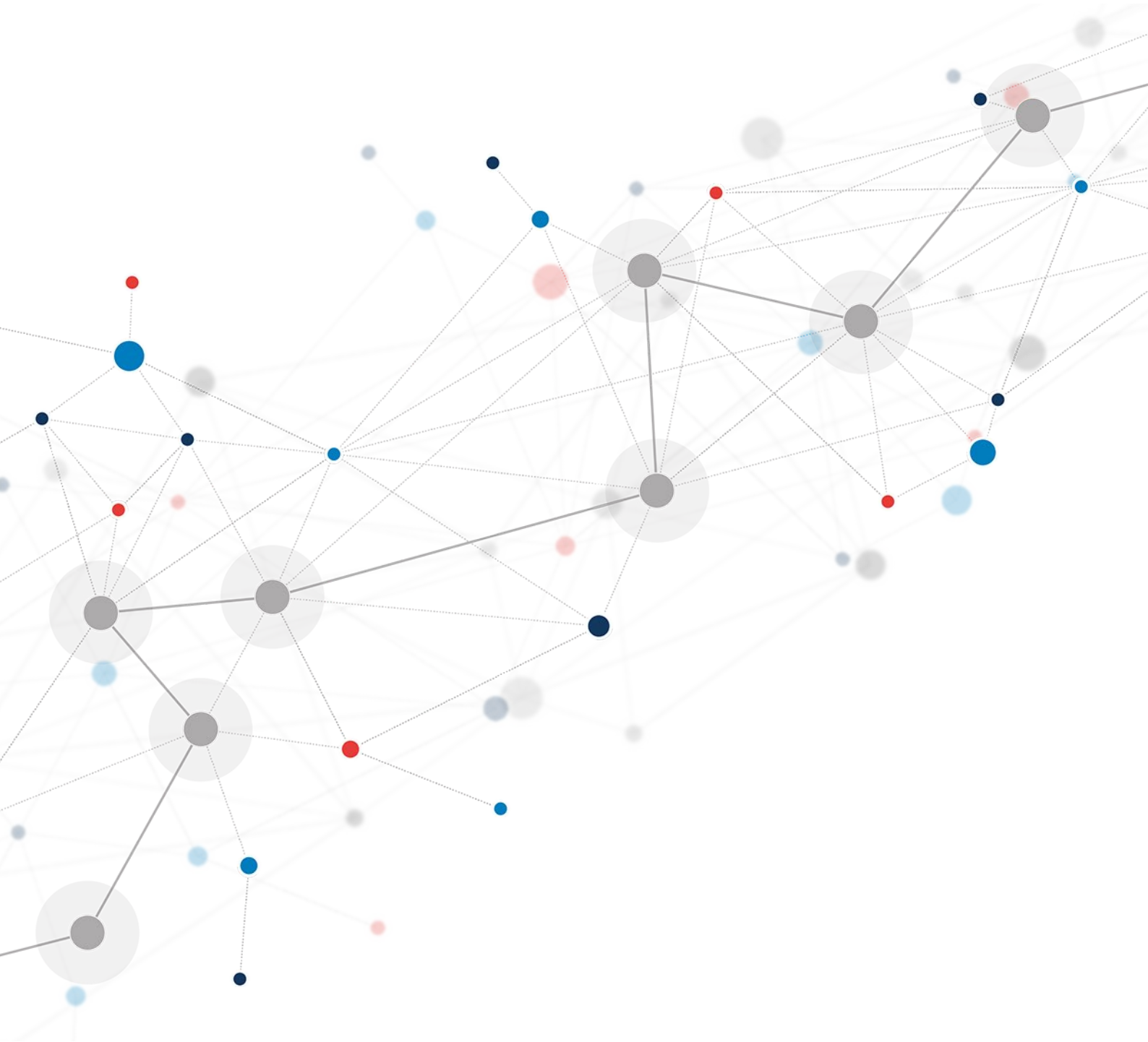

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1 Introduction

Background

1.1 Mobile and fixed data traffic is growing fast in Europe, and video content is a major driver of such growth. Compared with traditional voice and text messages, video traffic creates significant investment needs: video requires substantially more bandwidth than other content, increasing the need for costly network capacity investments to always maintain quality of service (even if that capacity is under-utilised from time to time).

1.2 Meeting the demand for data while maintaining quality of service requires large investments to expand network capacity. Telecom Operators ('**TELCOs**') spend tens of billions of euros every year on infrastructure to keep up with growing traffic. ETNO estimates that TELCOs' investment peaked at €56.3 billion in 2021. A study commissioned by Deutsche Telekom, Orange, Telefónica and Vodafone put a value of at least €15 billion a year on network costs caused by Large Traffic Originators ('**LTOs**') – such as TikTok, Netflix or Google's YouTube.[1]

1.3 The European Commission's targets for 5G, seeking to achieve coverage of all urban areas and transport paths by 2025 and all populated areas by 2030, will drive up expected growth in data traffic, given that access to high speed and reliable internet enables data intensive services to become popular. The expected growth in data traffic will only be met satisfactorily with additional investment in network infrastructure. Achieving the European Commission's target of 5G coverage of all populated areas in the EU by 2030 is estimated to require an additional €150 billion of investment.

1.4 The extensive network investments needed for 5G are critical to provide the enhanced quality of service (e.g., faster speeds, lower latency, and greater reliability) required to enable the innovative services that are expected to transform productivity and service delivery across a host of industries, including in relation to the Metaverse, www3, holographic communication, the Internet of Things and mission critical services. A failure to make the required investments could mean that it would not be possible to deliver these services or only with a reduced quality of service, forgoing the expected large benefits from services dependent on full 5G functionality.

1.5 TELCOs will undertake such needed investments only if they can successfully monetise them. So far, they have predominantly relied on end users to recover their costs and obtain the rate of return investors demand. However, due to fierce competition across and within networks, as well as the typical fee structure of TELCOs that does not depend on data traffic, revenues from end users have been flat, despite increases in data volumes. HSBC estimates that average ROIC (return on invested capital) for the major listed European telecommunication operators fell from around 8% in 2012 to around 5% in 2020 and that many operators now have returns below their cost of capital.

[1] There is no commonly accepted quantitative threshold to define which traffic originators ('**TOs**') are LTOs. These are likely to be the market players who account for the vast majority of traffic, such as Google, Netflix, Facebook, Microsoft, Apple and Amazon. According to Sandvine, these six companies generated nearly 50% of internet traffic in the first half of 2022. See Sandvine, The Global Internet Phenomena Report, 2023.

The Fair Share Proposal

1.6 TELCOs claim that they will be unable to undertake the significant investments needed to meet the expected growth in demand, as well as the European Union's digital target of connecting 45 million Europeans to gigabit broadband and 5G by 2030, unless LTOs make a fair and proportionate contribution to the costs of such infrastructures (the '**fair share proposal**').

1.7 TELCOs explain that extant peering arrangements – i.e., bilateral agreements governing the reciprocal exchange of traffic between two networks – result in network cost recovery coming predominantly from prices charged to end telecommunications users in Europe, since (a) inbound traffic is significantly greater than outbound traffic (e.g., even for platforms with user generated content such as YouTube, videos are likely to be viewed more often than they are uploaded); and (b) even if LTOs are not TELCOs' peers, their content is often fed to TELCOs' networks (without paying any fees, irrespective of whether they connect in transit, through peering or directly).

1.8 TELCOs also argue that, because of the imbalance in negotiation power, it is unlikely that LTOs will agree to make significant, if any, payments, which justifies the need for an *ad hoc* contribution for network investment. That TELCOs do not enjoy market power *vis-à-vis* LTOs is clear from the fact that LTOs generally pay nothing for injecting traffic in TELCOs' networks.

1.9 TELCOs also claim that such payments will likely incentivise LTOs to be more data-efficient – e.g., by using better compression codecs, disabling auto-play for videos by default, or refraining from sending very high-definition content to unsuited screens – thus reducing the need for investment in capacity. In their opinion, such payments would also contribute to the European Union's green agenda, since they could allow the telecom industry to switch off older network equipment and move over to energy-efficient kit, materially reducing its carbon footprint.

Reactions from LTOs and Regulators

LTOs

1.10 LTOs reject TELCOs' proposal arguing that

a. Traffic growth is not getting out of control;[2]

b. Traffic is generated by TELCOs' own customers, who already pay for receiving the data;[3]

c. TELCOs should not be allowed to charge twice – customers and content providers – for the same service;[4]

d. LTOs are already contributing to the needed infrastructure by investing in subsea cables, datacenters, and Content Delivery Networks ('**CDNs**');[5]

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2 See, for example, the response of the Computer and Communications Industry Association (CCIA), available at https://ccianet.org/news/2022/10/network-usage-fees-techs-infrastructure-investments-deliver-major-savings-for-eu-telcos-new-study-finds/.

3 See, for example, a quote from Christian Borggreen, head of CCIA Europe, available at https://www.politico.eu/article/telecom-netflix-tiktok-youtube-fair-share-why-telcos-are-going-at-war-with-big-tech/.

4 See, for example, Netflix, A cooperative approach to content delivery, 2021.

5 Ibid.

e. LTOs will have less money available for investment in content;[6]

f. LTOs may have to offer degraded services – lower-quality video – that take up less space on infrastructure networks; and

g. TELCOs' proposal infringes on net neutrality and, therefore, may result in the unfair discrimination of some online services.

BEREC

1.11 The body of European regulators ('**BEREC'**) also expressed concerns about the abovementioned proposal, which it refers to as a "sending party network pays" charging mechanism, in October 2022.[7] BEREC sustain that traffic is requested and thus caused by TELCOs' customers and that LTOs do optimise the data efficiency of the content and applications they provide. They also claim that

a. The costs needed to handle increased traffic at the margin are very low,

b. Connectivity costs are covered and paid for TELCOs' customers, and

c. The provision of telecom access infrastructures is a profitable business with a relatively attractive risk return (i.e. with relatively high return gained on investment given the level of risks involved).

1.12 In short, BEREC conclude against the fair share proposal, since in their opinion there is no evidence of free riding by LTOs. Further, BEREC's interpretation of the proposal leads them to conclude that it risks allowing TELCOs to exploit their termination monopoly.

OXERA

1.13 A report prepared by Oxera for the Dutch Ministry of Economic Affairs in January 2023 looks at the welfare effect of introducing a transfer from LTOs to TELCOs.[8] It concludes that a policy introducing such a transfer

a. Is unlikely to lead to large net welfare gains (based on a static analysis), and

b. Would result in substantial transaction costs, including regulatory, compliance and litigation costs.

1.14 The Oxera report further argues that the policy cannot be justified on the grounds of promoting investment by network operators as

a. The proportion of funds that is passed on to consumers in the form of price reductions is not available to invest;

b. The relationship between increased cash flow and investment is weak; and

c. Any effect would need to be offset against reduced incentives of LTOs to invest.

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6 Ibid.

7 BEREC preliminary assessment of the underlying assumptions of payments from large CAPs to ISPs, 2022.

8 Oxera, Proposals for a levy on online content application providers to fund network operators, 2023.

Object of the Report

1.15 In this report we consider whether it is appropriate for the European Commission or the Member states to intervene in the market based on the fair share proposal described above.[9]

a. We first seek to identify the source and nature of the market failure that the proposal endeavours to correct. Absent such a failure the proposal would lack justification as a matter of economics. We also investigate whether such a failure could be resolved through untethered bilateral negotiations or, instead, requires public intervention to be effectively addressed.

b. We then assess whether the fair share proposal can correct such a failure and explore its possible drawbacks and limitations.

c. We proceed to discuss how that proposal could be implemented in practice and the likely consequences of alternative implementation designs.

d. We conclude by assessing whether our main conclusions are dependent of the business model used by the LTOs and, in particular, on whether the results for subscription-based LTOs and online advertising LTOs are different.

1.16 In addition, in light of the concerns raised by LTOs, BEREC and other regulators, we assess whether TELCOs' fair share proposal

a. Implies that TELCOs would charge twice – customers and content providers – for the same service, thus exploiting their alleged termination monopoly, as LTOs aver;

b. Is unjustified since connectivity costs are already paid by TELCOs' end users, and the provision of telecom access infrastructures is a profitable business with a relatively attractive risk return, as the LTOs and BEREC claim; and

c. Is unlikely to lead to enhanced investments by TELCOs, and that any effect may be offset by reduced incentives of LTOs to invest.

1.17 In what follows we will not discuss whether the fair share proposal will infringe TELCOs' *net neutrality* obligations, since we understand, contrary to what the LTOs claim, that it is now common ground that this is not the case. In particular, we understand that the European Commission ('**EC**') is committed to protecting net neutrality as embedded in the Open Internet Regulation with independence of the possible adoption of a fair share scheme.

Main Conclusions

1.18 **Economic context.** Contrary to what LTOs and BEREC maintain, the available evidence shows that:

a. Data traffic is growing fast, driven primarily by increased demand for video content;

b. Meeting that growth requires significant investments in network capacity by TELCOs; and

c. Traffic is not driven exclusively by TELCOs' end users. LTOs can reduce the need for investment in access infrastructure by e.g. investing in CDNs, limiting the provision of video content not

[9] For the purposes of this report, we focus on the proposal that LTOs should make a fair share contribution. To the extent that the arguments apply to smaller TOs, these could contribute proportionally.

requested by consumers (e.g. video advertisements) and/or using more efficient compression codecs.

d. While some LTOs already contribute to manage traffic by investing in subsea cables, datacenters, and CDNs, the need for investment in expanding networks and increasing network capacity by TELCOs remains significant.

1.19 **Complementarities between access and content**. TELCOs and LTOs sell "complementary" products: access and content, respectively; so that the demand for access is declining in the price of content and the demand for content is declining in the access price.

a. Access and content are not perfect complements, however. In particular, access and content are not consumed in "fixed proportions": consumers demand access for reasons other than consuming LTOs' content, and they may demand and consume more or less content without adjusting their demand for access.

b. Both the demand for access and, especially, the demand for content are increasing in the quality with which that content is accessed *via* a network (which for brevity we will denote as "access quality"). Access quality is bound to have a very significant impact on the demand for content, since consumers' utility from content consumption crucially depends on the quality with which it is rendered.

c. Access quality in turn depends on the network investments made by TELCOs, primarily, and LTOs, to a lesser extent. The greater the investments made by either TELCOs and LTOs, the greater access quality and hence the demand for access and content.

d. Access quality also depends on the data-efficiency of the LTOs whose content is distributed through TELCOs' networks. The more efficient are the LTOs the lower the capacity needed to deliver the same amount of traffic and, therefore, the less significant the network investments needed to maintain quality. Likewise, the greater the capacity of the network resulting from network investments, the less efficient LTOs need to be to deliver the same quality. As a result, investments in data-efficiency by LTOs reduce the need for network investment and *vice versa*.

1.20 **Externalities and underinvestment**. TELCOs' network investments generate a positive externality on LTOs, which will not be internalised absent payments from LTOs to TELCOs. Since TELCOs do not receive the full value of carrying additional traffic (i.e. beyond their general end-user revenues), they will only invest where the costs of congestion (in terms of risks of subscriber switching to rivals) become so great as to exceed the cost of the investment. They may not invest even if the cost of investment is below the value generated for all participants to the product chain, including LTOs, which is inefficient. The resulting underinvestment problem is bound to be significant because the size of the externality is large. This is because: (i) access quality crucially depends on TELCOs' investments; (ii) the demand for content is elastic to access quality; and (iii) LTOs' profit margins are large.

1.21 **Incentivising investment in networks.** TELCOs' incentives to invest can be increased either using sticks (penalties associated with low access quality), carrots (contributions from LTOs), or both. TELCOs typically face two sticks: (a) their licenses may impose obligations regarding access quality; and (b) competition among TELCOs provides discipline, as end consumers are likely to substitute away poor quality networks with superior ones. Yet, if LTOs paid a charge for the delivery of traffic covering the costs of the additional capacity required, TELCOs would gain incremental direct revenues as an additional return on their investment. The cost of providing for additional capacity would be covered in part by those charges.

1.22 LTOs facing charges relating to the additional network investment costs caused by their activities will have the incentive to reduce such costs, making heavier use of CDNs, adopting more efficient compression technologies, not pushing video content that end users did not request (such as video adverts) or releasing popular content at off-peak hours. They may also change their end-user prices or other aspects of their offers, e.g., encouraging customers to download content (or automatically downloading next episodes in series) during off-peak hours for later viewing.

1.23 **Payments contingent on investment**. TELCOs' network investment incentives would increase if LTOs paid a charge to fund the costs of those investments. LTOs' contributions would add to the incentives provided by the regulatory obligations TELCOs already face. The magnitude of TELCOs' externality, and hence the need to provide TELCOs with the appropriate incentives, increases with LTOs' profits, which implies that it is indeed the larger LTOs who should contribute to fund TELCOs' network investment rather than smaller ones.

1.24 **Consumer welfare implications**. Those payments would unambiguously increase consumer welfare, though they are insufficient to implement the level of investment which maximises total welfare since this is typically above the level that maximizes joint industry profits.

a. On the one hand, consumers will naturally benefit from the improved access quality resulting from increased network investments by TELCOs.

b. On the other hand, since the investment-contingent payments made by LTOs are lump sum payments, i.e. unrelated to the number of consumers or their traffic, their use will not result in higher prices for content and, therefore, necessarily will lead to lower quality-adjusted content prices. Prices for access will also remain unaffected in absolute terms but will fall in quality-adjusted terms.

1.25 One could worry about the payments' potentially adverse impact of on LTOs' ability and incentive to invest. We do not believe this is a real problem. As regards ability, it is well-known that financially constrained firms may be unable to raise capital from third-party investors and so they must rely on their cash-flows to fund costly investments. If those cash-flows are significantly reduced by the payments calculated above, this may reduce the investments made by LTOs, reduce the amount and/or quality of their content, and make consumers worse off. Yet, this concern is mute if the payments are targeted to LTOs, with abundant cash and, more importantly, unfettered access to capital markets.

1.26 As regards incentive, the concern has no justification. The payments referred to above are meant to incentivise TELCOs to undertake investments that are beneficial to the LTOs and their customers. Those payments will increase the demand for content and, therefore, should also increase the incentives of LTOs to invest in developing more and better content.

1.27 **Market failure**. Regulatory intervention may be needed to ensure that LTOs pay adequate contributions to TELCOs. While TELCOs and LTOs may attempt to resolve the underinvestment problem to which they are exposed by means of bilateral agreements, that has not happened and is unlikely to happen.

a. Due to their incomplete understanding of the technology of the TELCOs, LTOs may fear that they would pay more than needed to incentivise investment. If the cost of investment is higher than what the LTO believes it to be, the level of payment the LTO is willing to make will be below the level that would be optimal from the point of view of joint industry profits.

b. LTOs may also be reluctant to contribute to fund TELCOs' investments in network capacity because their contributions likely will benefit their competitors as well since, under network neutrality, TELCOs cannot discriminate in favour of those contributing to the development of the

networks. Each LTO would want other LTOs to contribute but would prefer to avoid doing so itself. This free-riding problem will not be easy to resolve unless all LTOs are compelled to contribute to the funding of TELCOs' investments in network capacity.

c. The greater the bargaining power of the LTO, the less likely is that a bilateral negotiation results in the industry optimal level of investment. We expect this risk to be large given the imbalance in bargaining power between LTOs and TELCOs.

1.28 Given the difficulties described above, it is clear that some form of intervention will be needed to address the underinvestment problem we have identified.

a. One option is to regulate TELCOs' investments and LTOs' contributions to fund them. This option may face difficulties, however, since the regulator would need detailed information on the parameters of TELCOs' and LTOs' profit functions and would then need to monitor and enforce the regulated outcomes, which is also complex and costly.

b. Depending on the cost and effectiveness of such audits, a better alternative may be for the regulator to mandate both sides to negotiate a deal while instituting a mandatory arbitration system in case such negotiations stall. Unlike the untethered bilateral negotiations discussed above, which are unlikely to yield positive results, the parties would be required to negotiate "under the shadow of arbitration". Thus, they should rationally anticipate that, in the event of impasse, the arbitrators will compel them to produce the information needed for their award at their own expense and may subject that information to adversarial review.

c. However, there are reasons to believe that this alternative may also fail to deliver if TELCOs and LTOs negotiate investment deals, i.e. the former commit to a level of investment in exchange for payments contingent on that investment, because network investments may not be contractible. This could be either because the nature and magnitude of the required investments may be both uncertain and TELCOs' private information *ex ante* (i.e. when the contract is negotiated), and/or investment may be difficult to verify *ex post* (e.g. the extent and quality of TELCOs' actual investments may be hard to verify).

d. An alternative is to mandate negotiations based on per-unit traffic fees. Unlike network investments, traffic is contractible, since it can be monitored and verified *ex post*.

1.29 **Traffic-based payments.** Properly calibrated per-unit traffic fees can provide TELCOs with the appropriate investment incentives and resolve the underinvestment problem. These fees will affect access prices (will fall) and content prices (will increase) but their net effect on TELCO's investment will be positive.

1.30 These traffic fees could be the result of bilateral negotiations occurring under the shadow of arbitration. Because TELCOs' and LTOs' bilateral negotiations are conditioned by the possibility of arbitration, we expect that they successfully reach agreement on traffic fees without unnecessary delay. This process will obviate the need for explicit interventions in setting those fees, a process which would be more costly and less flexible (i.e. less likely to yield fees that are fine-tuned to reflect differences among LTOs) than the abovementioned decentralised negotiations under the shadow of arbitration.

1.31 The impact of the implementation of traffic-based fees on consumer welfare is less clear than the impact of an investment-contingent payment (unconditional on traffic and/or the number of consumers). This is because, while the increase in network capacity and thus on access quality, is unambiguously beneficial for consumers, the effect of those fees on prices is not: consumers will benefit from the reduction in access prices but will be harmed by the increase in the prices for content resulting from the introduction of such fees.

1.32 However, there are various reasons to believe that the net effect will be an increase in consumer welfare. Firstly, we expect the demand for LTOs' content to be no more price elastic than the demand for access. Secondly, while the price of content increases due to the traffic fees, quality adjusted content prices may fall due to the increase in quality. Lastly, consumers may weigh quality more than price.

1.33 **Online advertising LTOs.** The main conclusions of our analysis are not dependent on whether the LTO adopts a subscription-based or online advertising base business model. The externality and the associated underinvestment problem we identify is independent of the business model adopted by the LTO. TELCOs' investment incentives can be corrected using investment-contingent payments or traffic-based payments and the pros and cons of both alternatives are also independent of the LTO business model.

Policy Implications

1.34 Our analysis yields the following **policy conclusions**:

a. In the absence of payments from LTOs, TELCOs will underinvest because they fail to internalise the positive externality their investments generate on LTOs.

b. TELCOs' incentives to invest can be increased if LTOs contribute to fund their investments either directly or by means of traffic-related payments.

c. If correctly set, these payments will unambiguously increase joint industry profits and also increase consumer welfare. Larger LTOs should contribute more and will do so if the payments are traffic-related.

d. There is a risk that the current unregulated arrangements result in no payments from LTOs due to asymmetries of information between industry participants, free-riding among LTOs, and the large imbalance in bargaining power between LTOs and TELCOs.

e. Thus, some form of intervention will be needed to address the underinvestment problem we have identified.

    i. One option is to regulate TELCOs' investments and the LTOs' contribution to funding them. This option is informationally demanding and hence unlikely to be feasible in practice.

    ii. An alternative would be for the regulator to mandate both sides to negotiate a deal involving payments contingent on investment, and institute a mandatory arbitration system in case such negotiations stall. However, this is also likely to prove infeasible in practice, since network investments may not be contractible, either because the nature and magnitude of the required investments may be uncertain *ex ante* (i.e. when the contract is negotiated), or difficult to monitor *ex post* (i.e. once the TELCOs have sunk their investments).

    iii. Another alternative is to mandate negotiations based on per-unit traffic fees. Unlike network investments, traffic is contractible, since it can be monitored and verified *ex post*.

f. Properly calibrated per-unit traffic fees can provide TELCOs with the appropriate investment incentives and resolve the underinvestment problem. These fees will affect access prices (will fall) and content prices (will increase) but their net effect on TELCO's investment will be positive. These traffic fees would be the result of bilateral negotiations occurring under the shadow of arbitration and not the outcome of a regulatory process, which is unlikely to be able to deliver the right fees due to informational asymmetries.

Structure of the Report

1.35 The remainder of this report is structured as follows:

a. In **Section 2**, we describe the relevant economic context.

b. In **Section 3**, we develop our economic analysis.

c. In **Section 4**, we conclude.

d. **Appendix A** contains our bios.

e. **Appendix B** provides a brief literature review.

Disclaimer

1.36 This report has been prepared at the request of Telefonica. However, the opinions in this report are the exclusive responsibility of its authors and need not represent the views of other Compass Lexecon's experts and affiliates or its clients, including Telefonica.

2 Where are We Now?

2.1 In this Section, we provide evidence that (a) data traffic is growing fast, driven primarily by video content; (b) meeting that growth requires significant investments in network capacity by TELCOs; and (c) traffic is not driven exclusively by TELCOs' end users, since LTOs can reduce the need for investment in access infrastructure by e.g. using more efficient compression codecs, investing in their own infrastructure and/or limiting the provision of video content not requested by consumers (e.g. video advertisements).

Data Traffic Growth

2.2 Global data traffic over the Internet continues to grow rapidly, with a 23% increase in total between 2021 and 2022. This varies by operator, with increases up to 50% on fixed broadband networks and up to 35% on mobile networks.[10]

2.3 The large increase in data traffic growth is primarily due to significant increases in the demand for video, which includes streaming and downloading video and TV services. In the first half of 2022, video accounted for 66% of total volume over the Internet,[11] compared to 54% in the first half of 2021[12] (which represents an over 20%-increase). Netflix, a key provider of video services, experienced 45% growth in internet volume during the first half of 2022. Further, app complexity is increasing with many apps now offering some form of video service (video call, video conferencing, etc.). Together with Netflix, large content providers, such as Google, Facebook, Microsoft, Apple and Amazon, accounted for almost half of all internet traffic in 2022.[13]

2.4 These trends are equally pronounced on fixed and mobile networks, video being as important on mobile as on fixed networks, accounting for 68% of traffic, followed by social networking (12%) and messaging (6%). In fact, mobile network data traffic doubled in just two years (from 60 EB per month in Q4 2020 to close to 120 EB per month in Q4 2022),[14] and is expected to reach 450 EB a month by the end of 2028 provided that the necessary infrastructure is put in place.[15]

Investment Requirements

2.5 Meeting the demand for data while maintaining quality of service requires large investments by network operators to expand network capacity. In 2021 total telecom capital expenditure in Europe reached 56.3 billion euros.[16]

2.6 Furthermore, authorities have set ambitious targets for European consumers and businesses to gain access to the enhanced quality of service and functionality provided by the new fixed and

10 Sandvine, The Global Internet Phenomena Report, 2023.
11 Ibid.
12 Sandvine, The Global Internet Phenomena Report, 2022.
13 Sandvine, The Global Internet Phenomena Report, 2023.
14 Ericsson Mobility Report, Q4 2022 Update, 2023.
15 Ericsson Mobility Report, 2022.
16 ETNO, State of Digital Communications, 2023.

mobile infrastructures, including the European Commission's targets for 5G to cover all urban areas and transport paths by 2025 and all populated areas by 2030.[17]

2.7 Investment to increase capacity and performance so that the full 5G potential is realised and to extend 5G coverage is estimated to require 2.4 times more capex over 2020 to 2027 than 2018 capex levels.[18] Achieving the European Commission's full 5G coverage target by 2030 is estimated to require an additional €150 billion of investment.[19]

2.8 Further, as hardware using Ultra High Definition ('**UHD**') becomes available, streaming platforms have started to offer "picture quality option" streaming. The bit rates associated with UHD are double the High Definition ('**HD**') rates and nine times larger than for Standard Definition ('**SD**') rates. HD requires approximately 3GB/hour speed, whereas the UHD requirement is about 7GB/hour.[20] Netflix's recommendation for internet download speeds shows even higher differences: 3 Mbps for HD, 5 Mbps for FHD (full high definition) and 15 Mbps for UHD.[21] Industry analysts expect the increase in popularity of UHD streaming to result in a "tremendous growth in demand and traffic".[22]

2.9 A report by Frontier Economics, on behalf of several network operators, estimated the costs attributable to current Over-the-Top ('**OTT**') traffic.[23] This report estimates both (i) total costs, including some costs which network operators incur to deliver traffic, but which do not vary with traffic; and (ii) incremental costs, which vary with traffic.[24] Annualised costs across Europe are estimated to be €28-30 billion on mobile and €8-10 billion on fixed networks. The incremental costs are estimated to be €13-22 billion on mobile and €2-6 billion on fixed networks.

2.10 While Google, Facebook, Amazon and Microsoft have all invested to a greater or lesser extent in submarine cables worldwide,[25] these subsea cables are only used for improving inter-region and inter-country connections, so that the need to invest in expanding networks within regions and within countries, as well as enhancing the capacity of these networks, remains with TELCOs.

LTOs' Contributions

2.11 LTOs argue that data traffic growth is driven by TELCOs' customers and maintain that the investments needed to address that growth should be undertaken and fully funded by TELCOs. However, it is clear that LTOs themselves can reduce the capacity expansion required to meet the increase in the demand for access by increasing their data efficiency.

2.12 For instance, LTOs have been developing and/or using CDNs, which provide for traffic to be handed over closer to TELCOs' access networks, and thus help reduce the demands on core network capacity. Smaller content providers can use independent CDNs (e.g. Akamai or Lumen), while

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17 European Commission, 5G Action Plan, 2016, and 2030 Digital Compass: the European way for the Digital Decade, 2021.

18 GSMA, Realising 5G's full potential: Setting policies for success, 2020.

19 Frontier Economics, Shaping Policies to Support Investment in Very High-Capacity Networks, 2022.

20 Sandvine, The Global Internet Phenomena Report, 2023.

21 See https://help.netflix.com/en/node/306, accessed on 6 April 2023.

22 Sandvine, The Global Internet Phenomena Report, 2023.

23 Frontier Economics, Estimating OTT Traffic- Related Costs on European Telecommunications Networks, 2022.

24 For fixed networks, total costs exclude subscriber sensitive network costs such as cost of access equipment up to the first switching layer. For both fixed and mobile networks, the incremental part of total costs is calculated based on high-level assumptions, without specifying which cost elements are considered to be incremental.

25 See, for example, https://broadbandnow.com/report/google-content-providers-submarine-cable-ownership/.

others have developed their own (e.g. Netflix, Facebook). However, even with the use of CDNs, operators need to carry traffic to end-users over the access part of their networks, which requires expensive investments.

2.13 Better encoding reduces the congestion of TELCOs' networks, as transmitting the same quality content requires less data. According to Netflix, it is possible to create more efficient video streams by: (i) encoding multiple versions of the same video file which then adapts automatically to the capability of the device and the available bandwidth, and/or (ii) improving video compression so that the same quality of visual image to be delivered with less bandwidth.[26] The latter, however, requires the devices used by end users to be compatible with these more efficient compression codecs.

2.14 Netflix estimates that its investment in the CDNs and codec improvements resulted in savings of $1-1.25 billion for Internet service providers globally in 2021,[27] which clearly demonstrates that the level of traffic passing through TELCOs' networks is impacted by LTOs' investment decisions.

2.15 Based on the above facts, we conclude that:

a. Data traffic is growing fast, driven primarily by increased demand for video content;

b. Meeting that growth requires significant investments in network capacity by TELCOs; and

c. Traffic is not driven exclusively by TELCOs' end users. LTOs can reduce the need for investment in access infrastructure by e.g. investing in CDNs, limiting the provision of video content not requested by consumers (e.g. video advertisements) and/or using more efficient compression codecs.

d. While some LTOs already contribute to manage traffic by investing in subsea cables, datacenters, and CDNs, the need for TELCOs' investment in expanding networks and increasing network capacity remains significant.

26 Netflix, A cooperative approach to content delivery, 2021.

27 Analysis Mason, Netflix's Open Connect program and codec optimisation helped ISPs save over USD1 billion globally in 2021, 2022.

3 The Logic of the Fair Share Proposal

3.1 In this Section, we explain the logic of the fair share proposal and find it to be properly grounded in economics.

The Interaction Between LTOs and TELCOs

3.2 Our economic analysis rests on various key assumptions, which we consider realistic and explain in what follows.

3.3 *First*, TELCOs and LTOs sell "complementary" products: access and content, respectively; so that the demand for access is declining in the price of content and the demand for content is declining in the access price. Access and content are not perfect complements, however. In particular, access and content are not consumed in "fixed proportions": consumers demand access for reasons other than consuming LTO's content, and they may demand and consume more or less content without adjusting their demand for access.

3.4 *Second,* both the demand for access and, especially, the demand for content are increasing in the quality with which that content is accessed *via* a network. Access quality is bound to have a very significant impact on the demand for content, since consumers' utility from content consumption crucially depends on the quality with which it is rendered.

3.5 *Third,* access quality in turn depends on the network investments made by TELCOs, primarily, and LTOs, to a lesser extent. The greater the investments made by TELCOs and LTOs, the greater access quality and hence the demand for access and content.

3.6 *Fourth***,** access quality also depends on the data-efficiency of the LTOs whose content is distributed through TELCOs' networks. The more efficient are the LTOs the lower the capacity needed to deliver the same amount of traffic and, therefore, the less significant the network investments needed to maintain quality. Likewise, the greater the capacity of the network resulting from network investments, the less efficient LTOs need to be to deliver the same quality. As a result, investments in data-efficiency by LTOs reduce the need for network investment and *vice versa*.

Impact of TELCOs' and LTOs' Investment on Consumer and Total Welfare

3.7 Total surplus, TS, is defined as the sum of the consumers' surplus, CS, and joint industry profits Π.

$$TS = CS + \Pi.$$

3.8 Both consumer welfare and industry profits depend on the network investments of TELCOs (NA) and LTOs (NC).

3.9 The change in total surplus resulting from an increase in TELCOs' investment, ΔTS_{NA}, will be equal to the sum of the change in consumer surplus, ΔCS_{NA}, the change in the TELCOs' profits from the

sale of access (A), $\Delta\Pi^A_{NA}$,[28] and the change in LTOs' profits from the sale of content (C), $\Delta\Pi^C_{NA}$.[29] That is,

$$\Delta TS_{NA} = \Delta CS_{NA} + \Delta\Pi^A_{NA} + \Delta\Pi^C_{NA}.$$[30]

3.10 Likewise, the change in total surplus resulting from an increase in LTOs' investment, ΔTS_{NC}, will be equal to

$$\Delta TS_{NC} = \Delta CS_{NC} + \Delta\Pi^A_{NC} + \Delta\Pi^C_{NC}.$$

where, ΔCS_{NC}, denotes the change in consumer surplus, $\Delta\Pi^A_{NC}$, the change in the TELCOs' profits from the sale of access (A), and $\Delta\Pi^C_{NC}$ the change in LTOs' profits from the sale of content (C).

3.11 TELCOs and LTOs will invest provided they obtain a positive return on investment, i.e. the change in their profits (net of investment costs) are non-negative:

$$\Delta\Pi^A_{NA} \geq 0, \Delta\Pi^C_{NC} \geq 0.$$

3.12 It follows then that a *sufficient condition* for TELCOs' investment to be socially desirable is that the change in consumers' surplus plus the change in LTOs' profits has to be positive, i.e. if the net investment effect (NIE_{NA}), which equals

$$NIE_{NA} = \Delta TS_{NA} - \Delta\Pi^A_{NA} = \Delta CS_{NA} + \Delta\Pi^C_{NA}$$

is positive. Since investment will occur when $\Delta\Pi^A_{NA}$ is non-negative, a positive NIE_{NA} implies a positive change in total economic surplus.

3.13 Likewise, a *sufficient condition* for LTOs' investment to be socially desirable is that the change in costumers' surplus plus the change in LTOs' profits has to be positive, i.e. if the net investment effect (NIE_{NC}), which equals

$$NIE_{NC} = \Delta TS_{NC} - \Delta\Pi^C_{NC} = \Delta CS_{NC} + \Delta\Pi^A_{NC}$$

is positive. Since investment will occur when $\Delta\Pi^C_{NC}$ is non-negative, a positive NIE_{NC} implies a positive change in total economic surplus.

Investment Externalities

3.14 It is easy to see that NIE_{NA} and NIE_{NC} are both positive.

a. The change in consumer, $\Delta CS_{NA}, \Delta CS_{NC}$, will be positive since, TELCOs' and LTOs' investment will increase access quality and will benefit customers, other things equal. Of course, not everything need to stay equal. As TELCOs' and LTOs' investments increase, their prices may adjust upwards. Nonetheless, consumers will be better off since quality-adjusted access and content prices will fall.

b. The change in TELCOs' profits (respectively, LTOs' profits) resulting from an increase in LTOs' network investment (respectively, TELCOs' network investment), $\Delta\Pi^A_{NC}$ (respectively, $\Delta\Pi^C_{NA}$) will

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28 Net of investment costs.

29 Id.

30 Formally, the operator Δ denotes a partial derivative so that, e.g., $\Delta\Pi^C_{NA} = \partial\Pi^C/\partial NA$.

be unambiguously positive, since it will boost the demand for access (respectively, content) and hence increase volumes and margins for TELCOs (respectively, LTOs).

3.15 The investments of TELCOs and LTOs thus generate positive externalities on (a) consumers, since they have a positive effect of consumer welfare ($\Delta CS_{NA} \geq 0, \Delta CS_{NC} \geq 0$), and (b) each other's profits ($\Delta \Pi^{A}_{NC} \geq 0, \Delta \Pi^{C}_{NA} \geq 0$).

3.16 The magnitude of the profit externalities is increasing in

a. The impact of the TELCOs' and LTOs' investments on access quality;

b. The impact of access quality on access and content demand; and

c. TELCOs' and LTOs' profits of using the network.

3.17 The magnitude of the positive externality generated by TELCOs' investments on LTOs' profits will be larger the greater the impact of such investment on access quality, the greater the effect of an increase in access quality on the demand for LTOs' content, and the greater the profit impact of an increase in demand, i.e. the greater LTOs' profits are.

3.18 Formally,

$$\Delta \Pi^{C}_{NA} = Change\ in\ access\ quality\ (NA) \times Elasticity\ of\ Content\ Demand \times LTO\ profit\ margin$$

3.19 Similarly, the magnitude of the positive externality generated by LTOs' investments on TELCOs' profits will be larger the greater the impact of such investment on access quality, the greater the effect of an increase in access quality on the demand for TELCOs' access services, and the greater the profit impact of an increase in demand, i.e. the greater TELCOs' profits are.

3.20 Formally,

$$\Delta \Pi^{A}_{NC} = Change\ in\ access\ quality\ (NC) \times Elasticity\ of\ Access\ Demand \times TELCO\ profit\ margin$$

3.21 We believe TELCOs' externalities are likely to be more significant than LTOs' because:

a. Access quality is more responsive to TELCOs' investments than to the investments of the LTOs;

b. The demand for content is relatively more elastic to access quality than the demand for access; and, finally,

c. TELCOs' profits are relatively lower than LTOs' profits.

3.22 In relation to the impact of investments by TELCOs and LTOs on access quality, we understand that ways in which LTOs have invested in networks (as explained in Section 2) are likely to lead to a smaller impact on access quality than typical investments by TELCOs.

a. LTOs' investments may lead to improvements in access quality for their own content as well as for other LTOs' content, but the primary quality increase (for any content) comes from TELCOs investing in, for instance, FTTH or 5G infrastructure, and from upgrading the core network to serve access points.

b. The capacity of the access part of the network which is achieved by TELCOs' investments provide an upper limit on the level of quality at which LTOs' content can be delivered to end users. This is particularly relevant for dynamic content, such as live sport streaming, where the number of simultaneous users is high.

c. Encoding multiple versions of the same video file optimises the quality to the capability of the device and the available bandwidth but does not, as such, improve access quality. Using more efficient compression codecs that require the use of compatible devices by definition only affects end users who have purchased and are using these more modern devices.

3.23 Regarding the elasticity of the demand for content to changes in access quality, Netflix itself states that access to high speed and reliable internet have enabled streaming services to become popular.[31] End users may choose not to demand a particular content if the access quality is such that it inhibits enjoyment, whereas demand for internet access is unlikely to respond in the same way.

3.24 Finally, as regards profitability, the available information indicates that LTOs earn a significantly higher margin than TELCOs. For instance, publicly available data shows that as of 31 December 2022, Alphabet's (Google's) operating profit margin was 26.5%, Meta's (Facebook's) 22.7% and Netflix's 13.2%, compared to Deutsche Telekom's 7.9% and Telefonica's 5.3%.[32]

Private vs. Social Incentives to Invest

3.25 LTOs' incentives to invest are given by the impact such investments have on their own profits: $\Delta\Pi^{C}_{NC}$. Likewise, TELCOs' incentives are driven by the effect of such investments on their own profits: $\Delta\Pi^{A}_{NA}$. Because of this, we can conclude that market outcomes will feature underinvestment, both from a total welfare and a consumer welfare point of view.

3.26 Comparing the private and social incentives to invest we have that the social incentives to invest (characterised by ΔTS_{NC} and ΔTS_{NA}) exceed the private incentives (characterised by $\Delta\Pi^{C}_{NC}$ and $\Delta\Pi^{A}_{NA}$) since

$$\Delta TS_{NC} - \Delta\Pi^{C}_{NC} = \Delta CS_{NC} + \Delta\Pi^{A}_{NC} = NIE_{NC} \geq 0,$$

and

$$\Delta TS_{NA} - \Delta\Pi^{A}_{NA} = \Delta CS_{NA} + \Delta\Pi^{C}_{NA} = NIE_{NA} \geq 0.$$

3.27 TELCOs and LTOs will not take into account the positive externality their investments generate on consumers, $\Delta CS_{NA} \geq 0, \Delta CS_{NC} \geq 0$, because their return is determined by the investments they can monetise. To the extent that they cannot perfectly price discriminate among consumers, they will not be able to fully appropriate the value (driven by consumers' willingness to pay for access and content) that their investments generate on consumers. This well-known "appropriability" problem results in underinvestment both from a consumer welfare and a total welfare perspective.

Private vs. Industry Incentives to Invest

3.28 TELCOs and LTOs will also underinvest from the viewpoint of the maximisation of joint industry profits. LTOs' investments, whether in infrastructure or in traffic-reducing practices, generate a positive externality on TELCOs which, absent payments from TELCOs, will not be internalised. Likewise, TELCOs' network investments generate a positive externality on LTOs, which absent payments from LTOs will not be internalised either.

3.29 The impact of LTOs' investment on joint industry profits equals

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31 Netflix, A cooperative approach to content delivery, 2021.

32 Source: macrotrends.net, accessed on 20 March 2023.

$$\Delta\Pi_{NC}^{A} + \Delta\Pi_{NC}^{C},$$

which exceeds LTOs' private incentives to invest, $\Delta\Pi_{NC}^{C}$, because of the externality generated on TELCOs, $\Delta\Pi_{NC}^{A} \geq 0$.

3.30 Similarly, The impact of TELCOs' investment on joint industry profits equals

$$\Delta\Pi_{NA}^{A} + \Delta\Pi_{NA}^{C},$$

which exceeds TELCOs' private incentives to invest, $\Delta\Pi_{NA}^{A}$, because of the externality generated on LTOs, $\Delta\Pi_{NA}^{C} \geq 0$.

3.31 LTOs and TELCOs fail to take into account that their investments not only increase the demand for their own products (content and access, respectively) but also the demand for the demand for their complements (access and content, respectively). As a result, they fail to maximise industry profits and ultimately harm consumers as access quality is too low.

3.32 LTOs' and TELCOs' investment decisions are taken independently and non-cooperatively and, to a large extent, without full information about each other's investment plans. Because of this, TELCOs and LTOs face a "prisoner's dilemma": they would be better off if they could coordinate their investment decisions, but acting independently they are unable to invest optimally, as each of them has an incentive to reduce its investment, even more so when the other invests.

3.33 In a sense, LTOs and TELCOs "free ride" on each other.

a. LTOs' profit maximising investment decisions impose excessive demands on TELCOs' network capacity, creating congestion and requiring costly network upgrades, even when there might be relatively low-cost ways for the LTOs to limit their traffic and they could contribute to the required network capacity with their own investments.

b. TELCOs' investment, while privately profitable, is insufficient from the viewpoint of the LTOs, which are then required to invest and make technical adjustments in order to avoid a degradation of access quality and, hence, a reduction of demand and profits.

3.34 The severity of the underinvestment problem is directly proportional to the magnitude of the externality that originates it. The greater the externalities are the more significant the gap between the investments made non-cooperatively by TELCOs and LTOs and their respective joint profit maximising levels.

3.35 Because we expect the externalities generated by TELCOs on LTOs to exceed in magnitude those flowing in the opposite direction, we also expect TELCOs' underinvestment problem to be the most significant in actuality.

Aligning LTOs' and TELCOs' Incentives

3.36 Maximising joint industry profits requires aligning LTOs' and TELCOs' incentives so that each of them internalise the positive externalities described above. This could be done by subsidising investment (a carrot) and/or taxing the lack of investment (a stick). Alternatively, optimum investment levels could be mandated with penalties in case of non-compliance (another stick).

3.37 Thus, for example, TELCOs' incentives to invest can be increased either using a stick (penalties triggered by low access quality), a carrot (contributions from LTOs), or both. Likewise, LTOs' incentives to invest can be increased with a stick (taxing them in case they fail to contribute to manage access quality), a carrot (contributions from TELCOs), or both.

3.38 To the best of our understanding, TELCOs already face two sticks. First, their licenses impose obligations regarding access quality. Second, competition among TELCOs provides discipline, as end consumers are likely to, and commonly do, switch away from poor quality networks. The strength of this second stick may be limited, however. This is because competition among TELCOs may lead to additional investment but only when the opportunity cost of peak hour congestion (i.e. low access quality) in terms of risks of subscriber switching to rivals exceeds the cost of the additional investment. But such an opportunity cost may be reduced since all TELCOs are likely to underinvest relative to the level that maximises industry profits.

3.39 On the contrary, LTOs face no or limited sticks, since (a) they are not subject to regulatory obligations; and (b) competition among LTOs is unlikely to discipline their investment decisions since:

a. While the demand for content falls with a generalised deterioration of access quality, content tends to be highly differentiated and highly valued and, as a result, LTOs may not lose much business to other LTOs even when their access quality of their content is relatively low; and

b. The impact of their investment decisions will impact their competitors' access quality and not only their own access quality. This is because by reducing the capacity it uses, the LTO increases the capacity available to its rivals. This intra LTO externality adds to the externality on TELCOs and aggravates the LTO underinvestment problem.

3.40 Of course, TELCOs' incentives would also be increased if LTOs were to pay a charge to fund the costs of the TELCOs' network investments, since that would increase their return on their investment. LTOs' contributions would add to the incentives provided by the sticks TELCOs face. Likewise, LTOs' incentives would be improved if TELCOs were to pay a charge to fund the costs of LTOs' network investments. The resulting improvements in capacity would provide a better quality of service during and outside peak hours and benefit both LTOs and TELCOs.

3.41 Aligning TELCOs' investment incentives with those of the industry would require to increase their marginal return on investment by $\Delta\Pi_{NA}^{C} \geq 0$. Likewise, to align LTOs' investment incentives with the industry their marginal return to investment should be increased by $\Delta\Pi_{NC}^{A} \geq 0$.

3.42 That is, in principle maximising joint industry profits may require reciprocal payments between TELCOs and LTOs. Yet, there are various reasons why, in practice, we expect TELCOs' to receive a net positive transfer. As explained above,

a. The underinvestment problem is relatively more severe when access quality is significantly increased by network investment; the demand for access and content is relatively elastic to access quality; and, finally, when profit margins are large.

b. TELCOs' underinvestment problem is likely to be more severe than LTOs' underinvestment because access quality is likely to be more responsive to TELCOs' network investments than the investments of LTOs; the demand for content is likely to be more elastic to access quality than the demand for access; and, finally, TELCOs' profit margins are lower than LTOs' profit margins.

c. Moreover, to the extent that TELCOs' net margins are relatively low, we would expect the profit externality generated by LTOs' investments, $\Delta\Pi_{NC}^{A}$, to be relatively small.

3.43 LTOs facing charges relating to the additional network investment costs caused by their activities will likely have the incentive to reduce such costs, making heavier use of CDNs, adopting more efficient compression technologies, not pushing video content that end users did not request (such as video adverts) or releasing popular content at off-peak hours. They may also change their end-

user prices or other aspects of their offers, e.g., encouraging customers to download content (or automatically downloading next episodes in series) during off-peak hours for later viewing.

3.44 The magnitude of TELCOs' profit externality, and hence the need to provide TELCOs with the appropriate incentives, increases with LTOs' profits from using their networks, which implies that it is indeed the larger LTOs who should contribute to fund TELCOs' network investment rather than smaller ones.

Incentivising TELCO's investments

3.45 Let us assume for simplicity that the market is populated by a TELCO and a LTO and denote by Π_A the profits of the TELCO (who sells access) and by Π_C the profits of the LTO (who sells content). Furthermore, suppose that the demand for access, $D_A(p_A, p_C;\ I_A)$, and content, $D_C(p_A, p_C;\ I_A)$ are a function of p_A, the price of access, p_C, the price of content, and I_A, the TELCO's network capacity.

3.46 The demands for access and content are both decreasing in the price of access and the price of content and increasing in I_A, because an increase in I_A increases access quality and, therefore, results in a higher willingness to pay for access and content. That is, an increase in capacity I_A results in an increase in demand for access equal $\Delta D_{IA}(p_A, p_C; I_A) \geq 0$, an increase in the TELCO's revenues equal to $(p_A - c_A)\Delta D_{IA}(p_A, p_C; I_A) \geq 0$, an increase in the demand for content $\Delta D_{IC}(p_A, p_C; I_A) \geq 0$, and an increase in LTO's profits equal to $(p_C - c_C)\Delta D_{IC}(p_A, p_C; I_A) \geq 0$. (For simplicity, and given the discussion above, we abstract from considering the possibility of investment by the LTO.)

3.47 Formally, then,

a. the TELCO's profits are

$$\Pi_A = (p_A - c_A)D_A(p_A, p_C; I_A) - N(I_A),^{33}$$

where c_A is the incremental cost of access and $N(I_A)$ denotes the costs of investing in network capacity I_A;[34] and

b. the LTO's profits are

$$\Pi_C = (p_C - c_C)D_C(p_A, p_C; I_A),$$

where c_C is the incremental cost of content.

Network Capacity in the Absence of Payments

3.48 In the absence of payments from the LTO to the TELCO,

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33 This formulation accommodates access prices per unit of traffic as well as access prices that are invariant to traffic (i.e. flat tariffs). In the former case $D_C(p_A, p_C; I_A)$ measures traffic whereas in the latter it represents the number of customers demanding access at given prices and network capacity.

34 $N(I_A)$ includes the opportunity cost of the funds needed to invest in network capacity I_A. That is, it is a measure of the long-run incremental costs of that capacity, which incorporates a reasonable return on investment (related to the TELCO cost of capital). $N(I_A)$ is increasing in network capacity. For analytical convenience, we assume that $N(I_A)$ is convex so that $\Delta N(I_A)$ is increasing in I_A and the TELCO's profit function is concave in capacity and thus has a maximum.

a. the TELCO will then choose a price p_A so that,[35]

$$(p_A - c_A) = -D_A(p_A, p_C; I_A)/\Delta D_{PA}(p_A, p_C; I_A),$$

where $\Delta D_{PA}(p_A, p_C; I_A) \leq 0$ denotes the change in demand for access when p_A changes.

b. The LTO price p_C will be such that

$$(p_C - c_C) = -D_C(p_A, p_C; I_A)/\Delta D_{PC}(p_A, p_C; I_A),$$

where $\Delta D_{PC}(p_A, p_C; I_A) \leq 0$ denotes the change in demand for content when p_C changes.

3.49 The TELCO will set a capacity level I_A so that the additional revenue it makes equals the increased costs of capacity; i.e.

$$(p_A - c_A)\Delta D_{IA}(p_A, p_C; I_A) = \Delta N(I_A),$$

3.50 This level of capacity is below the level of capacity that maximises industry profits at given prices p_A and p_C, I_A^*, which equals

$$(p_A - c_A)\Delta D_{IA}(p_A, p_C; I_A^*) + (p_C - c_C)\Delta D_{IC}(p_A, p_C; I_A^*) = \Delta N(I_A^*),$$

since $(p_C - c_C)\Delta D_{IC}(p_A, p_C; I_A^*) \geq 0$ and $\Delta N(I_A)$ is increasing in I_A.

Network Capacity with Payments

3.51 Let $F(I_A)$ be a payment made by the LTO to the TELCO conditional on the level of capacity I_A, which increases with the level of capacity, i.e. $\Delta F(I_A) > 0$.

3.52 Then, the profits of the TELCO and the LTO become

$$\widehat{\Pi}_A = (p_A - c_A)D_A(p_A, p_C; I_A) + F(I_A) - N(I_A), \text{ and}$$

$$\widehat{\Pi}_C = (p_C - c_C)D_C(p_A, p_C; I_A) - F(I_A),$$

respectively.

3.53 The prices for access and content, $\hat{p}_A$ and $\hat{p}_C$, will be given by

$$(\hat{p}_A - c_A) = -D_A(\hat{p}_A, \hat{p}_C; I_A)/\Delta D_{PA}(\hat{p}_A, \hat{p}_C; I_A).$$

and

$$(\hat{p}_C - c_C) = -D_C(\hat{p}_A, \hat{p}_C; I_A)/\Delta D_{PC}(\hat{p}_A, \hat{p}_C; I_A),$$

respectively.

3.54 That is, for given I_A,

$$p_A = \hat{p}_A \text{ and } p_C = \hat{p}_C.$$

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35 Formally, we assume that (p_A, p_C, I_A) are chosen simultaneously and non-cooperatively. We do not solve for the Nash equilibria of the games in this paper. Our discussion focuses on the TELCO's and LTO's incentives on the basis of the first-order conditions that derive from their respective profit functions. We believe this is without loss of rigour. But in any event we refer the reader to the paper titled "Fair Share Payments for Network Investments" in which we undertake a full-fledge theoretic analysis of the problem discussed here.

3.55 The TELCO's new capacity level $\hat{I}_A$ will be given by.

$$(\hat{p}_A - c_A)\Delta D_{IA}(\hat{p}_A, \hat{p}_C; \hat{I}_A) = \left(\Delta N(\hat{I}_A) - \Delta F(\hat{I}_A)\right),$$

which given that $p_A = \hat{p}_A$ and $p_C = \hat{p}_C$, implies that

$$I_A < \hat{I}_A.$$

3.56 Paying the TELCO for capacity increases its return to investment because, while such a payment does not affect access and content prices and, therefore, has no impact on the demand for access, the payment increases with capacity.

3.57 The payment $F(I_A)$ could be fine-tuned so that it implements the industry optimal level of capacity, I_A^*. This can be done by fixing $F(I_A)$ such that $\Delta F(I_A) = \Delta\Pi_{NA}^C$. Under standard regularity conditions, the fundamental theorem of algebra then implies

$$F(I_A) = \int_0^{\hat{I}_A} \Delta\Pi_{NA}^C \, dI_A.$$

3.58 To see why, recall that the industry optimal level of capacity, I_A^*, is given by

$$\underbrace{(\hat{p}_A - c_A)\Delta D_{IA}(\hat{p}_A, \hat{p}_C; I_A^*)}_{\Delta\Pi_{NA}^A} + \underbrace{(\hat{p}_C - c_C)\Delta D_{IC}(\hat{p}_A, \hat{p}_C; I_A^*)}_{\Delta\Pi_{NA}^C} = \Delta N(I_A^*)$$

which is identical to the equation that determines $\hat{I}_A$, when $\Delta F(I_A) = \Delta\Pi_{NA}^C$, i.e.

$$\underbrace{(\hat{p}_A - c_A)\Delta D_{IA}(\hat{p}_A, \hat{p}_C; \hat{I}_A)}_{\Delta\Pi_{NA}^A} + \underbrace{\Delta F(\hat{I}_A)}_{\Delta\Pi_{NA}^C} = \Delta N(\hat{I}_A).$$

Larger LTOs Should Pay More

3.59 The magnitude of TELCOs' profit externality, $\Delta\Pi_{NA}^C$, at prices $\hat{p}_A, \hat{p}_C$ and with a level of capacity I_A is equal to

$$\Delta\Pi_{NA}^C = (\hat{p}_C - c_C)\Delta D_{IC}(\hat{p}_A, \hat{p}_C; I_A) = -D_C(\hat{p}_A, \hat{p}_C; I_A)\frac{\Delta D_{IC}(\hat{p}_A, \hat{p}_C; I_A)}{\Delta D_{PC}(\hat{p}_A, \hat{p}_C; I_A)}.$$

3.60 Suppose the impact of investment in capacity on the demand for content were *multiplicative*, so that $D_C(\hat{p}_A, \hat{p}_C; I_A) = I_A \times \overline{D}_C(\hat{p}_A, \hat{p}_C)$, then

$$\Delta\Pi_{NA}^C = -\frac{\overline{D}_C(\hat{p}_A, \hat{p}_C)^2}{\Delta\overline{D}_{PC}(\hat{p}_A, \hat{p}_C)} \geq 0,$$

so that,

$$F(I_A) = -\frac{\overline{D}_C(\hat{p}_A, \hat{p}_C)^2}{\Delta\overline{D}_{PC}(\hat{p}_A, \hat{p}_C)} I_A \geq 0,$$

and increasing in I_A, where $\overline{D}_C(\hat{p}_A, \hat{p}_C)$ is a measure of the traffic generated by the content provider and, therefore, is greater for larger LTOs and, $\Delta\overline{D}_{PC}(\hat{p}_A + \hat{p}_C)$ denotes the change in demand when p_C changes and is likely to be smaller for highly-valued content, i.e. the content typically offered by larger LTOs. It follows that LTOs should contribute to fund an increase in capacity more than the smaller TOs ought to do so.

3.61 More generally, larger LTOs will pay more because $D_C(\hat{p}_A, \hat{p}_C; I_A)$ will be greater and $\Delta D_{PC}(\hat{p}_A, \hat{p}_C; I_A)$ will be smaller for them, and $\Delta D_{IC}(\hat{p}_A, \hat{p}_C; I_A)$ is either independent of the size of the LTO (as in the additive case) or increasing in it (as in the multiplicative case).

3.62 The same conclusion applies if the impact of capacity on the demand for content were *additive*, so that $D_C(\hat{p}_A, \hat{p}_C; I_A) = \theta I_A + \overline{D}_C(\hat{p}_A, \hat{p}_C)$, with $0 < \theta < 1$, since then

$$\Delta \Pi_{NA}^{C} = -\frac{1}{\Delta \overline{D}_{PC}(\hat{p}_A, \hat{p}_C)} \left(\theta I_A + \overline{D}_C(\hat{p}_A, \hat{p}_C)\right) \geq 0,$$

and, under a linear approximation,

$$F(I_A) = -\frac{I_A}{\Delta \overline{D}_{PC}(\hat{p}_A, \hat{p}_C)} \left(\frac{\theta I_A}{2} + \overline{D}_C(\hat{p}_A, \hat{p}_C)\right) \geq 0,$$

and increasing in I_A, which is also greater when $\overline{D}_C(\hat{p}_A, \hat{p}_C)$ is large and $\Delta \overline{D}_{PC}(\hat{p}_A, \hat{p}_C)$ is small.

Consumer Welfare Implications

3.63 The payment, $F(I_A)$, will increase consumer welfare. On the one hand, consumers will naturally benefit from the improved access quality resulting from increased network capacity by TELCOs. On the other hand, since the payments made by LTOs are lump sum payments, the payment will not result in higher prices for content and, therefore, necessarily will lead to lower quality-adjusted content prices. Prices for access will also remain unaffected in absolute terms but will fall in quality-adjusted terms.

3.64 One could worry about the potentially adverse impact of these payments on LTOs' ability and incentive to invest. We do not believe this to be a real problem. As regards ability, it is well-known that financially constrained firms may be unable to raise capital from third-party investors and so they must rely on their cash-flows to fund costly investments. If those cash-flows are significantly reduced by the payments calculated above, this may reduce the investments made by LTOs, reduce the amount and/or quality of their content, and make consumers worse off. Yet, this concern is mute if the payments are targeted to LTOs, with abundant cash and, more importantly, unfettered access to capital markets.

3.65 As regards incentive, the concern has no justification. The payments calculated above are meant to incentivise TELCOs to undertake investments that are beneficial to LTOs and their customers. They are derived so that the positive externality created by TELCOs' investments on LTOs' profits is internalised by the former. As such, therefore, these payments will increase the demand for content and, therefore, will also increase the incentives of LTOs to invest in developing more and better content.

3.66 Consider a variant of the model with payments above where both TELCO and LTO invest in network capacity, I_A and I_C, respectively, and the demand for content is increasing on the total amount of capacity $I_A + I_C$. Suppose, in addition, that while the demand for content grows with total capacity, the rate at which it grows decreases when capacity is greater. This implies that as I_C increases, the positive externality generated by investing in I_A falls (and *vice versa*). Under these reasonable assumptions, therefore, we expect that the LTO may have an incentive to increase its capacity I_C to save a proportion of the payment $F(I_A)$ provided that the incremental cost of such capacity is less than the amount it saves in payments to the TELCO.

Inefficient Bargaining and the Need for Intervention

3.67 The TELCO and the LTO may attempt to resolve the underinvestment problem to which they are exposed by means of a bilateral agreement. To the extent that their joint profits are maximised at the industry optimal level of capacity, one may expect that the LTO would agree on a payment $F(I_A)$ and resolve the problem. This is what the famous "Coase theorem" would suggest.

3.68 However, to the best of our understanding, that has not happened and, as for the reasons stated below, it is unlikely to happen.

Asymmetric Information Hurdles

3.69 There are two ways of calculating the payment $F(I_A^*)$. The first option is to calculate

$$F(I_A^*) = \int_0^{I_A^*} (\hat{p}_C - c_C)\Delta D_{IC}(\hat{p}_A, \hat{p}_C; I_A)\, dI_A$$

3.70 The other is to calculate it as:

$$F(I_A^*) = \underbrace{N(I_A^*)}_{Cost\ of\ Investment} - \underbrace{(\hat{p}_A - c_A)}_{Profit\ Margin} \times \underbrace{\big(D_A(\hat{p}_A, \hat{p}_C; I_A^*) - D_A(\hat{p}_A, \hat{p}_C; 0)\big)}_{Demand\ Response}.$$

3.71 None of these approaches is simple since they depend on factors that need be common knowledge. First, LTO and TELCO may disagree about the optimal capacity level I_A^* if they have asymmetric information about its determinates. The TELCO may not have accurate information on $\Delta\Pi_{NA}^C$ – the externality it generates on the LTO's profits – and the LTO may not have reliable information on $\Delta\Pi_{NA}^C$ – the impact of additional capacity on TELCO's profits.

3.72 Second, even if they agreed on I_A^*, the first approach requires modelling how content prices and the elasticity of the demand for content to changes in network capacity evolves with network capacity, which seems very complex. The second approach is also complex. In particular, the cost of capacity I_A^*, $N(I_A^*)$ is likely to be asymmetric information. The LTO may not have a complete understanding of the technology of the TELCO. In short, the negotiation between LTO and TELCO for the determination of the joint profit maximising payment will take place under asymmetric information.

3.73 The LTO may thus fear that it may pay more than needed to incentivise investment if it overestimates the cost of capacity. Suppose, for example, that the cost of capacity is high, $N_H(I_A)$, but the LTO believes it is low, $N_L(I_A)$, with probability σ, $0 < \sigma < 1$.

3.74 Then, the LTO will offer to pay $F_\sigma(I_A^*) < F(I_A^*)$ in exchange for a level of capacity I_A^*, where

$$F_\sigma(I_A^*) = N_\sigma(I_A^*) - (\hat{p}_A - c_A)\big(D_A(\hat{p}_A, \hat{p}_C; I_A^*) - D_A(\hat{p}_A, \hat{p}_C; 0)\big),$$

where $N_\sigma(I_A^*) = \sigma N_L(I_A^*) + (1-\sigma)N_H(I_A^*) < N_H(I_A^*)$.

3.75 That is, the LTO will only offer a limited payment and the TELCO will underinvest.

Free-Riding by LTOs

3.76 LTOs may also be reluctant to contribute to fund TELCOs' investments in network capacity because their contributions likely will benefit their competitors as well since, under network neutrality, TELCOs cannot discriminate in favour of those contributing to the development of the networks. Each LTO would want other LTOs to contribute but would prefer to avoid doing so itself. This free-riding problem will not be easy to resolve unless all LTOs (and possibly all smaller TOs) are compelled to contribute to the funding of TELCOs' investments in network capacity.

Imbalances in Bargaining Power

3.77 The bilateral negotiation is more likely to fail when the LTO's bargaining power is relatively large. Thus, for example, if the LTO has all bargaining power, then it will offer $F_\sigma(I_A^*)$ in exchange for a level of capacity I_A^*, which will be rejected by the TELCO if the cost of capacity is high and the probability of the LTO believing this cost to be low σ is sufficiently high.

3.78 The risk of a bargaining impasse is large given the imbalance in the bargaining power of LTOs and TELCOs, which reflect their very different "outside options".

a. European Open Internet Access Regulation imposes obligations on operators and not content providers. In particular, it prevents European Internet Service Providers from restricting connectivity to any accessible endpoint of the internet and prevent TELCOs from discriminating in terms of quality of service between different types of content for commercial purposes.

b. LTOs' content offerings may be considered highly valuable, almost indispensable, by end-users and, therefore, by TELCOs. Thus, an individual TELCO may not be able to credibly threaten to not provide its end-users with access to a particular digital platform (if this was permitted by open internet regulation).

c. Conversely, LTOs are unlikely to view access to an individual TELCOs' end-users as indispensable, particularly as there are generally multiple routes to serve such customers. Thus, an LTO would in principle be able to discriminate across competing TELCOs.

The Need for Intervention

3.79 Given the difficulties described above, it is clear that some form of intervention will be needed to address the underinvestment problem we have identified.

3.80 One option is to regulate TELCOs' investments and the LTOs' contributions to fund them. This option may face difficulties, however, since the regulator would need detailed information on the parameters of the TELCOs' and LTOs' profit functions and would then need to monitor and enforce the regulated outcomes, which is also complex. Of course, the regulator could undertake audits to complete its information. Those audits are bound to be costly and may prove sterile, however, since the regulator would have to ascertain with a fair degree of precision the cost of capacity, the private return to investment for the TELCOs and/or the magnitude of the externality to LTOs (which requires assessing the profitability of TELCOs and LTOs as well as the responsiveness of their respective demands to increases in access quality).

3.81 Depending on the cost and effectiveness of such audits, a better alternative may be for the regulator to mandate both sides to negotiate a deal while instituting a mandatory arbitration system in case such negotiations stall. Unlike the untethered bilateral negotiations discussed above, which are unlikely to yield positive results, the parties would be required to negotiate "under the shadow of arbitration". Thus, they should rationally anticipate that, in the event of impasse, the arbitrators will compel them to produce the information needed for their award at their own expense and may subject that information to adversarial review.

3.82 There are reasons to believe that this alternative may also fail to deliver if TELCOs and LTOs negotiate investment deals, so that the former commit to a level of capacity in exchange for payments contingent on that investment. This sort of contracts may prove infeasible in practice, since network capacity may not be contractible. This may be either because the nature and magnitude of the required investments may be both uncertain and TELCOs' private information *ex ante* (i.e. when the contract is negotiated), and/or investment may be difficult to verify *ex post* (e.g. the extent and quality of TELCOs' actual investments may be hard to verify).

3.83 Against this background, LTOs likely will reject making lump-sum payments before the investments have made and will insist in agreements where payments are made once the investments are sunk. Arbitrators are likely to agree with LTOs on this front in order to address potential moral hazard issues on the TELCOs' side. Yet, this opens the door to opportunism by LTOs. LTOs may try to renegotiate a lower compensation once the investments are made than that negotiated (or arbitrated) *ex ante*. They may claim that the investments made are insufficient and/or that they are incapable of delivering the target level of access quality. Anticipating this, TELCOs will not internalise the positive externality they generate on LTOs and, hence, the industry will feature an inefficiently low level of network capacity. Of course, these *ex post* disputes could also be arbitrated but that would add further litigation costs and may also distort the sort of investments made from those with a greater impact on access quality to those which are more likely to be verified by the arbitrators.

3.84 An alternative is to mandate negotiations based on per-unit traffic fees. Unlike network investments, traffic is contractible, since it can be easily monitored and verified *ex post*.[36]

Traffic-Based Payments

3.85 An alternative option to incentivise the TELCO to increase its capacity, I_A, would be to require the LTO to pay a per-unit or traffic fee f. In this way, the LTO would pay *ex post* an amount equal to $f \times D_C(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)$, where $(\tilde{p}_A, \tilde{I}_A)$ maximise the TELCO's profits given $\tilde{p}_C$, and $\tilde{p}_C$ maximises the LTO's profits given $(\tilde{p}_A, \tilde{I}_A)$, so that the TELCO's and LTO's profits are

$$\tilde{\Pi}_A = (\tilde{p}_A - c_A)D_A(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) + fD_C(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) - N(\tilde{I}_A), \text{ and}$$

$$\tilde{\Pi}_C = (\tilde{p}_C - f - c_C)D_C(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A),$$

respectively.

3.86 Equilibrium prices $\tilde{p}_A$ and $\tilde{p}_C$ will be given by

$$(\tilde{p}_A - c_A) = -D_A(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)/\Delta D_{PA}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) - f\Delta D_{PAC}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)/\Delta D_{PA}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A),$$

and

$$(\tilde{p}_C - f - c_C) = -D_C(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)/\Delta D_{PC}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A),$$

where $\Delta D_{PAC}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) \leq 0$ measures the impact on the demand for content of an increase in the price of access.

3.87 Under standard regularity conditions, the adoption of a per-unit fee will reduce the price of access, i.e. $\tilde{p}_A < p_A$, and it will increase the price of content, so that $\tilde{p}_C > p_C$.

3.88 Importantly, since $\left|\Delta D_{PAC}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)\right| < \left|\Delta D_{PA}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)\right|$, i.e. since the demand for content is less responsive than the demand for access to changes in the access price,

$$\tilde{p}_A + f > p_A.$$

3.89 The TELCO's new capacity level $\tilde{I}_A$ will be given by

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[36] Yet another alternative would be to contract on access quality. We do not discuss this alternative in this paper; its viability would depend on whether quality is indeed verifiable *ex post*, which seems doubtful at best.

$$(\tilde{p}_A - c_A)\Delta D_{IA}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) + f\Delta D_{IC}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) = \Delta N(\tilde{I}_A).$$

3.90 Comparing $\tilde{I}_A$ and I_A (the level of capacity without payments) in general is not straightforward, because the adoption of a per-unit traffic fee affects equilibrium prices and hence margins and the level of supply.

3.91 However, given that $\tilde{p}_A + f > p_A$ and since the demand for content is more elastic to access quality and hence to capacity than the demand for access, i.e. $\Delta D_{IA}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A) < \Delta D_{IC}(\tilde{p}_A, \tilde{p}_C; \tilde{I}_A)$, we have that $\tilde{I}_A$ will be greater than I_A. Consider, for example, that both the demand for access and the demand for content were additive, so that $D_A(p_A, p_C; I_A) = \mu I_A + \overline{D}_A(p_A, p_C)$, with $0 < \mu < 1$ and $D_C(p_A, p_C; I_A) = \theta I_A + \overline{D}_C(p_A, p_C)$, with $0 < \theta < 1$.

3.92 Then, $\tilde{I}_A$ will be given by

$$(\tilde{p}_A - c_A)\mu + f\theta = \Delta N(\tilde{I}_A),$$

while I_A solves

$$(p_A - c_A)\mu = \Delta N(I_A).$$

3.93 It follows that $\tilde{I}_A$ is greater than I_A when

$$(\tilde{p}_A - c_A)\mu + f\theta > (p_A - c_A)\mu, \text{ or}$$

$$\tilde{p}_A + f\frac{\theta}{\mu} > p_A.$$

3.94 Given that $\tilde{p}_A + f > p_A$, we have that a sufficient (albeit not necessary) condition for $\tilde{I}_A$ to be greater than I_A is that $\theta > \mu$; i.e. that the demand for content responds to changes in the level of network capacity more than the demand for access, which we expect to be the case in practice.

3.95 In short, the per-unit fee f will affect access prices (will fall) and content prices (will increase) but its net effect on TELCO's investment will be positive.

3.96 The remaining question is to calibrate f so that it implements the joint profit maximising level of capacity I_A^*, which under the additivity assumption is given by

$$(p_A - c_A)\mu + (p_C - c_C)\theta = \Delta N(I_A^*).$$

3.97 The value of f that makes $\tilde{I}_A = I_A^*$ is

$$f^* = (p_C - c_C) - (p_A - \tilde{p}_A)\mu/\theta < (p_C - c_C),$$

Since $p_A > \tilde{p}_A$.

3.98 The industry optimal level of capacity can be implemented by means of per-unit transfer fee that allows the TELCO to share some of the unit profits made by the LTO. The optimal per-unit traffic fee, f^*, is greater when the LTO margin, $(p_C - c_C)$, is large and the sensitivity of the demand for content to incremental capacity, θ, is large relative to the corresponding sensitivity of the demand for access, μ.

3.99 This traffic fee could be the result of a bilateral negotiation between the TELCO and the LTO occurring under the shadow of arbitration. Because this bilateral negotiations is conditioned by the possibility of arbitration, we expect that they successfully reach agreement on the traffic fee optimal f^* without unnecessary delay. This process will obviate the need for explicit intervention in setting that fee, a process which may be more costly and less flexible.

3.100 The impact of the implementation of a fee f^* on consumer welfare is less clear than the impact of an investment-contingent payment (unconditional on traffic and/or the number of consumers). This is because, while the increase in network capacity and thus on access quality, is unambiguously beneficial for consumers, the effect of the fee on prices is not: consumers will benefit from the reduction in the access price but will be harmed by the increase in the price for content.

3.101 However, there are various reasons to believe that the net effect will be an increase in consumer welfare. Firstly, we expect the demand for LTOs' content to be no more price elastic than the demand for access. Secondly, while the price of content increases due to the traffic fees, quality adjusted content prices may fall due to the increase in quality. Lastly, consumers may weigh quality more than price.

Online Advertising LTOs

3.102 Hitherto, we have considered LTOs using a subscription based model, with a subscription fee equal to p_C and profits given by $\Pi_C = (p_C - c_C)D_C(p_A, p_C; I_A)$, where c_C is the incremental cost of content. We now investigate whether the results derived above are robust to a change in the LTO business model.

3.103 The online advertising LTO's profits are:

$$\Pi_C = (p_C - c_C)(D_C^{adv}(p_C, \beta) \times D_C^{tra}(p_A, \beta; I_A)).$$

3.104 The LTO sells online ads at a price p_C. The incremental cost of this business is c_C. The demand for its online ads is $D_C(p_A, p_C, \beta; I_A) = D_C^{adv}(p_C, \beta) \times D_C^{tra}(p_A, \beta; I_A)$, where (i) $D_C^{adv}(p_C)$ measures online ad sales per unit of traffic, which is decreasing in p_C and increasing in β the behavioural data extracted from its users by the LTO; (ii) and $D_C^{tra}(p_A, \beta; I_A)$ measures traffic, which is increasing in access quality, and hence on I_A; decreasing in the price of access p_A; and decreasing in β.

3.105 Importantly, the demand for online ads is affected by β in two ways. First, it may reduce traffic since users may prefer to use a different service due to privacy concerns. Second, online advertisers may be willing to pay more per online ad since the LTO can better target those ads using more behavioural information.

3.106 We expect the first effect to be very small and possibly zero because consumers may not be aware of how much behavioural data is collected by the LTO, they may not understand how to manage the amount of data they provide, and/or they may have no outside option to switch to because the LTO is the only (credible) provider of the relevant service. Instead, we expect the second effect to be material since online advertisers appear to be prepared to pay more for behaviourally targeted ads.[37]

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[37] See Rafieian, O and Yoganarasimhan, H. (2021), "Targeting and Privacy in Mobile Advertising", *Marketing Science,* Vol. 40(2), 193-394. They find that an efficient targeting policy improves the average click-through rate by 66.80%. These gains mainly stem from the use of behavioural information compared to contextual information. Theoretical and empirical counterfactuals show that while consumer and total surplus grows with more granular targeting. See also IHS Markit, *The Economic Value of Behavioural Targeting in Digital Advertising*, page 2 (prepared on behalf of IBA Europe and European Interactive Digital Advertising Alliance). Available at https://datadrivenadvertising.eu/wp-content/uploads/2017/09/BehaviouralTargeting_FINAL.pdf; and Guttman, A. (2021), *Marketing personalization - statistics & facts*, available at https://www.statista.com/topics/4481/personalized-marketing/.

3.107 Formally,

$$\Delta D_{\beta C}^{adv}(p_C, \beta) > 0, \text{ and } \Delta D_{\beta C}^{tra}(p_A, \beta; I_A) \cong 0$$

3.108 As with the subscription-based business model, the TELCO's investment decision creates a positive externality on the profits of the LTO equal:

$$(p_C - c_C)(D_C^{adv}(p_C, \beta) \times \Delta D_{IC}^{tra}(p_A, \beta; I_A)) \geq 0.$$

where $\Delta D_{IC}^{tra}(p_A, \beta; I_A)$ captures the increase in traffic caused by an increase in I_A.

3.109 Thus, the need for payments from the LTO to the TELCO to avoid underinvestment is not dependent on the nature of the business model. The magnitude of this externality and, therefore, the size of the payment needed to correct it are larger for large LTOs, as before.

3.110 Implementing the joint profit maximising investment in network capacity, I_A^*, requires the LTO to pay

$$F(I_A^*) = \int_0^{I_A^*} (p_C^* - c_C) D_C^{adv}(p_C^*, \beta) \Delta D_{IC}^{tra}(p_A^*, \beta^*; I_A)\, dI_A$$

where (p_A^*, p_C^*) solve

$$(p_A - c_A) = -D_A(p_A, \beta; I_A)/\Delta D_{PA}(p_A, \beta; I_A),$$

$$(p_C - c_C) = -D_C^{adv}(p_C, \beta)/\Delta D_{PC}^{adv}(p_C, \beta), \text{ respectively.}$$

and the LTO sets β^* at the maximum level since, the change in profits associated with an increase in β is

$$\begin{aligned}\Delta \Pi_C &= (p_C - c_C)\,[D_C^{adv}(p_C, \beta) \times \Delta D_{\beta C}^{tra}(p_A, \beta; I_A) + D_C^{tra}(p_A, \beta; I_A) \times \Delta D_{\beta C}^{adv}(p_C, \beta)] \\ &= (p_C - c_C)\,[D_C^{tra}(p_A, \beta; I_A) \times \Delta D_{\beta C}^{adv}(p_C, \beta)] > 0\end{aligned}$$

3.111 Consider, as above, that investment is incentive requiring the LTO to pay a per-unit or traffic fee f, which is then transferred to the TELCO. The TELCO's and LTO's profits are

$$\Pi_A = (p_A - c_A) D_A(p_A, \beta; I_A) + f D_C^{tra}(p_A, \beta; I_A) - N(I_A), \text{ and}$$

$$\Pi_C = (p_C - c_C)(D_C^{adv}(p_C, \beta) \times D_C^{tra}(p_A, \beta; I_A)) - f D_C^{tra}(p_A, \beta; I_A),$$

respectively.

3.112 Equilibrium prices $\tilde{p}_A$ and $\tilde{p}_C$ will be given by

$$(p_A - c_A) = -D_A(p_A, \beta; I_A)/\Delta D_{PA}(p_A, \beta; I_A) - f \Delta D_{PAC}^{tra}(p_A, \beta; I_A)/\Delta D_{PA}(p_A, \beta; I_A),$$

and

$$(p_C - c_C) = -D_C^{adv}(p_C, \beta)/\Delta D_{PC}^{adv}(p_C, \beta),$$

where $\Delta D_{PAC}^{tra}(p_A, \beta; I_A) \leq 0$ measures the impact on the demand for content of an increase in the price of access.

3.113 Under standard regularity conditions, the adoption of a per-unit fee will reduce the price of access, i.e. $\tilde{p}_A < p_A$. Yet, since $|\Delta D_{PAC}^{tra}(p_A, \beta; I_A)| < |\Delta D_{PA}(p_A, \beta; I_A)|$, i.e. since the demand for the LTO service is less responsive than the demand for access to changes in the access price,

$$\tilde{p}_A + f > p_A.$$

3.114 In contrast, the adoption of a per-unit fee will not change the price of the online ads, so that $\tilde{p}_C = p_C$, or the value of β. Indeed, the LTO will set $\tilde{\beta}$ at the maximum level independently of f since, the change in profits associated with an increase in β is

$$(p_C - c_C)\left[D_C^{tra}(p_A, \beta; I_A) \times \Delta D_{\beta C}^{adv}(p_C, \beta)\right] - f \times \Delta D_{\beta C}^{tra}(p_A, \beta; I_A) =$$

$$(p_C - c_C)\left[D_C^{tra}(p_A, \beta; I_A) \times \Delta D_{\beta C}^{adv}(p_C, \beta)\right] > 0$$

3.115 The TELCO's new capacity level $\tilde{I}_A$ will be given by

$$(\tilde{p}_A - c_A)\Delta D_{IA}(\tilde{p}_A, \tilde{\beta}; \tilde{I}_A) + f\Delta D_{IC}^{tra}(\tilde{p}_A, \tilde{\beta}; \tilde{I}_A) = \Delta N(\tilde{I}_A).$$

3.116 Given that $\tilde{p}_A + f > p_A$, a sufficient condition for $\tilde{I}_A$ to be greater than I_A is that end-user demand for the LTO service is more elastic to access quality and hence to capacity than the demand for access, i.e. $\Delta D_{IA}(\tilde{p}_A, \tilde{\beta}; \tilde{I}_A) < \Delta D_{IC}^{tra}(\tilde{p}_A, \tilde{\beta}; \tilde{I}_A)$. We expect this condition to hold in practice.

3.117 To sum up, the main conclusions of our analysis are not dependent on whether the LTO adopts a subscription-based or online advertising base business model.

4 Concluding Remarks

4.1 In this report we have considered whether the fair share proposal constitutes an appropriate market intervention.

4.2 First, we have identified the main market failure that the fair share proposal endeavours to correct: TELCOs' investments generate a positive externality on LTOs as well as on consumers, and without regulatory intervention, these externalities will not be internalised. That means that TELCOs underinvest in network capacity compared to the level that would be optimal considering joint profits and social welfare. This is the market failure that provides the justification for the proposal.

4.3 We have then assessed whether the fair share proposal is capable of correcting such a failure and concluded that it would lead to internalising externalities between TELCOs and LTOs, but not the externalities on consumers. In particular, TELCOs' network investment incentives would be increased if LTOs were to pay a charge to fund the costs of those investments. These payments will unambiguously increase consumer welfare.

4.4 We have also demonstrated that regulatory intervention may be needed to ensure that LTOs pay adequate contributions to TELCOs. While TELCOs and LTOs may attempt to resolve the underinvestment problem to which they are exposed by means of bilateral agreements, that has not happened and is unlikely to happen, due to asymmetric information problems, free riding, and the imbalance in the bargaining power of TELCOs and LTOs.

4.5 The option to regulate TELCOs' investments and the LTOs' contribution to funding them may be impracticable due to asymmetries of information between regulator and the regulated. An alternative would be for the regulator to mandate both sides to negotiate a deal and institute a mandatory arbitration system in case such negotiations stall. However, there are reasons to believe that this alternative may also fail to deliver because network investments may not be contractible. A further alternative is to mandate negotiations under the shadow of compulsory arbitration based on per-unit traffic fees.

4.6 We have discussed practical aspects of implementing this last solution and concluded that properly calibrated per-unit traffic fees can provide TELCOs with the appropriate investment incentives and resolve the underinvestment problem. Unlike network investments, traffic is contractible, since it can be monitored and verified *ex post*. Also, while the investment-related payments needed to resolve the abovementioned underinvestment problem are informationally demanding, the traffic-related payments we characterise for a given LTO can be (approximately) expressed as fraction of the LTO's per-unit gross margin, where the fraction is increasing in the elasticity of the demand for content to access quality and decreasing in the elasticity of the demand for access to access quality.

4.7 The impact of the implementation of traffic-based fees on consumer welfare is less clear than the impact of an investment-contingent payment (unconditional on traffic and/or the number of consumers). This is because, while the increase in network capacity and thus on access quality, is unambiguously beneficial for consumers, the effect of those fees on prices is not: consumers will benefit from the reduction in access prices but will be harmed by the increase in the prices for content resulting from the introduction of such fees. However, there are various reasons to believe that the net effect will be an increase in consumer welfare. Firstly, we expect the demand for LTOs' content to be no more price elastic than the demand for access. Secondly, while the price of content

increases due to the traffic fees, quality adjusted content prices may fall due to the increase in quality. Lastly, consumers may weigh quality more than price.

4.8 Finally, as regards the specific concerns raised by LTOs, BEREC, and other regulators. We conclude that TELCOs' fair share proposal:

a. Will not allow TELCOs to charge twice – customers and content providers – for the same service, as a correctly designed contribution from LTOs will increase TELCOs' investments and thus lower the quality-adjusted prices end users pay;

b. Is not unjustified on the basis that the provision of telecom access infrastructures is a profitable business with a relatively attractive risk return, given (i) the relatively low levels of profit TELCOs currently earn, and (ii) the combination of already high and increasing level of investments required and the intense competition between TELCOs, which would not allow them to recover the cost of investments from their customers; and

c. Is likely to lead to enhanced investments by TELCOs, and that this effect would not be offset by reduced incentives of LTOs to invest. We found that fair share payments will have no impact on LTOs' ability and incentive to invest. On the contrary, the additional investment by TELCOS are likely to benefit LTOs more than the additional cost that LTO will incur. Hence, ultimately demand for content will increase and so will the profits of LTOs.

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Daniele Condorelli

A.1 Dr Daniele Condorelli is an Academic Affiliate at Compass Lexecon, based in London.

A.2 Daniele received his B.A. in Economics from Bocconi University and his Ph.D. in Economics from the University College London. He is currently an Associate Professor of Economics at the University of Warwick, where he teaches economic theory. Prior to joining Warwick, he was a lecturer at the University of Essex and spent two years as a postdoctoral fellow at the Kellogg School of Management. He has also been a visiting scholar at Columbia University and Stanford University.

A.3 Daniele is an economic theorist and his research focuses on auction design, collusion in markets, and on the economics of networks and platform markets. His papers have been published in academic journals such as the *Review of Economic Studies*, the *Journal of Political Economy*, and the *Journal of Economic Theory*.

A.4 Daniele has extensive consulting experience in competition policy and regulation. He has worked on many antitrust cases across several industries including payments, transports, telecommunications, and manufacturing.

Jorge Padilla

A.5 Dr Jorge Padilla is a Senior Managing Director and the Head of Compass Lexecon EMEA. Compass Lexecon is a global economic consultancy, part of FTI Consulting, Inc. Jorge has more than 20 years' experience as an economic consultant and have taught economics for approximately 30 years at CEMFI (Madrid), Boston University, the Barcelona Graduate School of Economics, King's College (London) and the Toulouse School of Economics.

A.6 He advises clients on a variety of regulation, competition policy and intellectual property issues. He has submitted written testimony and given oral testimony in cases involving many competition authorities and courts globally, including the U.S. authorities and courts, the European Commission, the competition authorities of several European Union member states, the Canadian Bureau of Competition, the UK Competition and Markets Authority, the European Union Courts, the Federal Court of Australia, the UK Competition Appeals Tribunal and the South African Competition Tribunal. He has also given expert testimony in international arbitration cases, including at the International Court of Arbitration (based in Paris), the London Court of International Arbitration and the Court of Arbitration of Madrid.

A.7 He earned MPhil and DPhil degrees in economics from the University of Oxford. He have published extensively in journals on industrial organization, finance and competition economics in the *Antitrust Bulletin*, the *Antitrust Law Journal*, the *Economic Journal*, the *European Competition Journal*, the *European Competition Law Review*, the *European Economic Review*, the *Fordham International Law Journal*, *Industrial and Corporate Change*, the *International Journal of Industrial Organization*, the *Journal of Competition Law and Economics*, the *Journal of Economics and Management Strategy*, the *Journal of Economic Theory*, the *Journal of Industrial Economics*, the *Journal of Law and Economics*, the *RAND Journal of Economics*, the *Review of Financial Studies*, the *University*

of Chicago Law Review, and *World Competition*. He is co-author of *The Law and Economics of Article 102 TFEU*, 3rd Edition, Hart Publishing, 2020.

Zita Vasas

A.8 Dr Zita Vasas is Vice President at Compass Lexecon, based in Toulouse.

A.9 She has over ten years of experience as a competition economist, including at a national competition authority (Hungary), in the competition team of a sectoral regulator (the Financial Conduct Authority, UK) and in consulting.

A.10 She has been involved in cases in a wide range of sectors (e.g. retail financial products, FMCG, healthcare, telecommunications), policy areas (market investigations, abuse of dominance cases, mergers and policy advice) and jurisdictions (e.g. EU, UK, South Africa, Oman and India).

A.11 While working at the FCA, she gained experience in applying behavioural economics and consumer policy. Her background is also in competition: she completed her PhD in 2022 on topics in competition policy at the University of East Anglia and holds an MSc in Competition and Market Regulation from the Barcelona School of Economics.

B Literature review

B.1 Our paper is related to Julien and Bouvard (2023),[38] Baranes and Vuong (2023),[39] and Jeanjean (2023).[40] These are the only academic papers that, to the best of our understanding, explore the potential benefits of a cost-sharing mechanism where content providers contribute to covering the costs incurred by network operators.

B.2 In Julien and Bouvard (2023), a network operator and a content provider offer access and content, which are perfect complements in consumption. Users consuming content generate traffic that is costly for the network operator. The content provider may thus reduce network costs by reducing quality. Absent a cost-sharing mechanism traffic may be excessive from both the viewpoint of the network operator and society in general. A cost-sharing mechanism would cause content providers to internalise the effect on network costs of their content quality decisions. The study finds that the impact of cost-sharing depends *inter alia* on the content provider's business model, which affects access and content prices, investment incentives, and welfare. They show that cost sharing will (i) incentivise the content provider to generate less traffic, (ii) cause a reduction in lower access prices and, possibly, an increase in the (explicit or implicit) price of content, and (iii) can be consumer and total welfare increasing depending on the impact of cost sharing on the total price of access and content.

B.3 Like Julian and Bouvard, Baranes and Vuong (2023) and Jeanjean (2023) consider scenarios where a content provider will fail to take into account the negative externalities created by the traffic it generates. They both advocate in favour of traffic-based contributions aimed at inducing the content provider to control that traffic.

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38 Bruno Jullien and Matthieu Bouvard, "Fair Cost Sharing: Big Tech v Telcos", TSE Working Paper No. 1376, March 2023.
Available at https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/wp/2022/wp_tse_1376.pdf.

39 Edmond Baranes and Cuong Hung Vuong, "Economic contribution to the debate on cost sharing policy", SSRN, March 2023. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4383218.

40 François Jeanjean, "Fair Cost Sharing in Telecommunication Industry, a Virtuous Circle", SSRN, March 2023. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4282687.