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In Pursuit of Fairness? Infrastructure Investment in Digital Markets

Abstract

Recent and ongoing investments into telecommunications infrastructure have facilitated the repeated waves of digitization, both in personal and professional life. I address the question of which actors should contribute to investment costs into telecoms infrastructure and how. One widely discussed proposal (made, for example, by ETNO, the European Telecom Network Operations' Association) is to mandate a few select large firms that offer complementary applications and services through the telecom infrastructure to compensate infrastructure providers by way of a lump sum. I discuss and evaluate this proposal from the perspectives of incentives, risk sharing, fairness, and implementability. Given the undisputed positive external effects of infrastructure investments on different actors in the internet ecosystem, I outline two theoretical first-best solutions and argue that the current proposal from ETNO is far from realizing the potential benefits of these options.

JEL-Codes: L400, L860, L960.

Keywords: telecommunications infrastructure, investment, OTTs.

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1. Introduction

There is a lively discussion about the roles and responsibilities of Telecoms infrastructure providers (“Telcos”) and over the top service and application providers (OTTs) in the investment and maintenance of internet infrastructure. Internet usage has been growing for several decades and growth shows little sign of stagnating (Axon Partners Group, 2022; statista.com[2]). This trend requires ongoing capacity expansion and quality improvement as needs and requirements by consumers continuously expand. The use cases for mobile and stationary internet are changing constantly and it is obvious that the internet holds significant promise to those who succeed in developing a service, an application, or an infrastructure that end users will value.

This creates a challenging situation. The changing and expanding requirements by end users and the opportunities generated by new services and applications generate incentives for upgrading and investing in the internet backbone (mobile and stationary), which benefits multiple actors. For example, the share of mobile internet in total web traffic worldwide has steadily increased and now stands at almost 60% of total traffic (statista.com). Moreover, the number of mobile applications downloaded has grown by over 60% since 2016 (statista.com). The Telcos themselves incur a positive revenue uplift from data growth (Williamson, 2022), users enjoy and value novel services and ubiquitous availability as the technology advances, and applications and service developers deliver and monetize novel and popular services and applications. A discussion has recently emerged around who should take the responsibility for this ongoing investment, and who should bear the cost. Should Telcos carry the burden of investing on the grounds that they own the infrastructure, or should OTTs share some of these investments given they and their end users also benefit from better infrastructure? Moreover, should all OTTs be treated equally in this respect or should contributions only be required by a subset of (large) OTTs and if so, why? Several organizations have contributed to this discussion, and although this discussion has been most active in South Korea and Europe (most notably through the proposal by ETNO, the European Telecoms Network Operators’ Association, and the related contributions), the general principle applies throughout all economic areas.

I will first outline the different business models of the ecosystem around a telecommunications infrastructure (Section 2) and subsequently outline several theoretical principles on who should carry the cost of infrastructure investment (Section 3). Next, I will discuss the implications of these principles (Section 4) and assess the current proposal from the viewpoint of the conceptual considerations developed before (Section 5). I will close with a summary of my findings and some concluding thoughts (Section 6).

[2] https://www.statista.com/topics/1145/internet-usage-worldwide/

2. Telecommunications infrastructure – Platform or Linear Reseller?

To adequately assess the claim that Telcos should be compensated for their investments into infrastructure, we first need to establish the economic characteristics of the relationship between telco infrastructure, OTTs, and end users. Specifically, we discuss whether this combination of actors constitutes a platform ecosystem, a reseller of services of sorts, or yet another business model. In Figure 1, we outline the conceptual difference between a platform and a reseller, or merchant (adapted from Hagiu 2007).

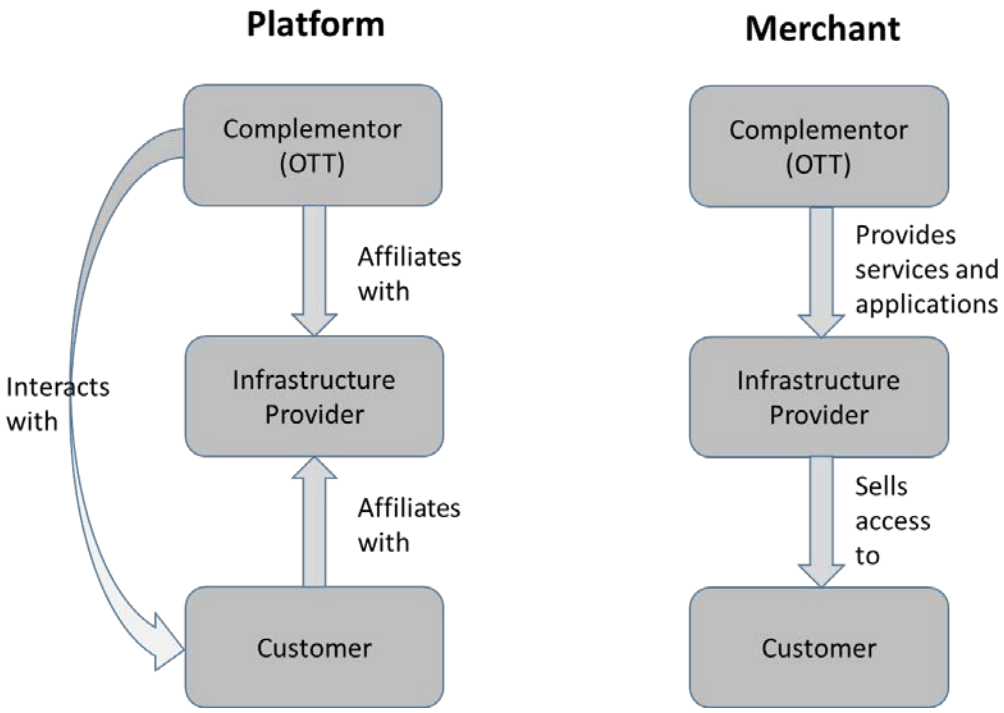

Figure 1: Difference between platform and merchant business model

One key difference between the platform and merchant business models is that in the former, the platform **organizes** interactions between end users and complementors (OTTs). Here, the overall value created depends both on the infrastructure itself and the interactions enabled by it. Conversely, for a merchant the key relationship is between the customer and the infrastructure provider, and the complementors are essentially just distributed through the infrastructure provider. Interestingly, while most of the literature presents these two examples as polar opposites and provides respective examples, in many cases digital services are likely to contain elements of both platform ecosystems and merchants. I argue that this is the case in the relationship between Telcos, OTT providers, and end users.

Consider the context of telecommunications services. Here, the central service is the provision of data and voice services either to a mobile device or to the end user’s home. The value of this basic service depends on the nature of the applications and data that can be accessed, i.e. the ecosystem

around the basic connectivity service. However, the role of Telco infrastructure is not to enable transactions between the end user and OTT services and applications. Rather, Telcos provide access to a basic service (voice) and a gateway to data transmission for any (ex-ante unspecified) purpose. Hence, **the service sold by Telcos is not predominantly access to specific secondary services**, but rather the ability to communicate via voice or exchange and access data. To be clear, the value of this service is not independent of the quality and type of complementary services and apps offered by OTTs– this is the "platform" component of Telco services – but **the business model of Telcos and how they link to complementary services does not justify a definition as a platform in the pure sense of the word**. One of the key differences is that in a platform context, the provider and operator of the platform actively manages its complementors through setting participation rules, providing tools to facilitate the provision of complements, and designing monetary and non-monetary incentives to encourage investment in the quality of complements (Kretschmer et al., 2022). Instead, infrastructure providers do not appear particularly active in cultivating an ecosystem that creates maximum value.

For example, **the price paid to Telcos is independent of the value created by apps**. Such uniform pricing would not seem optimal if Telcos would play a role in facilitating better interactions between end users and OTTs, which would require using price as an incentive mechanism. Moreover, the fee for basic internet and voice provision is set independently of the type of complementary applications used. In other words, **the revenues per user for Telcos are largely independent of the apps and services a user actually consumes (except for commercial versus private use), and certainly independent of the revenues these apps generate.** Telcos do not charge a share of the transaction value between end user and complementors like OTTs, as would be the norm for platform business models. Regulators confirmed this view by establishing the regulatory principle of net neutrality (e.g. Krämer et al., 2013), which stipulates that all data transmission should be treated equally on the internet. Hence, **data transmission as such should be considered a homogenous good and not be charged at different prices conditional on the demand characteristics for specific services**.[3]

Thus, on balance it seems plausible to think of Telco infrastructure as a basic service that end users pay for to have access to (generic) data transmission capacities. The precise use case for specific end users does not enter into considerations for pricing the basic service. Having said that, Telcos are also not resellers in the sense of a supermarket purchasing complementary services and selling them on to end consumers. Thus, it may be more appropriate to think of Telco infrastructure as comparable

[3] Of course, there is price discrimination by quality and/or quantity, but the price is still independent of the end user's actual usage type. Recently, Telcos have developed more targeted tariffs (e.g. "StreamOn" by T Mobile in Germany targeted at intensive social media users), but they again do not establish a direct correspondence between the specific complementary service used and the price paid to the Telco.

to access to a motorway. There are different models of designing motorway access for drivers, but a common one (e.g. practiced in Switzerland and Austria) is to charge a one-off fee that allows for access to any motorway in the country, and it is independent of the driver's extent or location of usage, or the purpose of usage (e.g. business, personal or touristic purpose). Even the range of complementary services such as gas stations, rest areas, safety provisions etc. as well as their likely use by specific end users (proxied, e.g. by their type of car) do not affect the flat fee paid for motorway access. This model is in stark contrast to, say, a credit card network where the platform (the credit card company) carefully balances the prices on both sides (vendors and consumers). A credit card network also actively manages participation on both sides. Vetting processes and introductory offers on the consumer side and a multi-step process of becoming a credit card merchant imposing conditions on data security, revenue levels as well as a multi-tiered fee structure on the vendor side ensures a curated ecosystem of attractive, reliable and heterogeneous platform participants.

The distinction between these business models and the classification of Telco infrastructure is not simply a semantic exercise. Rather, it determines the rights and responsibilities of the different actors in the system. A platform stands to gain from a lively and dynamic ecosystem of complements and complementors. As such, it will have to actively manage the ecosystem by setting incentives and granting residual decision rights to the complementors (Kretschmer et al., 2022). Investments into the basic infrastructure of a platform are made in the expectation that more and higher-quality interactions of any kind are enabled, expanding usage and generating revenues for the infrastructure provider. Thus, improved interactions between users and complementors are the main driver for infrastructure investments on platforms. Conversely, if infrastructure acts as a backbone for all types of data transmission, the **main goal of infrastructure investments by Telcos is to increase end users' willingness to pay for data transmission services in general** because they become faster and possess higher capacity. This can be seen in the current pricing models for mobile and fixed-line Telco services where price discrimination takes place along the dimensions of speed (faster connections cost more) and capacity (higher data allowance is more expensive). Improving the basic infrastructure will then increase the willingness to pay by end consumers irrespective of their eventual use of specific complements.

To summarize, a platform owner's willingness to actively manage the ecosystem of complements on the platform is closely linked to the incentives to invest to increase quality and volume of the transactions and services on the platform, which in turn drive platform revenues. Conversely, the **incentives of Telco infrastructure providers depend on overall consumer willingness to pay, which emerges without the active management of complementors by the Telco.** Thus, payments to the

Telco providers to compensate for “managed access” to the infrastructure and the ecosystem on it appear inappropriate here.

3. Who Should Pay for Network Infrastructure Investments?

a. What is the investment need and for which functions/services?

As outlined in the previous section, the question of who should pay for network infrastructure investments cannot be considered independently of the role of the Telco operator in the value generation and organization of the digital services it supports. In this section, I discuss in more detail the nature of infrastructure investments and what this implies for the obligation to pay for the investment. Generally, investments can come in the form of increasing the **quality** of services, most notably speed and stability of a Telco network, and the **quantity** of services, i.e. ensuring that a larger amount of data can be transmitted at any one time. Many European countries have seen heavy investments[4] or extensive investment programs[5] to improve both quality and quantity of the network infrastructure.[6] A third important dimension is investing in higher **coverage** in geographical areas that are not covered by existing Telco infrastructure.

Investments in any of these directions may benefit different actors in the system. Increases in network quality for example in terms of latency and stability will especially improve the delivery of any service that crucially relies on these dimensions. Put simply, even an email service will benefit slightly from a more stable network (as emails will be sent and received reliably and without delay), but a streaming service will benefit much more. Thus, the “marginal beneficiary” can differ for each investment category – in the case just discussed, streaming services would be the marginal beneficiary, while email services would benefit to a much smaller extent.

For quality investments, a network with higher-speed and stability improves the delivery of high-density and latency services. For example, mobile streaming services from crowded events like live concerts or sports events will require low latency and the capability to transmit content from mobile

[4] For example, Spain, Portugal, Sweden and Bulgaria have over 80% of households passed with fibre. (FTTH, 2021), and the takeup rates (the percentage of subscribers per home passed) are particularly high (>70%) in Spain, Portugal, Finland and Lithuania.

[5] See, e.g. Germany (https://www.kfw.de/About-KfW/Newsroom/Latest-News/Pressemitteilungen-Details_576320.html) or Spain (https://espanadigital.gob.es/sites/agendadigital/files/2022-01/Digital-Spain-2025-Exec-Summary.pdf).

[6] Of course, the two dimensions are not completely independent from each other. A faster network can transmit more data in the same time interval, thus increasing capacity, while a network with higher capacity will run less into congestion issues, which in turn increases the average speed of transmission for many services. For conceptual purposes, however, it is useful to think of these two as separate dimensions. See also FTTH (2022).

devices without interruptions. Moreover, low-latency mobile services need to work seamlessly, i.e. the handover from one mobile cell to another has to be uninterrupted. In the future, such needs are likely to originate either from autonomous driving or from concepts revolving around “smart cities”, which include multiple services interacting with each other and real-time updates, which benefits 5G and FTTH dependent applications (Axon Partners Group, 2022). The “marginal investment” in network quality and even higher transmission speeds is therefore likely to benefit future high-density and low-latency services. In the past, quality investment has been undertaken in the expectation that services will emerge once the infrastructure is in place. Even to the present day, there is little evidence of network congestion (BEREC, 2022), which suggests that infrastructure investments are essentially undertaken in anticipation of future demand rather than in response to already articulated demand.[7] For example, data transmission capabilities on mobile networks have helped text messaging (SMS) take off, a somewhat unexpected “killer application”. Although streaming via fixed-line internet was already in place when investments in new generations of data networks were made, its ultimate potential remained unknown until the infrastructure was built.

The main motivation of investment in quantity, i.e. increasing transmission capacity, is to deliver a stable service to users and to be able to cope with unexpected increases in transmission demand without experiencing network outages or congestion. Investment in quantity may take the form of expanding reliability in transmission in peak demand periods (e.g. evenings, weekends and college breaks will typically lead to a spike in capacity requirements due to young users engaging in data-intensive activities) or in providing reserve capacities to be used in special situations such as, say, world events or crises that trigger a high demand in up-to-date information, or in the case of a longer-term but temporary shift in usage intensity. Specifically, infrastructure networks were able to deal with the sustained spike in demand for streaming services triggered by the Covid-19 pandemic quite well. For example, a recent report by WIK Consult on German and French internet infrastructure concluded that the “*evolved architecture and interaction of the networks has passed the stress test induced by the new traffic spikes during the COVID-19 pandemic.*” (Neumann, 2022: 67). Along similar lines, British Telecom issued a briefing to Members of Parliament reassuring them that even in periods of unprecedented, pandemic-induced demand, BT has “*seen daytime traffic effectively double. A notable increase, but one [BT] can manage as it is still significantly below the average evening peak.*” These and similar reports have led BEREC, the Body of European Regulators for Electronic Communications, to state that “*while traffic on fixed and mobile networks have*

[7] If infrastructure investment was reactive rather than prospective, we would expect to see recurring periods of congestion, followed by investments to relieve the congestion.

increased during the (approximate) sixteen months of the Covid-19 crisis, no major congestion issues have ever been reported by NRAs to BEREC.“ (BEREC, 2022).

More generally, given the ongoing competition among infrastructure owners (i.e. Telcos), a capacity shortage by one of the providers might lead to widespread switching to a competing provider. Minimizing the likelihood of an infrastructure outage or sustained congestion therefore is likely to be the (equilibrium) outcome of a competitive process among infrastructure providers.

In both quality and quantity investments, it is unlikely that any small group of existing OTT services and applications were the drivers of the respective investments. For quantity investments, competition among infrastructure providers and the need to always provide basic functionality to subscribers was paramount, and the “marginal beneficiaries” of quantity investments are likely to be the providers themselves (in the form of reduced churn of users thanks to quality access to a rich ecosystem of digital services). For quality investments, higher speed and lower latency will enable new services, some of which already exist but are not yet ready for widespread rollout (e.g. autonomous driving, connected cities). These novel services are likely to benefit from network quality improvements (AXON Partners Group, 2022) more than OTTs already operating successfully, as most of their services are not time-critical (reducing the need for high-speed connections) and are comparably low in data intensity (reducing the likelihood of OTTs contributing to capacity constraints in peak periods). That is, even access to streaming content or online video gaming is unlikely to impose the same demands on network quantity and quality as newly emerging use cases. Rather, the key dimensions in which OTTs are likely the “marginal beneficiary” for investments are related to geographical coverage, i.e. making sure that access to the internet is ubiquitous, allowing a large part of the population to connect and exchange via social networks.

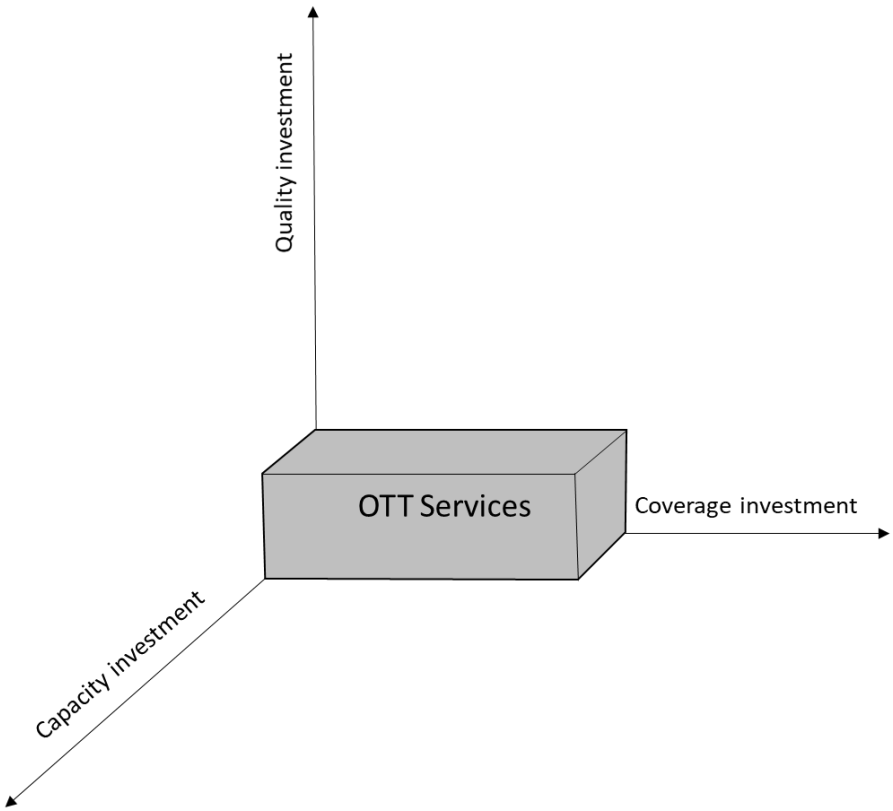

Figure 2: Investment dimensions and OTT requirements

b. What do OTTs need from network infrastructures and do they contribute to it themselves?

OTTs have spent a sizable amount of investment into infrastructure, including Telco infrastructure in recent years. These investments have taken two forms in particular. On the one hand, OTTs have invested in transatlantic transmission cables with sizable economic impact (Anderson et al., 2021), and on the other, they have been investing in infrastructure in underserved areas, for example Africa (The Economist, 2017, Abecassis et al., 2020), but have also made sizable investments in developed regions like Europe, e.g. through fiber, PoP, data centers (Basalisco et al., 2019), caching[8] etc. This has contributed to bridging the digital divide regarding internet availability between Central Europe and more peripheral regions like Eastern or Southern Europe, and connecting Europe to sub-Saharan Africa and other regions through subsea transmission cables.

The investment pattern we observe reflects the requirements of OTTs on the basic infrastructure: there is a need for a relatively high volume of data transmission (especially for outgoing traffic from the US, where many of the currently popular OTTs have their headquarters) as well as wide accessibility in infrastructure-poor areas. Therefore, in line with Figure 2 above, the infrastructure

[8] See, e.g. the Streaming Video Technology Alliance working on open caching (https://opencaching.svta.org/what-is-open-caching/).

investments by OTTs have taken place in the use cases and domains in which OTTs are most likely to reflect the “marginal beneficiary” of the investment. Hence, where network needs originate from the business model and the operating principles of OTTs, OTTs have contributed to the investment needed to maintain and increase the value of OTT services. Conversely, where investments in higher speed and/or peak load capacity driving demand for Telco services in general are concerned, most investment has been undertaken by the Telcos themselves.

c. Do OTTs add value to network providers?

If investments are concentrated on a specific class of firms, a plausible line of argument might be that the investment of the infrastructure provider benefits everyone using it – Telcos, end users and OTTs – and that Telcos receive too little in return. However, complementors’ (i.e. OTTs) applications and services also confer benefits to Telcos through their popularity and variety.

First, the variety of OTTs generates indirect network effects, i.e. the base product and demand for data provided by Telcos becomes more valuable as complements improve and their number grows (Williamson, 2022; Kretschmer and Claussen, 2016). For example, the emergence of smartphones (a complement to Telco services) enabled Telcos to increase market penetration both at the extensive (i.e. more users) and intensive (i.e. more usage per user) margin. Similarly, the fact that a large share of the population everywhere (83% of Western Europeans use social media,[9] and even the majority (>50%) of over-65 year-olds in the USA have used Facebook or Youtube[10]) is using at least one social network means that demand for the base service also spans most of the population. Interestingly, in the early years of telecommunication services market penetration of fixed-line telephony approached 90-95% of households in most industrialized economies. Although fixed-line penetration has not increased much further (if anything, it has gone down slightly as users are disconnecting their fixed telephone lines), mobile penetration has increased steadily (GSMA Intelligence, 2021). Some individuals own multiple SIM cards for different uses, for example data and voice, or personal and professional use. This strong increase in demand of the base service has been driven by the availability of novel services and applications provided by complementors as the importance of voice telephony (the service most individuals and households needed a fixed line connection for up to the 1980s) has consistently declined. In the present day, the need to remain connected via email, messaging services and social media feeds back into demand for Telcos’ services in general, a fact also acknowledged by the Telco operators (Telefonica, 2010).

[9] Datareportal.com
[10] Pewresearch.org

Second, the global appeal of OTTs creates a need for some infrastructure everywhere, further driving demand for basic Telco services everywhere and inducing customers to sign higher-priced contracts with more data allowances (Williamson, 2022). In terms of the extensive versus intensive margin, the effect of OTTs in industrialized countries has been a renewed need for Telco services by users who already had some service, thus affecting the intensive margin. In emerging economies with a lower level of baseline infrastructure however, OTTs are creating a need for de-novo infrastructure to enable first-time users to use OTT services, creating demand at the extensive margin.

d. Infrastructure investment has benefits, but who should pay for it?

Investments in Telco infrastructure benefit the entire ecosystem of Telco providers, users and complementors. The question of who should pay for it remains. There are three related, but different lines of argument to identify the most appropriate distribution of investment costs, which I will outline below.

- The **first** line of argument starts from the premise that the EU and many other economic areas want to offer all their citizens full connectivity as a fundamental right (Mildebrath, 2021, Hutton, 2022). That is, just as every human should be free from fear of discrimination or should not suffer hunger, they should not be excluded from partaking in everyday life by not having internet access. If the benefits from a basic Telco infrastructure are broadly distributed and socially and politically desirable, then infrastructure investment up to the level considered a basic right should be publicly funded or at least supported. This argument is especially strong if the technology in question is a General Purpose Technology (GPT, Bresnahan, 2010), i.e. a technology that has wide applicability for different use cases and will generate significant “second-round innovations”, i.e. innovations made possible through the emergence of the GPT itself. Numerous studies have identified Information and Communication Technologies as a GPT (Basu and Fernald, 2007; Czernich et al., 2011; Cardona et al., 2013). Further, the call for publicly financed or at least supported infrastructure investments will be especially strong if there is a risk that the self-interest of some (private) actors in the provision of digital services may have negative external effects and may lead to less profitable parts of society not having access to these services, which would run counter to the demand for a “universal service obligation” for broadband (Hutton, 2022).
- The **second** line of argument states that if the investment in certain dimensions of Telco infrastructure benefits a clearly identifiable set of actors in the ecosystem, the actors benefitting from the “marginal investment” should pay for the investment, at least in part. This is simply a case of “internalizing externalities”, so that economic actors who benefit

from an action should be made to contribute to the investment itself.[11] The intuition here is similar to peak-load pricing (Williamson, 1966). If there is a group of consumers (or a specific segment of demand) that benefit from more capacity but the product or service is sold to multiple segments, the price for the segment “responsible” for the capacity investment should be higher because it incorporates the (marginal) investment cost. This logic implies that for each of the three investment dimensions, the group of firms most likely to benefit from an expansion in one dimension should co-finance the investment.

- **Finally,** and closely related to the previous lines of argument, the (un)certainty of rewards can also guide the optimal compensation for infrastructure investment. As I argued above, it is not obvious which service or application will ultimately benefit the most from investments in transmission speed, which service will be responsible for network infrastructures to reach their capacity limit, or which service will be used most extensively in areas currently not served by adequate Telco infrastructure. The past has shown, however, that the supply of infrastructure has created its own demand, i.e. through self-interested behavior and ingenuity, organizations were able to use the fact that technical restrictions were relaxed following infrastructure investments to their advantage and invest in new services that use the improved infrastructure in commercially attractive ways. That is, the expected returns at the infrastructure level tend to be less variable than at the OTT level because **some** OTTs will utilize the improved infrastructure, but it is not clear **which ones**. This will likely lead to a higher cost of capital for OTTs than Telco providers, less stable returns and ultimately a higher risk premium. To allocate risk efficiently, the actor with the lower risk should undertake the investment.[12] Indeed, Telcos often emphasize the numerous applications their infrastructure enables in annual reports and calls with analysts to underline the sizable potential their infrastructure holds for a wide variety of OTTs.

The first alternative will generate the first-best by definition because “society” undertakes the investment and subsequently profits from it. In a world where there is perfect information about investment spillovers, the second alternative can deliver the first-best investment outcome. The effectiveness of the second alternative is hampered, however, by both **static and dynamic**

[11] The more commonly used textbook case is one of negative externalities, where the actor undertaking the investment should pay for the private as well as the social costs of investments, e.g. pay for environmental damages arising from the investment. However, the logic applies to positive externalities too.

[12] Note that Telco providers made an argument closely related to the first and third rationales outlined above when it came to investing in high-speed internet in the early 2000s. Their argument was that returns from high-speed internet are highly uncertain because the precise use case had not been established and there was uncertainty over its ultimate attractiveness to end users, which would justify subsidized investments (i.e. government support) or a “regulatory holiday” which would allow network providers to benefit from their investment in an unrestricted way.

uncertainty. Static uncertainty refers to the difficulty of identifying the degree of spillovers for a current technology for all participants in the ecosystem. The extent of benefits depends, at a minimum, on the beneficiaries' activity (which application or service does the OTT offer?), on the respective shares of value generated by the infrastructure and the OTT itself (does the OTT "free ride" on the investment of the infrastructure providers or does it contribute unique skills and investments to its value proposition?), and other OTT characteristics. Decomposing these benefits would allow for a retrospective allocation (and compensation) for past investments. However, even for existing technologies such a process is a complex undertaking. Dynamic uncertainty matters especially for prospective investments, where the use cases may still be developed and unexpected "killer applications" may emerge. Here again, if the degree of uncertainty about who will be the main beneficiary of an investment is high, setting compensation levels based on past performance seems inappropriate. Thus, higher uncertainty (the third argument above) will shift the optimal solution further from the second option and towards the first, i.e. public support of infrastructure investment.

In sum, these arguments call into question the prima facie attractive proposition that the investment cost should be distributed "fairly", which might imply imposing a higher share of the investment on the currently most profitable firms in the ecosystem. A fair allocation would at the very least have to correctly and accurately identify the degree of investment spillovers, both for current and future use cases.

4. Implications

The arguments outlined above suggest that a simple "lump-sum" transfer from a group of (large and mostly US based) OTTs to Telcos would fall short of the stated aim of achieving fairness and efficiency in investment incentives and burden. The discussion in the previous sections suggests that there are four main reasons against such a practice:

- First, **OTTs are unlikely to be the "marginal beneficiary" of investments** in quality (i.e. speed) or quantity (i.e. capacity) of fixed and mobile networks. Conversely, in terms of geographical coverage, OTTs services and applications are more likely to be the main driver of expansion, which is already reflected by significant prior investment by OTTs into providing infrastructure to underserved areas (The Economist, 2017).
- Second, the **relationship between network infrastructure providers and OTTs is not a one-sided dependency** (of OTTs having become an essential service and Telcos therefore having to grant the services access to their networks), but rather a symbiotic one. The ubiquity of network infrastructure benefits OTTs and their business model (even users with low

willingness and ability to pay can use their services, generating network effects for other users), but at the same time having a large variety of OTT services will generate demand for the baseline service (Williamson, 2022).

- Third, the network services and complementary OTTs do not resemble a platform ecosystem, which would justify an “access fee” for OTTs to benefit from the infrastructure that gives them access to users. Instead, **Telco infrastructure resembles a baseline service provided regardless of which OTT services run on it**. The only way in which OTT services and applications enter into a discussion on Telco infrastructure strategy is in the demand they create for the network, but they are not actively managed by Telcos.
- Fourth, the **returns to infrastructure investment are likely to be much more volatile for OTTs than for Telcos**. Put simply, history has shown that there has been (at least) one “killer application" (or service) that generates network traffic both in mobile and in fixed-line telecommunications networks, but it is not clear which service it will be. An optimal allocation of risk would therefore see the Telco shoulder most of the risk as their cost of capital is likely to be lower.

Moreover, the discussion around ordering a group of firms to pay for infrastructure investments while letting others benefit from the improved infrastructure “for free” is reminiscent of the discussion around net neutrality from the late 1990s. Both regulators and the public were strongly in favor of the principle that “all data should be treated equally” and that different services or types of data should not be charged different access or traffic fees. Treating large OTTs differently from the rest of data traffic would go against this principle, with the ETNO proposal facing a backlash from 34 civil society organizations from 17 countries in a joint statement (Epicenter, 2022). Further, ordering current-day “Big Tech” firms to pay for past successes may let firms and services that are likely to benefit from the next wave of investments (e.g. autonomous driving, distributed AI etc.) off the hook, countering the “fairness” argument put forward in favor of having Big Tech firms contribute to infrastructure investment (Williamson, 2022).

In sum, the economic rationale for singling out specific actors as “main” beneficiaries while other beneficiaries are not obliged to pay appears rather weak. Indeed, such a policy would counteract both the stated principles of fairness on the one hand and efficient investment incentives on the other hand.

5. What would a financial transfer from Big Tech to Telcos mean?

In this section, I comment on the proposed implementation of a direct transfer from OTTs to Telcos to compensate for prior investments and to set incentives for future investments. The implementation would likely be problematic for several reasons.

- **First, a transfer would necessarily be based on ex-post estimates of benefits from prior investments.** This would be equivalent to a “tax on success”, and it would not materially change incentives going forward. It is even possible that singling out a group of firms as funders of the previous investment may bias the forward-looking investment incentives of Telcos in the direction of large OTTs (to keep the “big funders” from the last round of infrastructure investment happy), thus constraining the unrestricted path of technological progress. This may hinder the emergence of radical new technologies in the future.
- **Second, a direct and unrestricted transfer to Telcos may not ensure sufficient infrastructure investment in the future as it is not conditional on future behavior**. Rather, it would serve as a windfall profit for past (imprudent) behavior that can finance any kind of activity by Telcos, such as developing and growing a platform business or investing in other business areas, or even continuing legacy businesses that would not be sustainable without cross-subsidies. Further, it is not clear if the current structure of ownership and investment responsibilities has led to any underinvestment on the part of Telcos. Indeed, many public statements by Telcos emphasize the large investments made by them, presumably because they saw the business case in doing so.[13] If Telcos had been forced to postpone or abandon investment projects due to a lack of financing, the burden would be on them to demonstrate this and to illustrate how a lump sum transfer would enable promising projects to go through. Some form of pre-commitment to undertaking further investments would be necessary and desirable. If indeed there have been projects that Telcos did not realize due to financing constraints, it is likely that Telcos postponed the less promising projects and realized the most promising ones instead. Consequently, special focus would have to be on the (private and social) benefit of the “marginal project” that could now be realized.
- **Third, a “fair” distribution of investment financing would require all complementors to the basic service to pay a share of future investments proportional to the (expected) benefit from the investments to be undertaken**.[14] This would link the cost of the investment to its

[13] See, for example this recent statement by Deutsche Telekom: https://www.telekom.com/en/media/media-information/archive/second-quarter-report-2022-1012842.

[14] This is also mentioned in Cremer et al. (2021)’s study which states that “**all players** benefiting from the digital transformation…make a fair and proportionate contribution to the costs of public goods, services and infrastructures” (author’s emphasis).

marginal beneficiary. Realistically, however, this practice is likely to face significant hurdles in its implementation. First and foremost, identifying the marginal beneficiary is difficult to determine ex ante and might include yet-to-be-incorporated organizations. For example, investments into battery technology before 2003 certainly benefited Tesla, which was only incorporated in 2003, and it is likely that future investments that enable the widespread adoption of autonomous driving would equally benefit existing or yet to be incorporated suppliers of autonomous cars. Second, and relatedly, as the risk at the complementor level is much higher than at the infrastructural level, the shares to be paid by complementors may be more expensive due to the higher cost of capital, which in turn would result in insufficient investment incentives as the “system-level” risk is lower than the “complementor-level” risk.

6. Summary assessment and conclusion

The question of who should pay for infrastructure investments is an old and recurring one, and it has been answered differently over the years and across different cases. In the case of investments into Telco infrastructure, there has recently been a discussion revolving around the duty of large OTT providers of services and applications to cover some of the costs of infrastructure investments as they have historically benefitted from a healthy and technologically advanced Telco infrastructure. While it is intuitively appealing to recognize the role of investment externalities in telecommunications and to find ways of addressing potential underinvestment or misdirected investments, I discuss the difficulties arising from one of the most-discussed options in policy circles: to order a group of large OTTs to compensate Telcos in the form of a lump sum for past investments. Such a solution would likely fall short of the principles of efficient risk allocation, time consistency, and net neutrality. Moreover, such a policy might seem like arbitrarily targeting a group of (largely US-based) firms while letting (at least partly European) newcomers and/or smaller firms enjoy the same externalities at no cost. The economic arguments for such a policy are as yet unconvincing.

In the past, two corner solutions have been proposed for investments with strong (and unavoidable) externalities. On one end of the spectrum, the investment will have to be provided by the public, i.e. through a state-owned utilities company, and the externalities will ultimately feed back into society through taxes and higher-quality basic services. If externalities or spillovers are broad and uncertain, this policy may be optimal. On the other end of the spectrum, a fully market-driven solution would imply that any investment would be borne jointly by its beneficiaries, and ultimately ownership would be shared among them. This solution will face a high burden on identifying and measuring investment externalities ex-ante, and it would limit externalities to the common owners of the

investment assets while excluding others from enjoying them. This, however, may come at the cost of reducing system-wide compatibility and externalities.

The dual goals of fairness and efficient incentive allocation are commendable for any policy. An exhaustive assessment of a policy that can achieve these goals at least to some degree will have to take myriad factors into account, including the ones I discussed in this note.

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