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DISCUSSION PAPER

// INGO VOGELSANG

Net Neutrality Regulation: Much Ado About Nothing?

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Net neutrality regulation: Much ado about nothing?[1]

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Abstract

The economics literature on Net Neutrality (NN) has been largely critical of NN regulation on the basis of theoretical findings that NN violations can be both welfare improving and welfare deteriorating, depending on the circumstances of the case in question. Thus, an ex post competition policy approach would be preferable to a strict ex ante prohibition of NN violations. In contrast, the current paper argues that NN regulation is largely ineffective, in particular, when it comes to the prohibition of fast lanes and other quality of service (QoS) differentiations, and to a lesser extent, when it comes to the zero price rule. NN regulation is effective only in preventing the blocking of specific content and in preventing the favoring of ISP owned content and in preventing some price discriminations. These are also areas where NN regulations are more likely to be welfare-enhancing. Where they are ineffective, NN regulations are likely to create inefficiencies through the cost and allocative inefficiencies caused by NN bypass. The paper ends with a call for theoretical and empirical economic analyses of NN circumvention techniques.

JEL codes: L50; L96;

Key words: Net neutrality (NN); quality of service (QoS); price discrimination; content delivery network (CDN); zero-rating; throttling

[1] This paper has been published in *Review of Network Economics*, March 2019.

1. Background

Network neutrality (NN) has been the most visible policy issue in electronic communications of the last decade. It culminated in lengthy and controversial decision making processes on both sides of the Atlantic, which have been going on in the US at least since 2005 (Jamison, 2018). Although in terms of party affiliation the battle over NN has been one between left-leaning and interventionist people favoring NN regulation and right-leaning and libertarian people against NN regulation, it is more a fight between an idealistic view of networks and that of economists (Maillé & Tuffin, 2014). Before this background the main economic hypothesis of this paper is that the presence or absence of NN policy makes surprisingly little difference for market outcomes, certainly not enough to justify any strict and controversial NN policy. In other words, the market pressures around the Internet are so strong that they find a way to overcome most of the NN regulations based on civil society considerations.

NN concerns the delivery of content over the Internet by an Internet service provider (ISP), to whom end-users subscribe. Under NN downloading speed and other quality aspects of content delivery over the Internet are supposed to be the same for any kind and source of content (although not necessarily for any end-user). NN further concerns the price for delivering content, which shall be the same for any kind and source of content. This is usually called the zero-price rule, although ISPs could, in my view without violating NN principles, impose a price on all content delivery, for example, in the manner of peak-load or real-time pricing.[2] NN could also concern a blend of quality and price provisions, which would apply to quality differentiation associated with price differentiation. Since NN is therefore a heterogeneous issue, one has to look at the various aspects separately. These are (1) no quality of service (QoS) differentiation, in particular no prioritization over best effort and no throttling; (2) no blocking; (3) no charges for content delivery (no gatekeeping charges) as opposed to free Internet traffic, such as email; (4) no price discrimination for different content providers; and (5) no preferences for an ISP's own content. For each case one needs to argue why and how the presence or absence of NN regulation makes little difference in the services experienced by end-users, although it can make a difference in terms of efficiency and wealth distribution among firms. It is impossible to fully do this, because arguably either some NN regulation or the threat of NN regulation has been around, since the NN discussion started. Thus, the factual is the case with (some) NN regulation, while the counterfactual cannot be observed.[3] The main argument thus will be that, while with NN regulation one observes considerable bypass one would observe similar or even more "NN violations" by the ISPs without such regulation.

The paper is structured as follows. Section 2 provides a literature overview of the main hypothesis. This is followed by Section 3 on priority service and fast lanes as examples for QoS differentiation. Section 4 addresses blocking, while Section 5 deals with the no price and no price discrimination rules. Section 6 on throttling is both related to QoS and to price as is Section 7 on favoring of ISP owned content. Section 8 presents potential inefficiencies and some efficiencies associated with bypass practices of NN regulation. Section 9 concludes and provides policy consequences and suggestions for future research.

[2] Even if this were forbidden as charges to be paid by CPs it would be allowed as charges to be paid by end-users.
[3] I owe this observation to an anonymous referee.

2. Literature review on the main hypothesis

Our main hypothesis has three parts. The first hypothesis is that NN regulation has little effect because NN violations are exceedingly rare (Faulhaber, 2011). This rarity has been explained by the observation that NN violations have in the past rarely been in the interest of ISPs. From an economic perspective ISPs offer their networks as two-sided platforms to end-users and content providers (in the widest sense). They charge both end-users and content providers as subscribers, noting that end-users are primarily interested in content (including the use of OTTs). The argument that NN violations were not in the interest of ISPs was that ISP discrimination against certain content would reduce the demand by end-users for the ISP's subscription service. Thus, the ISP would have to gain additional advantages on the content side in order to benefit from NN violations. As Broos & Gautier (2017), Dewenter & Rösch (2016) and Guo et al. (2010) point out, the inclination of ISPs to discriminate against CPs depends critically on the type of content, in particular, on whether non-discrimination increases subscriber demand for the ISP and if that effect is stronger than the loss of market power in the content market. Furthermore, the more congestion-sensitive some CPs have become relative to others and the more heterogeneous their QoS demands are today, the more they will have incentives to induce ISPs to offer priority and higher QoS. Today some form of QoS differentiation could well be a win-win situation benefiting ISPs, content providers and end-users. This clearly comes out in the main surveys on the theoretical economic literature about NN regulation, such as Krämer et al. (2013) and Greenstein et al. (2016). This also suggests that ISPs will have strong incentives for QoS-related NN violations. Thus, it may be the case that these violations are not easily observed, in particular when it comes to QoS differentiation. So, NN violations are maybe not rare, but just rarely observed.[4]

The second part of the main hypothesis is that certain NN violations such as blocking of senders may well be covered by general competition laws and consumer protection laws. This is the main reasoning behind the FCC's recent reversal on NN regulation based on the view that the Federal Trade Commission (FTC) as the consumer protection and competition policy agency would better than the FCC be able to address the issues posed by NN or the lack thereof (Jamison, 2018).[5] General competition laws in this area would mostly refer to ISPs with significant market power (SMP) and would characterize certain NN violations as an abuse of SMP. Some competition laws, such as the US Federal Trade Commission Act, also address consumer protection for firms without SMP status.

The third part of the main hypothesis is that the differentiations NN regulation wants to avoid occur anyhow, with or without such regulation. This means in particular that in the eyes of NN proponents "undesired" outcomes contrary to NN abound in spite of NN regulation. This hypothesis has been analyzed by Gans (2015) and Gans and Katz (2016), who derive pecuniary reactions to NN regulations by ISPs, content providers (CPs) and end-users as the main players. They consider different types of NN regulations ("weak" and "strong") and largely concentrate on paid content, although Gans (2015) also treats advertising-financed content. Some of their results will be used below. However, the main emphasis of the current paper is on physical and virtual bypass strategies by CPs. Some of these have been around for many years but have only recently been interpreted as ways to bypass NN regulations. This has been noted by Clark (cited by Jamison, 2017), in particular with respect to network bypass by

[4] I owe this observation to an anonymous referee.

[5] Since both general competition laws and consumer protection laws take an ex post approach to legal remedies, it is hard to differentiate these laws from a specific ex post NN regulation, which to the best of my knowledge has not been applied anywhere to date.

Netflix, by Jamison (2017), in particular with respect to the spread of apps that bypass the Internet, and by Renda (2015) and Vogelsang (2017), in particular with respect to CDNs. All three of these phenomena have been around for a long time and all three of them are not subject to NN regulation. Yet, they seem to yield results that are contrary to those the NN regulation promulgates. While this part of the current paper's hypothesis has not been analyzed systematically, Easley et al. (2018) have laid a foundation for such an analysis.

Easley et al. (2018) provide a systematic characterization and categorization of NN with the aim of applying the resulting framework to a generalized issue of data neutrality. Their framework is useful here for the purpose of showing how NN regulation can be circumvented without violations. Easley et al. (2018) point out the gatekeeper role of the ISP in the NN debate. The gatekeeper role means that multi-homing by end-users is either difficult or does not occur for other reasons (Vogelsang, 2017). This has, for example, been the basis for the gatekeeper role of telephone companies for call terminations. It also seems to hold for much of the NN issue. According to Easley et al. (2018) NN regulation applies to the ISP providing the last mile to the end-user as the subscriber. In general such ISPs do not only provide the subscriber with the last mile but also with the remaining Internet, including the backbone access. Consequently, Easley et al. show possibilities outside the last mile for bypassing NN regulations that are made for last-mile ISPs only. It is, however, much more difficult to bypass the last mile itself. This is where NN regulation is very similar to regulation of call termination, which also depends on the last mile subscription. However, as argued by Vogelsang (2019), the gatekeeper role for call termination can now be eliminated by multi-homing via dual fixed and mobile subscriptions and increasingly via over-the-top services (OTTs). Breaking up the gatekeeper function could be more difficult for Internet access than for call termination, but that may depend on specific cases.[6] For example, multi-homing for movie downloading may be harder on the small mobile screen or via OTTs that themselves may be subject to NN discrimination by the ISPs.

What does it mean that NN regulation has no effect? The answer could depend on the perspective of each potential actor involved. The current paper predominantly takes the perspective of the CP and end-user involved but will also consider the ISP perspective, where the results may differ.

3. Fast lanes and priority service

From the CP perspective the ineffectiveness of NN regulation on the creation of fast lanes or priority service means that CPs can procure fast lanes or priority service for themselves even under NN regulation. From the end-user perspective the ineffectiveness of NN regulation on the creation of fast lanes or priority service means that end-users have fast-lane or priority access to certain CPs. Since under NN regulation the ISPs may not offer fast lanes or priority service, the ineffectiveness of NN regulation in this regard means that the ISPs or at least their Internet services have to be bypassed by those CPs. ISPs therefore do not benefit from the bypass.[7] The current section characterizes several of such bypass options. They come in two

[6] A potential policy difference between NN and data neutrality is the crucial role of multi-homing or the lack thereof for the relevance of "neutrality" as a policy issue. Although Easley et al. (2018) work out the critical role of network externalities for the market power of data networks, multi-homing will generally be much easier for consumers of search engines than for ISP subscribers.

[7] However, in their roles as incumbent telephone companies or cable TV providers ISPs tend to benefit from VoIP services outside the Internet offered by them. Their superior QoS competes with OTTs.

versions depending on whether the ISP's Internet service is still involved or whether it is bypassed altogether.

3.1. Partial bypass

3.1.1. Content delivery networks (CDNs)

Content delivery networks (CDNs) are of paramount importance for the functioning of the Internet (Stocker et al, 2017). Already 50% of Internet traffic passes through CDNs (CISCO, 2017), and a large fraction of that is vertically integrated with content. CDNs allow CPs, who subscribe to or own them, to bypass the Internet backbone and to directly access the relevant ISP networks at or close to the last mile. Unless the ISP directly discriminates against the CDN delivery, the packets arriving this way are prioritized relative to packets running over the whole Internet (Easley et al., 2018). CDNs as separate networks thus provide fast lanes and they increase other aspects of QoS via storage facilities in caches.

Easley et al. (2018) note that ISPs may host their own CDN services. The case in point is Comcast, which offers CDN services for large and mid-sized CPs. Interestingly, Comcast argues that this is not an Internet service and does not violate NN principles, because it does not guarantee faster delivery and does not prioritize in terms of queuing, although it bypasses the queue before reaching the last mile. Also, the Comcast CDN service is intended for large file downloads and streaming video.

However, an Internet search on various CDN websites suggests that even small CPs with little traffic can and do use CDNs. In other words, there appear to exist no major economies of scale associated with CDNs. Since one of the main purposes of NN regulation has been to protect the little guys among CPs against the big guys, this kind of circumvention does not go against such an NN principle.[8]

So far mobile networks, because of the complexities involved, have been left outside the CDN networks, although those have been used for the fixed-network parts of mobile communications. However, the evolving 5G technology will enable CDNs on mobile networks as well (Frias & Menendez, 2018).

In summary, CDNs have become a widespread and effective vehicle for realizing faster than best-effort content deliveries. Because of the caches used they also provide better QoS features on other dimensions, such as latency.

3.1.2. CP owned networks and paid peering

Joint ownership of ISP and CP can happen in two forms. The ISP may own CPs or the CP may own networks. We treat the latter case here and leave the former case to Section 7 below.

CP owned networks come in several forms. The extreme case occurs when the CP owns the last-mile network, such as Google does in several cities. In this case NN regulations for this CP are totally superfluous. However, if that CP/ISP does not obey NN rules vis-à-vis other CPs NN violations with effects on traffic delivery could still occur.[9]

[8] As an anonymous referee remarked: "One idea in the NN debate was that CDNs represent a competitive market where even small CPs can be active, and that prioritization by an ISP with strong market power would be a different situation (this ISP would have the ability to be much more strategic in QoS differentiation)."

[9] This is only a made-up example. To the best of my knowledge Google access networks have pledged to obey NN.

The more important case for the ineffectiveness of NN regulation is that of CP owned backbone networks with access to the CP, such as the case of Netflix.[10] CDNs do not work so well for streaming video. Because Netflix can, however, now claim to have its own network it could arrange its own paid peering with other (higher-level) backbone networks. Such peering has recently been facilitated by the popularity of Internet Exchange Points (IXPs) which allow a single network to peer with hundreds of other networks (Lehr et al., 2018). As a consequence the CP as a peering partner can gain access to the whole Internet and deliver to all end-users. The speed of delivery would in this case depend on the extent of the CP's own network and on the paid peering conditions negotiated with the peering partner. Netflix has had difficulties in this respect in the past but has reached better results with a new partner and with new contractual arrangements.

3.1.3. Apps

As Jamison (2017) points out, mobile services are more and more dominating broadband use and here apps are responsible for 90% of the traffic as opposed to the Internet. Apps are "walled gardens" that definitely would be prohibited under NN rules, but they can bypass the Internet and therefore bypass NN rules. Apps are provided by app stores that are part of the operating system of mobile devices. They may be non-neutral in the sense that companies like Apple can control which apps they will approve and which restrictions they will impose (Easley et al., 2018).

Apps provide only a partial bypass of NN regulations, because apps may either download content from the Internet or download content directly without an Internet connection. Thus, apps are typically faster than downloading content from Internet websites. In particular, since apps are often provided by the device maker (such as Apple or Android) who has a contractual relationship with the ISP, they can circumvent the Internet and thus NN regulations. In particular, off-line mobile apps allow the end-user to run the apps even without connectivity.

3. Full bypass

3.2. Dedicated connections to cloud platforms

Cloud service providers can be seen as CPs that customarily use the Internet to connect with their clients. More recently, however, large cloud service providers have started to build dedicated lines to major clients, thereby bypassing the Internet altogether (Lehr et al., 2018, citing Microsoft and Amazon).

3.2.1. Network slicing (5G)

Network slicing is a manifestation of the development of various virtual networks within a physical network. While the idea has been around for some while ("future networks", see Knieps, 2016), it appears that 5G presents the first real opportunity for its implementation. Each slice could in principle be reserved for a specific CP or for a group of CPs with differentiated QoS needs. The question if such network slices can effectively be used to circumvent NN regulations on QoS differentiation is still open.[11] Both the US Internet Order

[10] Lehr (2018) notes that in the future with 5G large CPs are likely to become their own MVNOs and thereby supply themselves directly with mobile Internet services.

[11] Since NN regulations typically are restricted to the Internet, their scope depends on a clear definition of the Internet. The most extensive approach for such a definition (not geared at NN regulation) is by Lehr et al. (2018). Applied to the issue above they note that "today, with CDNs, cloud service providers, application and content providers all making use and adding to the functionality of the Internet to varying degrees, it is much more difficult to craft a clear definition to decide which businesses or services are Internet services and which are not."

of 2015 (now superseded by deregulation) and the EU NN regulation (EU regulation 2015/2120) allow for specialized services that run outside the Internet and are then exempt from the NN regulations. However, at least in the EU the interpretation of such specialized services is currently very narrow and may therefore be hard to fulfil (Frias & Menendez, 2018). This means that in the EU network slicing as an avenue to circumvent NN regulation may not work after all. This could lead to major inefficiencies if, as a result, the 5G technology will not be used to its fullest potential.

3.3. Conclusions on fast lanes and priority services

While none of the bypass options discussed above strictly provides "priority services", they all deliver fast lanes. They also provide at least large CPs with multiple options so that they do not depend on a single bypass network. Overall, they reduce the scope of the Internet that remains subject to NN regulations. They are all driven by speed and other QoS requirements of the content services to which they apply. It is therefore unclear to what extent they have spread or are predicted to spread independent of or as a result of NN regulations.

4. Blocking

Although blocking looks like the most drastic discrimination implemented by an ISP, not all blocking is necessarily violating NN regulations. This definitely holds for blocking of illegal content. Also, an ISP can impose general data caps on end-users as part of its pricing options. A user could opt for unlimited data or for a data cap, the latter at a substantial price discount. Once the cap is reached, the subscriber may be unable to download further content. This would be perfectly in line with NN regulations because no specific CPs would be targeted or discriminated against (so-called "neutral" data cap, Easley et al., 2018). Less drastic optional plans may be associated with a steep price step or with throttling after the data cap has been reached. All these practices do not violate NN principles. However, a violation could occur if certain CPs either are exempt from the data caps (zero-rating, see below) or are the only ones subject to throttling.

Blocking in the sense of not allowing a subscriber to download content from specific sources is exceedingly rare, although it has happened in the past, for example, when mobile ISPs blocked services like Skype. This already hints at the possibility that blocking is associated with an ISP favoring its own content (treated below in Section 7). "Bypassing" NN regulation on blocking would mean that something similar to blocking would occur in spite of the NN regulation against it. Since this is not in the interest of CPs or end-users that would be blocked, there is no natural incentive for them to circumvent this rule. It could, however, be in the interest of competitors to the CPs that would be blocked. There does not seem to be a legal way for such competitors to engage in such "sabotage". Thus, a no-blocking rule may actually be effective, unless it is already sufficiently covered by competition law and by general consumer protection policies.

A remaining question is therefore if such discriminatory blocking would be legal in the absence of an NN rule prohibiting it. The most prominent case here would be the blocking of a rival, such as the past blocking of Skype by mobile ISPs. Access to mobile networks could be seen as essential for Skype. A right to such access may then depend on an application of the essential facilities doctrine. In its original form this doctrine is restricted to facilities that cannot easily be duplicated. In a market with three or four mobile networks one might argue that duplication has already occurred so that the essential facilities doctrine would not apply. However, even in the context of an oligopoly for mobile or fixed line connections Skype might

find it prohibitively expensive to induce a consumer to change network providers simply to access Skype. These networks as gatekeepers to the consumers would then act as competitive bottlenecks. In Europe the essential facilities doctrine is not interpreted as strictly as in the US but is interpreted more in terms of access denial by a carrier with SMP. Thus, SMP would in this case be a prerequisite for a no-blocking rule based on competition policy.

In the presence of SMP a case against blocking could potentially also be made on more general grounds of monopolization (US) or abuse of market power (EU). However, it would be much harder to make the case in the absence of SMP. Even in the presence of SMP, given the dismal record of the essential facilities doctrine in US antitrust history, it is likely that NN regulation, which works ex ante, is going to be more effective than competition laws in preventing blocking and will do so with lower transaction costs. This holds, in particular, since the essential facilities doctrine has not been really successful in the U.S. antitrust history (Areeda, 1989)

After the 2015 NN regulations in the US have been repealed, the US is now depending on the FTC for the implementation of any NN requirements. These would have to be covered either by the antitrust statutes (which in this case means the Clayton Act) or by the Federal Trade Commission Act, which forbids unfair trade practices. It therefore needs to be seen, which of the potential NN violations will fall under these laws. It can be expected that the FTC will offer some guidelines on these issues. Since the FTC is a large federal agency with offices throughout the country, at least the most blatant NN violations should be covered, which means that for those violations NN regulation would make little difference. The EU does not have a similar EU-wide watchdog, but given available staff and expertise the Body of European Regulators for Electronic Communications (BEREC) or national consumer protection agencies may be able to fulfil a similar function.

5. The no price and no price discrimination rules

From the perspective of CPs and end-users the no priority pricing rule is circumvented automatically along with their QoS bypass, because the CPs bypassing the ISP network have to pay for this bypass to others, or they incur extra costs themselves. Again, like for the QoS bypass the ISP does not receive any of these payments but also does not incur the network costs.

Easley et al. (2018) differentiate between consumer-driven, CP-driven and ISP-driven discrimination, depending on who pays for achieving the discrimination. In case of consumer-driven discrimination the consumer pays the ISP for achieving the discrimination (or having the discrimination lifted, such as, for example a blocking of non-ISP VoIP service). In case of CP-driven discrimination the CP pays for prioritization or for other favors. In case of ISP-driven discrimination the ISP gets no pay but discriminates for traffic management or the like.

Gans (2015) and Gans and Katz (2016) consider consumer-driven and CP-driven discrimination for the case of CPs who charge end-users for content. For most part they assume a fully-informed monopoly ISP and two CPs with differentiated services. Gans (2015) shows in a simple model with a single representative consumer that NN regulation preventing price discrimination by the ISP between the two content providers can only have an effect on any agent's payoff if it prevents both differentiation vis-à-vis CPs and vis-à-vis end-users (so-called "strong" NN regulation). The reason is that the monopoly ISP under NN regulation that only disallows content-based termination charges can differentiate reception charges paid by consumers and under NN regulation that only disallows differentiated reception charges the ISP can differentiate termination charges paid by CPs (so-called "weak" NN regulation). These

possibilities are not open under strong NN regulation, where the ISP can only change charges related to both CPs and end-users. Essentially, in his model the ISP without NN regulation will implement the efficient perfect discrimination outcome.[12] Under weak NN regulation the ISP can still reach this result, while under strong NN regulation this is no longer possible. Consequently NN regulation reduces efficiency.

In contrast, Gans & Katz (2016), assuming a unit mass of consumers, show that the Gans (2015) result on strong NN only holds if the regulator imposes a binding cap on the ISP's (common) charges vis-à-vis CPs and/or if consumers have heterogeneous preferences for the two content providers. Since both these conditions are likely to hold in reality, strong NN regulation would reduce social welfare relative to the unconstrained discriminatory equilibrium outcome. The potential inefficiency in the case of a binding price cap is excessive quality provision by the CPs, while the potential inefficiency from heterogeneous tastes is the exclusion of low-value content. Under the binding price cap the CPs compete by increasing their quality, while under heterogeneous consumers the ISP may increase the price so that consumers only choose the high-quality CP.[13] In the Gans & Katz (2016) model the unregulated case is efficient. NN regulation can therefore only produce worse outcomes if it has behavioral effects.

While the Gans (2015) and Gans & Katz (2016) results are the first to show that NN regulations can be circumvented by ISPs and CPs they are restricted to the case of CPs that charge prices to end-users and they do not extend to advertising-financed CPs. This excludes a major, although potentially decreasing portion of Internet traffic. The reason why the results do not work for advertising-based ISPs is that there is a missing price and thus the ISP now has fewer pricing instruments at its disposal (Gans, 2015).

A second major drawback of the Gans (2015) and Gans & Katz (2016) analyses is that they are restricted to an idealized framework, where the monopoly ISP in the absence of NN regulation can implement the fully efficient perfect discrimination outcome. In reality ISPs are not fully informed and can only imperfectly discriminate and are in imperfect competition with each other. Nevertheless, they will take advantage of the absence of NN regulation and will adjust their pricing behavior to NN regulation.

In general, if the no price and no price discrimination rules are binding on an ISP's behavior it means that the ISP's pricing freedom is restricted. This is particularly important in the context of two-sided markets. The ISP is offering subscription and transport services to content providers and end-users. It is well known that the prices charged these two sides are interdependent so that an increase in the price to one side reduces demand by the other side. Thus, keeping the price to CPs low (at zero) ceteris paribus increases demand by end-users for some other services, such as subscriptions. As a result the ISP will try to change its behavior or prices on some other front, something known as the waterbed effect (Genakos & Valletti, 2011). However, it is not clear that the ISP can rip all the benefit of the zero price for the CP, because the CP may increase its price to the end-user or may change its offerings to end-users.

[12] In contrast, in the simple Gans (2015) model competition between ISPs would allow consumers to extract all surplus from ISPs in the form of negative subscription fees (or subsidies, such as those for handsets), while the ISPs as gatekeepers for CPs to consumers extract all the surplus from CPs. This is an example of a competitive bottleneck, similar to mobile call termination. In this case neither weak nor strong NN regulation affects the outcome.

[13] Alternatively, the ISP may keep a low price if sales to both CPs respond strongly to lower prices.

The price restrictions imposed by NN regulation will be beneficial at least for some CPs or end-users who will then have an increased willingness to pay for the ISP's subscription service. In particular, ISPs can then increase and differentiate charges for end-users. Also, under price and QoS restrictions ISPs will be incentivized to use more usage-sensitive pricing vis-à-vis end-users, and CPs will find it more useful to charge end-users rather than depend solely on advertising revenues (Katz, 2017).

To the extent that NN regulations forbid charging CPs for access to end-users or forbid price discrimination between different sources of content such regulations can in practice only partially be circumvented via other prices, such as subscription fees to ISPs and prices charged by CPs to end-users.

6. Throttling

Throttling can happen involuntarily but is now regularly part of a contractual arrangement of zero-rating (Krämer & Peitz, 2018). One may therefore distinguish two cases of throttling, one that happens against the wish and interest of the end-users affected by it and one that occurs with the end-users' consent. The former is presented by the Comcast 2008 case before the FCC. Starting in 2005, Comcast, was accused of secretly throttling peer-to-peer technologies that its customers were using over its network. In particular, the users of BitTorrent were blocked or slowed down in using this file-sharing service. In view of the fact that such content used a lot of Internet capacity Comcast could have discriminated this way as an act of traffic management. However, it occurred selectively and even during off-peak times and was kept secret from Comcast's customers (Max Planck Institute for Software Systems, 2008).

In contrast, zero-rating typically is an arrangement, where the end-user agrees to sometimes suffer throttling in exchange for a lower subscription price. The potentially discriminated against party in the latter case is that of CPs, who are not part of the agreement between ISP and end-users and whose content is being throttled.

Fairly obviously zero-rating with throttling provides QoS differentiation and thereby would violate NN regulations against QoS differentiation, unless the throttling can be interpreted strictly as traffic management, which would only be the case if all traffic were subject to the same throttling or if throttling was an exceptional or temporary phenomenon. Thus, zero-rating with throttling restricted only to zero-rating customers and happening on a permanent or repeat basis would violate NN rules (in particular, Recital 15 and Article 3(3)c of EU regulation 2015/2120) and would therefore fall under the same cases as discretionary throttling applied by ISPs (Krämer and Peitz, 2018).

So how can and do ISPs avoid such throttling that violates NN rules? The obvious way is to build excess capacity and/or to throttle all traffic inclusive of that most sensitive to QoS deteriorations. Such traffic then moves to the QoS options discussed above, such as CDNs. Thus, a rule forbidding selective throttling can only be circumvented in the shady area of traffic management, where throttling decisions are declared to be traffic management that in fact they are not.

7. Favoring ISP owned content (incl. zero-rating)

The classic way for ISPs to circumvent the NN rule on not favoring own content has been for them to create actual or virtual networks that are separate from the network covering the Internet. The most prominent example is that of cable TV services offered by cable TV companies or by incumbent telephone companies. In this case the ISP benefits from the

circumvention both as an ISP and as a CP. Neither in the US nor in the EU has this circumvention been seen as a violation of NN regulations, because NN regulations typically allow for specialized services that are exempt under certain conditions. Cable TV and incumbent telephone services seem to fulfil these conditions, or they are grandfathered as offering services outside the Internet. It is surprising, however, that this issue has not yet been raised by OTTs who compete with these services and under NN rules would be restricted to best effort content delivery. This holds in particular, since major ISPs have been on an acquisition spree for CPs that deliver entertainment services and compete with OTTs. Lehr et al. (2018) note that it is not clear how one might distinguish between such entertainment media and other types of Internet traffic with the same types of content.

Zero-rating may favor ISP-owned content to the extent that the content that does not count against data caps is vertically integrated content by the ISP. In case zero-rating is restricted in such a way it definitely violates NN regulations.

Internet fragmentation can occur, among others, when an ISP excludes content other than that owned by it. It can happen with or without NN regulation but appears to be more common in the absence of NN regulation (Easley et al., 2018). To the extent that fragmentation is due to blocking of content it could be prevented by a no-blocking rule both under NN regulation and under competition and consumer protection laws. Fragmentation could, however, also be caused by discriminatory treatment of content short of blocking, such as by zero-rating in favor of ISP-owned content. Thus, there may be no NN bypass that for sure would prevent Internet fragmentation.

The conclusion on NN regulation of ISP-owned content is that such regulation will generally be effective with the exception of "grandfathered" telephony and cable-TV services.

8. Potential inefficiencies created by NN bypass

Even if NN regulations have little effects in terms of reaching their desired goals of no QoS differentiation and no delivery payments by CPs, they still affect economic behavior via restrictions on the ISPs' choices. Such restrictions could be inefficient if they are circumvented by others or by the ISP. Such potential inefficiencies could occur on the production side and on the pricing side.

On the production side CDNs, paid peering, network slicing, and apps are the main ways to physically circumvent NN regulations prohibiting QoS differentiations. There are two potential inefficiencies associated with these circumventions. First, the ISPs themselves may be in a position to more efficiently offer these "circumventions" that CPs (and their customers) obviously demand and benefit from. Comcast already does this with respect to CDNs, and ISPs will in the future most likely offer network slicing within their own networks. Also, CDNs have been an innovation that tremendously helped CPs with a large geographic footprint and that was introduced by entrepreneurs outside the traditional ISPs. Any additional costs of network duplication via CDNs is likely to be more than compensated by the additional competitive effects of CDNs on ISP-owned backbone networks (Chiang and Jhang, 2014). This already happened before the NN debate and was independent of it.

Similarly, it would be a hard stretch to argue that mobile apps were developed in order to circumvent NN regulations. However, to the extent that NN regulations slow down congestion-sensitive content requirements, apps, such as Waze, replace similar Internet-based applications. Thus, the only remaining candidate for production inefficiencies would be CP owned networks that use paid peering to interconnect with the Internet backbone. Again, these inefficiencies are

likely to be small, because the inefficiencies from duplicate networks would only loom large if those networks were small. However, this can hardly be said for Netflix, Google, Facebook and others who use this approach (Lehr et al., 2018). Thus, self-selection of CPs to become network owners assures that production inefficiencies will be small or negligent here. As mentioned above, if network slicing were disallowed under NN regulation the 5G technology may not be used to its fullest potential (Frias & Menendez, 2018).

While this discussion suggests that the production inefficiencies from circumvention are small, it so far leaves out the inefficiencies from unfulfilled demand for NN circumvention by smaller CPs that cannot make use of all the available avenues for NN circumvention. It appears that commercial CDNs cater to both large and small CPs. The same seems to hold for apps. Thus, these two avenues are open to various business sizes of CPs. As indicated above this is not the case for CP owned networks and may not be the case for network slicing.

A last production inefficiency following from NN regulation is that the technology of QoS differentiation that has been developed by CISCO (CISCO, without date) and others will remain idle. It would enable the ISPs to better balance the QoS requirements of various CPs and would encourage entry of congestion-sensitive CPs (Easley et al., 2018). Whether in the absence of NN regulation it would actually have been used across networks is doubtful, though, because of the difficulty or unwillingness of ISPs to reach agreements for achieving QoS across networks.

As described above NN restrictions on pricing cause the ISPs and CPs to adapt their behavior. These adaptations are imperfect and therefore will generally not yield the same outcomes as would occur without the NN regulations. They will generally increase ISP profits relative to the no-reaction case but their effects on CPs and end-users are ambiguous. Thus, whether these attempts of circumvention increase or reduce inefficiencies from the regulatory constraints will be case dependent.

A notoriously difficult question to answer is if circumventions of NN regulations cause higher or lower transaction costs than would occur either without such circumvention or without NN regulations. For example, preventing blocking via competition laws could incur high transaction costs, while NN regulations may yield more effective no-blocking without incurring high transaction costs, because ISPs hardly dare to disobey the rule. However, transaction costs gone into creating the rule can be exceedingly high.

While bypass of NN regulations is likely to create productive and allocative inefficiencies, it is at this stage impossible to put any numbers on these effects.

9. Conclusions and policy consequences

Bypass of NN regulations is driven by incentives and opportunities. In the case of QoS differentiations there are strong incentives for CPs and end-users alike to get priority and high QoS. These incentives have increased over time, and technical developments provide ample opportunities to fulfil them. In the case of the no-price/no price discrimination rules there are incentives primarily for CPs and ISPs, but the opportunities are restricted by market forces so that NN regulation “bypass” is likely to be imperfect. In the cases of blocking and throttling there are no incentives for the CPs and their end-users to “bypass” the no-blocking/no throttling rules, whereas ISPs would have incentives but little opportunities for such “bypass”.

The answer to the question in this paper’s title is that there has been “much ado”. It has, however, not been “about nothing” but rather about quite little. NN regulation has been and

will be ineffective in the following sense: First, the no QoS differentiation/no priority rule gets circumvented by CPs using CDNs, paid peering for CP-owned networks, network slicing and apps. Whether there would be more QoS differentiation without NN regulation remains to be seen by comparing countries with and without NN regulation. Second, the no-blocking rule is effective in the sense that no blocking occurs under NN regulation. However, at least some blocking will also be prevented by competition law and general consumer protection laws. This may, however, be less certain and be associated with more transaction costs than under NN regulation. Third, the no payment and no price discrimination rules get circumvented along with the QoS differentiation methods that are costly to CPs. To the extent that QoS remains at the best effort level the no price/no price discrimination rule gets partially circumvented via waterbed effects that shift the NN induced pricing constraints onto prices for other services. Fourth, selective throttling as part of zero-rating schemes will violate NN regulations and may therefore be prevented by them. Fifth, the rule against favoring ISP owned or ISP associated content has been circumvented in ISP owned VoIP and cable TV networks and may be circumvented in apps and via network slicing. However, favoring ISP owned content over the Internet may well be hard or impossible under NN regulation.

Overall, NN circumvention can be inefficient, because it prevents ISPs from using an integrated approach to QoS and price differentiation and it thus can lead to more expensive solutions in network integration and in pricing. However, for an overall evaluation of NN regulations one also has to count the potential inefficiencies associated with NN regulations that actually are effective. This is what most of the economics literature on NN regulation has concentrated on and which shows strongly case-dependent outcomes (in general Krämer et al., 2013; Greenstein et al., 2016; on zero-rating Hoernig & Monteiro, 2018).

Summing up, not all NN regulations are ineffective. However, given the potential inefficiencies associated with those that are ineffective it is important to limit NN regulations to those cases where they are likely to be effective and not harmful. This would mean that only the anti-blocking rule and the rule against favoring ISP owned content should survive. The no-priority/no QoS differentiation rule should be replaced by a rule disallowing discriminatory differentiation, i.e., forbidding QoS differentiation that is not open to all CPs.

This paper has developed some empirical hypotheses with largely anecdotic backing. Since these hypotheses if true would have important policy implications, they reveal two large research gaps. First, to the best of my knowledge, the theoretical literature on NN regulation has so far not addressed the issue of (partial) physical or virtual bypass of NN regulation of the relevant ISP's network.[14] Only Gans (2015) and Gans and Katz (2016) have addressed the related issue of "pecuniary" bypass, but have done so only in an idealized setting. Second, there exists no empirical work on the effects of physical or virtual bypass on the effectiveness of NN regulation. Such work could help determine if the main hypothesis of the current paper holds up against numerical evidence.

[14] Coucheney et al. (2014) provide some theoretical results on backbone networks but the relationship to the NN debate is spurious.

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