Centre on Regulation in Europe

Improving network and digital industries regulation

Data Traffic Exchange:

IP Interconnect – to regulate or not to regulate?

CERRE Project Report

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1. Introduction

The future regulation of traffic exchange mechanisms between networks will be the subject of significant revision under the proposed EECC.[1] A differentiated approach for different traffic types is proposed, reflecting the fact that today in Europe there are effectively three quite distinct traffic exchange schemes, or interconnect models, dealing respectively with fixed-voice traffic, mobile-voice traffic and then general data traffic (or IP traffic) in all its forms. While this paper seeks principally to address the third of these traffic exchange mechanisms, the first two schemes cannot be ignored as their very existence and future evolution create issues which are relevant in the consideration of the third form.

It is noteworthy that in other regulatory regimes the distinction between different traffic types may exist but it is of little practical consequence. For instance, the use of a common fixed and mobile numbering range in North America has meant that there were only ever two traffic exchange mechanisms (voice traffic and data/IP traffic); moreover, with the widespread use of Bill and Keep in the US, the distinctions in their traffic exchange mechanisms are much more limited than those that prevail in Europe.

European regulators and indeed the Commission itself also see a harmonised approach to traffic exchange as a kind of ideal. Thus BEREC, in its paper looking at future interconnect models, noted[2] that:

"As separate networks are expected to converge towards a multi-service (including voice) NGN IP-network such differences may not be sustainable or efficient in the long run and it may be appropriate to define a charging mechanism for voice termination that would avoid arbitrage between regulated and unregulated services and resulting competition problems. A converged multi-service NGN-IP could benefit from a single terminating charging mechanism."

BEREC identifies many criteria for such a harmonised outcome - not least of which is a reduction in the differential in pricing for the different service types, whether regulated or not. While the EU Commission in its Recommendation on Termination Rates was leery of any imposed Bill and Keep regime, it also noted that very low termination rates could facilitate the development of Bill and Keep without the feared drawbacks:[3]

"However, a significant reduction of termination rates from current levels might create appropriate incentives for voluntary inter-operator agreements and consequently Bill and Keep type arrangements could evolve naturally."

[1] COM(2016) 590 final/2 2016/0288(COD) Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing the European Electronic Communications Code (Recast).
[2] BEREC Common Statement on Next Generation Networks Future Charging Mechanisms / Long Term Termination Issues- BoR (10) 24 Rev 1.
[3] Explanatory note Section 6.1.2.

The distinction between the imposition of Bill and Keep and its natural adoption in the industry is an important one. Where it is imposed by regulatory fiat, the risks of abuse flowing from zero pricing are enhanced because operators face no sanction for misuse. Even with very low termination rates - rates which are so low that the transaction costs of billing and collection would not be covered - there remains a credible sanction that one side can impose on the other to ward off misuse. In any event, a study prepared for the Commission in the context of the 2009 review, noted that the imposition of Bill and Keep in Europe was not consistent with the regulatory framework and would be *ultra vires.*[4]

In the recent past the Commission proposed to introduce a new form of interconnect for data traffic in its original TSM proposal.[5] Its Article 19 Assured Service Quality (ASQ) product, with the associated recitals, was justified thus:

"In a context of progressive migration to 'all IP networks', the lack of availability of connectivity products based on the IP protocol for different classes of services with assured service quality that enable communication paths across network domains and across network borders, both within and between Member States, hinders the development of applications that rely on access to other networks, thus limiting technological innovation."

The Commission's current EECC proposal[6] has provisions dealing with a harmonisation measure for EU termination rates, in the form of a (very complicated) mechanism for establishing maximum voice termination rates across Europe. The EU Commission is already working on morphing its Recommendation on Termination Rates into an Article 19 Decision such that whatever the final form of Article 73, a similar outcome can be expected. It is another issue whether such a mechanism for harmonising termination rates could or should be used for other policy goals such as the promotion of Bill and Keep for voice traffic exchange (and thereby a single termination charging regime). Certainly, such an approach could give form to policy makers' aspirations for a harmonised termination regime for all service classes. In a way, while the Commission originally sought to create a harmonised termination regime by bringing data into the regulated interconnect fold via ASQ, it might now create a harmonised termination regime by pushing regulated voice to a Bill and Keep regime akin to data peering. If demand for differing Quality of Service (QoS) across networks evolves, questions arise about how that might be delivered. Technological change may be a means to address this issue in the future, and software defined networking (SDN) and network function virtualisation (NFV) technologies are already permitting the provision of network voice services by parties which are not the network

[4] Preparing the next steps of eCommunications - a contribution to the Review of the eCommunications regulatory framework", Hogan & Hartson LLP and Analysys Consulting, 2006.
[5] COM(2013) 627 final 2013/0309 (COD) Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012.
[6] COM(2016) 590 final/2 2016/0288(COD) Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing the European Electronic Communications Code (Recast).

owner. While such disintermediation of network services from the networks themselves is, in a sense, the final frontier for over the top (OTT) providers, such developments may provide for differentiated quality of services whilst simultaneously sidestepping interconnect as a control point, at least for the largest operators. Technological change therefore could bypass regulated control points but could also create new control points that are more likely to rest with the network service provider rather than the traditional network provider.

Since traffic trading evolved differently in the US compared to the EU, we can now see two different models at work and can compare the outcomes of those regimes. The US model is much more harmonised between the different traffic types while Europe and European operators continue to fight for, and build for, different interconnect regimes for different traffic classes. We consider the risks and opportunities of this twin track approach in Europe and whether regulators have sufficient tools under the new regulatory framework to address any issues that might arise.

This paper starts with a general overview of traffic exchange, it then looks at what has been considered in the past in terms of harmonising the interconnect regimes and what might now evolve from the current proposals.

2. An overview of traffic exchange for different traffic classes

2.1. Regulated voice traffic exchange in Europe

According to the Calling Party Pays (CPP) principle that prevails in Europe, a termination rate for traditional managed voice traffic is set by the called network and paid by the calling network. The called party is not billed for this price and has no incentive to respond to the termination price set by its network provider.

Analyses of demand and supply substitutability have shown that there are no substitutes at wholesale level which might constrain the setting of charges for termination in a given network. Although theoretically there are some constraints that might emerge, they are unlikely to do so in practice.

For traditional managed voice, even though the technology solution is migrating from analogue interconnect to IP interconnect, it is not changing the relevant economic or technological facts determining its regulatory character. Traditional voice service providers in Europe continue to treat fixed voice services as just that, not as generalised IP data packets. The associated E.164 number is attributed to a network owner and thereafter to a user at a designated geographic address. Any call from that number goes over a voice-specific interconnect. That means that parties on both sides of that interconnection know that it is a voice call and can agree to a specific quality of service for those voice calls across networks. These calls also incur a termination fee as compensation for the cost of terminating the call. As noted in the Commission Recommendation on Termination Rates:[7]

"Call termination can only be supplied by the network provider to which the called party is connected. There are currently no demand or supply side substitutes for call termination on an individual network. Therefore, each network constitutes a separate relevant market and each network operator has a monopolistic position on the market for terminating calls on its own network."

In an all-IP context, network owners can manage voice traffic exchange traffic over specific IP interconnects that only deal with voice traffic and with respect to which a termination fee can be charged. A similar mechanism relates to the E.214 numbering scheme in place for mobile networks. This mechanism for the exchange of traffic is the only one that exists today that allows the exchange of traffic between two or more networks as a voice call. Only this mechanism allows service level agreements (SLAs) that can attach to the quality of service for voice calls, through which guarantees on delivery can be made.

[7] European Commission Recommendation of 7 May 2009 on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU (2009/396/EC).

From a traditional voice termination perspective, the expected outcomes of a change in technology is that traditional (managed) voice traffic will continue to be exchanged as voice traffic and all the above-noted competition problems of traffic exchange will continue even in this changed technology context.

The reason for this outcome is that, as analogue voice is transitioned to voice in an all-IP environment, service providers have more difficulty in identifying or managing that traffic within the generalised IP streams in the way that they would want. One way of dealing with voice as a distinct service is to have a voice-only interconnect so that it can continue to be fully managed (and to which termination rates apply, rather than peering, as well as SLAs etc.). This is exactly what we see today. A study by BEREC which looked at a range of countries' approaches to regulating voice interconnect and the transition to all-IP networks found that a separate IP interconnect regime existed for voice traffic only, where no other traffic is exchanged:

"*The physical IC link of the IPvIC of all operators analysed can only be used to transport voice (and fax) traffic and not to exchange also other traffic (e.g. Internet traffic) between the interconnected networks except in Slovenia where additional services can be transported in the IC link of the IPvIC of the FNI if this is supported by the equipment.*"

The regulatory implications of the different traffic exchange schemes are quite profound. In the case of voice-specific interconnection, the economic implication flowing from the technical characteristics is that the absence of competition makes continued and detailed regulatory oversight essential.

2.2. Regulated voice traffic exchange in the US

The exchange of traffic between networks has evolved rather differently in the US.[8] In the US, the obligation to interconnect set out in the Telecommunications Act of 1996 mandated methods of interconnection and the compensation models for determining the rate. The FCC subsequently made its estimates[9] of an indicative range of prices governing the exchange of traffic between networks. That indicative rate was set differently depending on the service and area, with reciprocal pricing being the standard rule. Very often however, the cost of metering and collecting the traffic exchanged exceeded the value of the revenues. Operators chose not to bill for the traffic, or to bill on an estimated basis (subject to negotiation) where large traffic imbalances are observed. US mobile operators overwhelmingly opted for these Bill and Keep type solutions whereby no compensation changed hands.

The US is one of a few countries to use these alternative arrangements, under which network operators negotiate termination fees, subject to an obligation to interconnect and usually subject to the requirement that rates received by both networks that are parties to the same

[8] See for example JS Marcus, 2004 'Call Termination Fees: The U.S. in global perspective' for a synopsis.
[9] FCC Order FCC 96-325.

agreement are reciprocal. These operators often choose to set termination rates at zero. This is Bill and Keep. It is often (though not necessarily) related to the Receiving Party Pays (RPP) principle, according to which, in the absence of wholesale charges paid by the calling party's operator, the receiving operator directly charges its customer for receiving the call. RPP can, and usually does, follow from a Bill and Keep system. There is no record of Bill and Keep ever being actually imposed by a regulatory authority. It generally results from voluntary agreement between interested parties, made when the net financial settlements are close to zero.

It is argued that Bill and Keep obviates the need for regulatory intervention and resolves the termination bottleneck. Moreover, it is further argued that Bill and Keep leads to lower retail prices for call origination and increases usage via a demand response. Proponents of Bill and Keep also consider that it facilitates development of innovative offers, e.g., flat-rate offers promoting increased usage. It also brings immediate benefits by decreasing transaction and measurement costs. Finally, RPP internalises the call externality which arises if the calling party pays the whole bill.

Nevertheless, mandating that the price of any service is zero may have significant negative effects. It may, for example, cause distortionary behaviour, bring arbitrage opportunities, and lead to inefficient traffic routing and network utilisation. Thus an often cited problem in Bill and Keep is "hot potato routing", where the originating operator has an incentive to drop a call on the terminating network as soon as possible. Another potentially problematic issue is inefficient routing of traffic from operators not participating in the Bill and Keep scheme.

In order to recoup the costs of termination, US operators sought and received permission to invoice consumers directly for termination of the call - RPP. As noted above, with RPP the receiving network terminates calls without charging the originating operator the full cost of that termination service, and that operator recovers the termination costs from its own retail customers. Since this charge was noticeable to the consumer, there was an incentive by the consumer to respond to that charge where more competitive alternatives exist.

As Littlechild has noted, "Changing to a 'bill and keep' regime would avoid the bottleneck monopoly and associated distortions of conventional CPP regimes, yet enable operators and customers themselves to choose how to pay for calls - in effect, to choose between CPP and RPP."[10] RPP thus avoids most of the deficiencies of the CPP system, e.g., high termination rates resulting from the monopoly on termination markets, which produce negative competitive consequences both at the wholesale and retail level.

However, RPP met resistance from customers unwilling to shoulder the termination charge for unwanted calls. RPP might not be efficient if the calling party values the call highly but the called party does not and, as a result, an efficient call might not be completed. Over time, RPP proved

[10] Mobile Termination Charges: Calling Party Pays versus Receiving Party Pays, S C Littlechild Telecommunications Policy, 2006.

a constraint on usage and operators generally either waived the RPP charge directly or used very large bundles of minutes to effectively achieve the same end indirectly.

2.3. Unregulated data traffic exchange (IP-Interconnect)

The dynamics of data traffic exchange are normally very different from traditional voice traffic exchange[11]. In the first instance, there are many possible ways of 'terminating' a data connection – for instance mirror sites, or accessing the same site in different ways through different routes. The fact that most traffic does not require real-time delivery creates a huge variety of possibilities to route traffic in different ways (even a short buffering for video creates this opportunity). In addition, the basic structure of the internet's architecture inures the traffic exchange mechanism from the exercise of market power to a significant extent.

At the moment, the Internet consists of over 57,113 Autonomous Systems (AS).[12] An Autonomous System can independently decide which other AS to exchange traffic with on the internet; it is not dependent upon a third party for access.

Networks of internet service providers, hosting providers, telecommunications network operators, multinationals, schools, hospitals and even individuals can be Autonomous Systems; all that is needed is an 'AS number' and a block of provider independent IP-numbers. However, most organisations and individuals do not interconnect autonomously to other networks, but connect via an ISP. In order to get traffic from one end-user to another end-user, these networks need to have an interconnection mechanism. These interconnections can be either direct between two networks or indirect via one or more other intermediate networks that agree to transport the traffic. Either networks connect directly or a network that is already connected agrees to deliver the traffic (transit).

The vast majority of network connections are indirect, since it would be virtually impossible to interconnect directly with all networks on the globe. The economic arrangements that allow networks to interconnect directly and indirectly are called "peering" and "transit" respectively. Peering occurs when two or more autonomous networks interconnect directly with one another to exchange traffic; this is often done without charging for the interconnection or the traffic. Transit arises when one autonomous network agrees to carry the traffic that flows between another autonomous network and all other networks. Since no network connects directly to all other networks, a network that provides transit will deliver some of the traffic indirectly via one or more other transit networks. A transit provider's routers will announce to other networks that they can carry traffic to the network that has bought transit. The transit provider receives a "transit fee" for the service.

[11] An overview of this dynamic can be found at https://arstechnica.com/features/2008/09/peering-and-transit/
[12] As at end April 2017 http://www.cidr-report.org/

2.4. IP-Interconnect's built in stabilisers: peering/transit

Given the rules of peering, an ISP needs its own network to which customers connect. The costs of the ISP's network (lines, switches, depreciation, people, etc.) can be seen, as a first approximation, as fixed; costs do not increase when an extra bit is sent over the network. On-net traffic essentially incurs a virtually zero incremental cost while off-net traffic using peering costs a bit more, since the network will have to pay for certain equipment such as a port and the line to connect to the other network.

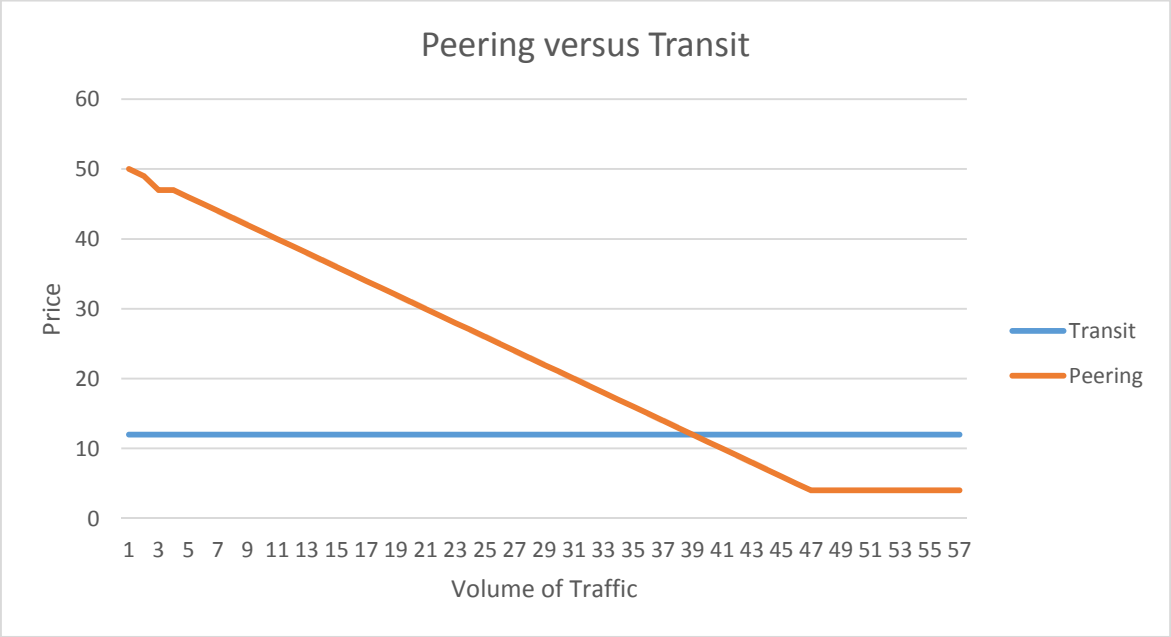
Transit is more expensive. The ISP will have to estimate how much traffic it needs, and any extra traffic will cost extra. If the ISP is faced with extra traffic, its first priority will be to keep the traffic on its own network. If it cannot, it will then use peering, and as a last resort it will pay for transit.

Since all networks need to buy some amount of transit to be able to interconnect with the entire world, and to achieve resilience, they choose more than one transit provider. Transit costs money, and as the network grows, its transit bill will grow too. In order to reduce its transit bill, the network will look for suitable networks to peer with. When two networks determine that the costs of interconnecting directly (peering) are lower than the costs of buying equivalent transit, they have an economic incentive to peer.

Peering's costs lie in the switches and the lines necessary to establish the direct connection between the two networks. Once traffic reaches some critical level (see Figure 1 for a stylised example of costs) it makes sense to invest in a direct interconnect. After a peering agreement has been made, the marginal costs of sending one bit becomes asymptotically close to zero. It then becomes economically feasible to send as much traffic between the two network peers as is technically possible, so when two networks interconnect at 1Gbps, they will use seek to use the full 1Gbps. But with transit, even though it is technically possible to interconnect at 1Gbps, if the transit-buying network has only bought 100Mbps, it will be limited to that amount. Transit will also remain as a backup for whenever a peering connection gets disrupted. As traffic exchanged increases, an operator saves money by moving to more and more peering arrangements, thereby limiting its transit arrangements.

An important limitation of peering is that it is open only to traffic coming from a peer's end-users or from networks that have bought transit. A transit provider will not announce a route toward a network it peers with to other networks it peers with or buys transit from. If it did announce the route, it would be providing free transit over its network for its peers or, even worse, buying transit from another network and giving it away without charge to a peer.

Figure 1: Stylised relationship between transit and peering.



Source: Authors' own work

A key point to note is the dynamic of the transit fee, which is based on a reservation made up-front for capacity (the number of Gbps) sent from (upstream) or to (downstream) by the network. So when you buy 10Gbps/month from a transit provider you get 10Gbps up and 10Gbps down. (This means that an operator which sends very little traffic but receives a lot would - in the absence of a direct interconnect - need to buy exactly as much transit capacity as the sending party.) The traffic can either be limited to the amount reserved, or the price can be calculated afterward (often leaving the top five percent out of the calculation to correct for aberrations). Exceeding a reservation may lead to a penalty charge.

Transit providers seek to charge fees which, at a minimum, recoup their investment in the lines and switches that make up their networks. The cost to be recouped will be a combination of the costs of running the transit provider's own network, plus the amount of transit that provider has to buy, which excludes the traffic that is destined directly for peers and customers of the transit provider. The larger the volumes of traffic offered, the lower the price of transit. Even the largest local access providers are much smaller than many internet operators, so local access operators are often at a cost disadvantage with respect to transit compared to internet operators. Given the need to buy transit where peering is unavailable whether sending or receiving, this creates a significant constraint on a local access operator's ability to exercise market power for IP-Interconnect. It could even be the case that, far from having the ability to exercise market power, even a large ISP might be forced to interconnect due to another party's pricing power.

This dynamic follows from what has been said above. If a local access operator refuses to peer even though it is a lower cost solution, then the party sending traffic can use transit even though this will be more expensive – since the party sending the traffic may have transit already in place or may face a relatively favourable price. In addition, since the local access operator will need to increase its transit capacity to match, its ability to refuse a more commercial solution is likely to be time limited.

The key point therefore is that if network A refuses to peer with network B then it is possible for network B to impose costs on network A. If network B is big enough then this tactic is likely to drive a solution, though of course if network A has sufficient size it might hold out for a longer period. This is the main reason IP-Interconnect has not needed to be regulated.

However, this description is necessarily oversimplified. Since IP-interconnect has not been regulated in the past, it exhibits a wide variety of outcomes, with paid peering co-existing with settlement-free peering, and special arrangements where data traffic from an ISP in one country is transited through a third country rather than direct traffic exchange etc. However, the key point to date is this: IP traffic continues to move freely across the internet and there does not appear to be any major problem with this mechanism.[13]

[13] A finding recently reaffirmed in BEREC's review (BoR (17) 111 1 June 2017 BEREC Report on IP-Interconnection practices in the Context of Net Neutrality).

3. The regulation of IP-Interconnect

3.1. Why would regulation of IP-Interconnect even be considered? What would it look like?

The provision of any service within a telecom network is clearly managed to a certain specification by that network operator. However, once that traffic is exchanged between two or more networks, then the sender of the service relies on the receiving network owner for delivery of the service to the end-user.

In a traditional voice context this is not a problem since there are specific QoS standards that are in place at interconnect points and which govern the treatment of that traffic on third party networks.

In an IP-Interconnect context, the problem for parties wishing to discriminate between traffic is that there is no mechanism to do so once that traffic goes off-network onto a third party network. The only traffic exchange points which exist are formulated on the basis of 'best-efforts'. There may be billing or not depending on a variety of factors: peering can be paid or free – transit is paid but even then, there are usually no formal mechanisms, more a rule of thumb is agreed/negotiated. However, the arrangements to send and receive traffic are often very *ad hoc* and informal and have no contractual terms attached.[14] Certainly, no Quality of Service parameters are specified – merely 'best efforts'. As a matter of fact, it is impossible to deliver an end-to-end QoS-based service unless the same operator controls that end-to-end process or unless there is a virtual end-to-end service agreed and provided by all the operators involved. The creation of such a QoS based interconnect service has never been prohibited, and leased lines and VPNs are often put in place precisely to replicate such a solution. But for it to extend to general internet traffic, two things would be required:(1) on the demand side, best efforts would not be seen as being good enough and (2) on the supply side, operators would have to create an internet exchange to pass traffic with a QoS stamp that would be prioritised AND they would have to believe that their counterparty would do the same.

There is nothing to stop operators from creating such an internet exchange and QoS mechanism if they choose to; indeed the use of voice-specific interconnection points might be considered such a mechanism for that service. However, the cost of implementing it would be extremely large and there is no evidence to suggest that best efforts traffic exchange is not good enough in most instances. So called OTT services in the voice domain (e.g. Skype, Viber, WhatsApp, etc.) operate on best efforts traffic exchange, and many or most users cannot tell the difference in terms of service quality compared to traditional voice. A second problem is that while some counterparties might choose to support the QoS system, many would not. By far, the biggest

[14] BEREC recently reported that 99.9% of all peering agreements had no written contract.

problem however is economic. The fundamental question has always come back to whether it is better to build the systems to segregate traffic, and prioritise some over other, or simply throw more capacity at it. As many reports have shown,[15] it has always been cheaper to build more capacity than to segment existing capacity. This remains true even in the last 5 years. The effect may even be accelerating, as the cost of interconnect capacity is falling faster than traffic is growing.

A question that arises is whether there is really a demand for a QoS that goes beyond what can be assumed or provisioned for under traditional best efforts interconnect for data. A number of new areas do point to potential demand for QoS that is not limited to the local access provider, and that would therefore need to be managed across networks. This could be, for example, real-time health care applications or newer IoT applications (e.g. in the automotive sector) which may have strict QoS parameters associated with them. The process of digitisation of the entire economy is likely to enhance such differentiation.

While in general, the exact form new deployments of 5G and advanced fixed networks is unknown and the associated standards are a work in progress, network slicing seems to be a widely recognised ingredient of the future. It remains to be seen how or whether network slicing would operate in a context where local network slices that enjoy different QoS do so across network borders. For instance, if emergency service networks ceased to exist as separate physical entities in a 5G environment and operate as a slice instead, how is QoS to be assured across networks?

There would appear to be two ways for network owners to offer services with QoS beyond their current physical network: (i) interconnect with QoS or (ii) increase the size of their network.

Already as a reaction to demand and QoS concerns (and as a result of the peering/transit model of IP-Interconnect), new physical networks such as Content Distribution Networks (CDNs) have come into existence.[16] CDNs are often built out into local exchanges in order to enhance end-user experience and to offset the distance traffic must travel. Such arrangements are purely commercial and have mutual benefits. They allow content suppliers to manage traffic to a greater extent: this is important where service quality is important (e.g. lower latency products like gaming or real time sensitive services like video). Moreover, CDNs also reduce the local access network owner's costs and enhance the consumer's experience. Some operators choose not to allow CDNs to mesh with their networks and prefer a traditional transit/peering model of traffic exchange. Already, CDNs are working on their own interconnect (CDN-I) standards to allow seamless QoS across CDN networks.

Other technology and network developments are less obvious but have potentially significant disruptive effects. For instance, software defined networks (SDNs) may be used to extend the QoS network beyond the host network, essentially by delegating management of one network

[15] E.g. Marcus, J. Scott. "Revising the ITRs: A European policy perspective." WIK-Consult Report (2012).
[16] See Volker Stocker et al., The growing complexity of content delivery networks, Telecommunications Policy, 2017.

to software in the hands of another (see for example trials by Colt and AT&T to use SDNs in such a way).[17] Such a development might be considered as the continued disintermediation of services and networks, but now it is the network services themselves that are separated from the networks, rather than the end-user services. Such a development strongly suggests that operators may have the ability to deliver QoS-based services across networks without traditional interconnect support or co-ordination. Indeed, as observed elsewhere,[18] such a development could lead to new (virtual) 'network operators' emerging but which do not own networks at all, in the model of a travel (UBER) or accommodation (Airbnb) operator.

New and interesting competitive constraints could emerge in such an environment. But they will still need an agreement to access the physical assets of the underlying network via SDN/NFV, which itself requires a very trusting and/or tightly contracted business relationship. If a large content provider were to control network services to retail consumers, not only would they control the quality parameters, they would likely be subject to Net Neutrality (NN) requirements associated with such control. However, since this virtual network may be in a position to extend its network footprint very far – limiting its need (if not its obligation) to interconnect – interesting concerns could arise regarding NN where some connections are made by extending the network scope, while others may be achieved via traditional interconnect regimes. Whilst not directly comparable, the impact would be the same as running two different 'interconnects'. In addition, given the nature and the depth of the business relationship required to give another party the ability to control part of the underlying network, this means that from a practical standpoint, this could only be done by a select few operators.

In such circumstances, interconnect might simply cease to be a relevant control point for policy makers, even where traditional market power concerns abound.

3.2. What regulation of IP-Interconnect has been considered?

In the past, the European Commission has considered imposing QoS-based interconnect for data. A possible justification for an intervention is the proposition that the non-emergence of an alternative to best-efforts is due to a co-ordination problem. The rationale in this circumstance would be that an alternative to best efforts that allowed prioritisation of certain traffic would be beneficial but does not emerge because the networks involved would need to interconnect based on a standard and adopt the processes more or less simultaneously. The Commission's ASQ proposal would have changed all of that. In the TSM proposal put forward in 2013 (COM(2013) 627), the Commission proposed[19] to introduce a QoS-based interconnect service for

[17] http://about.att.com/story/first_successful_software_defined_networking_interoperability_trial.html
[18] Richard Feasey 'The Future of (Virtual) Networks' (Lecture to students at University College London) 18 October 2016. Available here: https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxmZWFzZXl3YWxlc3xneDoyMWYwYzVjMGZjZGZlYWM3
[19] Specifically in Article 19 dealing with Assured Service Quality (ASQ).

data traffic precisely in order to allow services that require QoS at a pan-European level to do so without resorting to VPNs or other dedicated solutions. In the first instance, the proposal would have obliged every operator in Europe to support the QoS-based interconnect which would have existed in parallel to the best efforts regime. This obligation would have set aside the economic barriers to its implementation. In addition to Europe, parties outside Europe offering QoS-based interconnect could not be refused that service (the only requirement being reciprocity). Addressing demand in that context would have been rather easy since for the first time ever, an alternative to best efforts interconnection for data traffic would have existed.

Article 19 was quickly cut from the legislative proposal but it did much to colour the view of Parliament and the Council on the provisions on Network Neutrality (NN), and in particular what the Commission sought to achieve through the use of 'Specialised Services' exempt from certain NN rules. However, while the Connected Continent proposal passed a first reading, with enthusiastic support for a significant strengthening of the Commission's NN proposals from the Parliament, the mandate of both the Parliament and the Commission lapsed in the autumn.

Moreover, the new Commission conceived the plan of a more thorough-going review of regulation of the single digital market. The agreement of the Council to the NN proposals was only achieved in April 2015, and while its position was opposed to specialised services, its dislike of some traffic differentiation was less vehement than that of the Parliament.[20]

ETNO proposed in the WCIT-12 negotiations that: "3.1 Member States shall facilitate the development of international IP interconnections providing both best effort delivery and end to end quality of service delivery." And "3.2…to ensure an adequate return on investment in high bandwidth infrastructures, operating agencies shall negotiate commercial agreements to achieve a sustainable system of fair compensation for telecommunications services and, where appropriate, respecting the principle of sending party network pays". This proposal argued that QoS was needed but the rationale for the request has to do with money rather than issues of co-ordination and management.

The key issue at stake for the European ISPs was the competitive threat that OTT services were causing for traditional telecom services such as voice, SMS etc., even though OTT voice services have no specific interconnect (and no associated QoS, etc.) but rather piggyback on general data traffic flows. Voice traffic, therefore, is exchanged as general data traffic, which by virtue of the peering and transit systems for data traffic exchange, means that any market power issues can be readily overcome. It also turns out that best efforts deliver an adequate performance in most instances. Since the OTT services are provided over the internet, the scope of competition is global and given the absence of contractual obligations, a profound form of market contestability emerged from these OTT operators, which brought significant innovation to a historically staid market. The success of these services led to calls for 'a level playing field', whereby the same services would have the same obligations. This in turn led to fears about how

[20] See Annex for the relevant provisions.

these services could be treated on specific local access networks, which gave impetus to the provisions dealing with how traffic is treated via the Network Neutrality provisions put in place in the final Connected Continent Regulation adopted as Regulation 2015/2120. These provisions have to be administered by the individual national regulators, with guidance on their application being given by the umbrella body or BEREC.[21]

With regard to IP-interconnection, BEREC for its part said that the EU-Regulation 2015/2120 at Art. 3 (3) concerns equal treatment of all traffic "when providing internet access service" and therefore excludes IP interconnection practices from its scope.[22] However, it has acknowledged that NRAs may take into account the interconnection policies and practices of ISPs in so far as they have the effect of limiting the exercise of end-user rights under Art.3(1) of the Regulation.

We do not go into these issues fully in this paper. The interaction of IP-interconnection practices, which stands outside the scope of Article 3, and the handling of that traffic once it becomes 'on-net traffic', has passed through 'interconnect' and is routed by the ISP, is an area which will need to be examined further. However, it is clear from a preliminary examination that of the two ways for network owners to offer services with QoS beyond their current physical network – (i) interconnect with QoS or (ii) an increase the size of their network – both are likely to bypass the NN rules.

In the first instance, some special form of interconnect with a QoS associated with it is likely to be assessed as something which is not '*services other than internet access services'* and is likely to be exempt under Article 3(5) of the NN Regulation. BEREC refers to these as specialised services and gives extensive guidance on the various conditions that would apply. In a sense, this is already the framework in place where voice-specific interconnects are used to exchange voice traffic without translation.

In the second instance, where SDN/NFV is used to extend the Network Services control beyond the scope of the physical network, then in practice the relevant network for the application of NN rules is likely to be the (larger) network services network and not the underlying provider of the physical network. In the example cited of AT&T and Colt, where AT&T is controlling the Colt network and determining the QoS related to a service, then the NN rules would logically apply to AT&T and not Colt (who is no longer the relevant service provider). However, given the novelty of these issues, it has already been flagged for further research.[23] Even today, managed voice which goes over a dedicated IP-Interconnect and unmanaged voice product going over a general

[21] REGULATION (EU) 2015/2120 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks within the Union.
[22] BoR (16) 127 August 2016 BEREC Guidelines on the Implementation by National Regulators of European Net Neutrality Rules - paragraph 50.
[23] Study for the European Commission SMART 2015/0011: Implications of the emerging technologies Software-Defined Networking and Network Function Virtualisation on the future Telecommunications Landscape.

IP-Interconnect without any call for intervention, would appear to bear out this preliminary conclusion.

3.3. What is changing now from a technology and market perspective that has put this question back on the agenda?

With respect to regulated voice call termination, the regulators' grouping in Europe has always advocated a migration towards a Bill and Keep system, but the rationale for such an outcome has shifted over time from a desire to address the market failure issues in voice call termination (ERG 2007/2008)[24] to a desire to harmonise the mechanisms on a converged world (BEREC 2010).[25]

When Member States adopt different termination levels and exchange significant quantities of traffic, a transfer from one Member State (with a lower MTR) to the other Member State (the higher MTR) results. This creates a perverse incentive for NRAs not to move ahead of the norm and even to delay reductions in termination rates. The French Regulator, Arcep, who was very much in the vanguard of the move to lower termination rates in France, was admonished by the French Competition Authority for moving too far ahead of other Member States and thereby weakening French operators relative to other European operators:[26]

"Ces différences d'approche réglementaire entre pays, qui induisent des transferts financiers non négligeables au détriment des opérateurs français, ne sont aujourd'hui pas justifiées par des raisons techniques ni économiques objectives. C'est pourquoi l'Autorité de la concurrence appelle de ses vœux d'une part une application accélérée et généralisée du cadre réglementaire de l'UE et des recommandations de la Commission européenne, et d'autre part la mise au point d'un cadre permettant aux opérateurs européens de bénéficier de conditions de concurrence équilibrées avec leurs homologues non-européens."

European Commission efforts to move European termination rates to a more harmonised (and lower) level were among the primary goals of the Commission Recommendation on Termination Rates adopted in 2009. At that time the Commission noted that:[27]

'Mobile termination rates varied widely in the EU in 2008 from 2.00 euro cents per minute (in Cyprus) to 15 euro cents per minute (in Bulgaria). Mobile termination rates (on average 8.55 euro cents per minute) are also typically 10 times higher than fixed termination rates (on average ranging from 0.57 to 1.13 euro cents per minute). Higher mobile termination rates make

[24] ERG (2007): Report on IP-Interconnection, Project Team on IP-Interconnection and NGN, (ERG (07) 09), March 2007, http://www.irg.eu/template20.jsp?categoryId=260345&contentId=542632
ERG (2008), ERG Common Statement on Regulatory Principles of IP-IC / NGN Core – A Program towards a Common Position, ERG (08) 26 and ERG (2008b), Supplementary Document to the ERG Common Statement on Regulatory Principles of IP-IC / NGN Core – A Program towards a Common Position, ERG (08) 26b.
[25] BoR (10) 24 Rev 1 BEREC Common Statement on Next Generation Networks Future Charging.
[26] http://www.autoritedelaconcurrence.fr/user/standard.php?id_rub=482&id_article=2258
[27] http://europa.eu/rapid/press-release_IP-09-710_en.htm

it harder for fixed and small mobile operators to compete with large mobile operators. These divergences, and differing regulatory approaches, undermine the Single Market and Europe's competitiveness.'

However, in July 2016, the highest European MTR (in Ireland) was more than twice the European average, whilst in 2008 the highest (in Bulgaria) was less than twice the average European MTR in 2008 – suggesting that convergence has not happened even if the absolute rates are falling.[28]

This lack of harmonisation has led to the work currently underway in the European Commission to transform the Commission Recommendation on Termination rates into an Article 19 decision, thereby to enforce compliance and achieve greater harmonisation.

The Commission has also sought new powers under the proposed code in relation to the setting of voice-call termination rates (Article 73). Although this Article is complicated and constrained, it would allow the Commission to set a harmonised termination rate for voice traffic for the first time in Europe.

With respect to unregulated IP-Interconnection, as more and more services that used to have a specific relationship with the physical infrastructure of the network owner became separated from that network (or disintermediated in the lexicon of the industry), greater differences in terms of network requirements start to emerge. As services develop which are not attached to the infrastructure or physical network, but rather sit on the network of networks which is the internet, the best-efforts model of traffic management might not be sufficient. This may be particularly true in the context of mission critical solutions or solutions which require very specific QoS characteristics.

Thus, in a sense, the Commission (and BEREC and the industry) have been seeking to create the conditions for a single interconnect regime for all traffic classes for some time. The 2013 proposal for a telecoms reform from the Commission sought to create, through the ASQ proposal, a regulated termination regime for data. This implied that the sector would have moved to a regulated (and paid) termination regime for all traffic classes. What the 2016 European Electronic Communications Code (EECC) proposal appears to do instead is open up a path to a single interconnect regime for all traffic classes, not by regulating data termination but by nudging the voice call termination regime to a system that mimics the charging mechanisms at work for data interconnect.

[28] The highest rate in 2008 was 7.5 time the lowest and though closer the difference remained approximately 6.5 times in 2016. Fixed termination rate have diverged significantly with the ratio being less than 2 from highest to lowest in 2008 but it was a factor of 65 in 2016 (although Finland is an outlier, it is still a factor of 12 excluding Finland).

3.4. What has now been proposed?

The European Commission has made several proposals which touch off the issue of termination rates. In respect of regulated voice call termination, Article 73 introduces a Commission-led process for determining a binding methodology for setting voice termination rates across the EU. In addition, it creates a mechanism for establishing maximum termination rates at EU level, which according to the Commission will allow NRAs 'to focus their efforts on the analysis of the most complex broadband markets'.[29]

Article 73 sets out not only how the methodology for determining termination rates will be set out but it also, via the determination of a maximum termination rate, offers the Commission the possibility to set a European-wide termination rate.

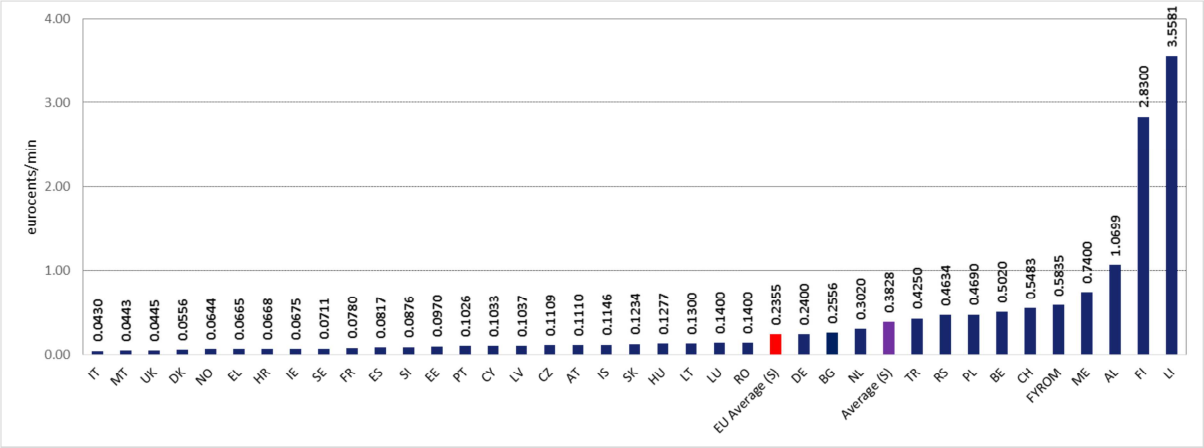
As proposed, the second paragraph of Article 73 states 'By [date] the Commission shall, after having consulted BEREC, adopt delegated acts in accordance with Article 109 concerning a single maximum termination rate to be imposed by national regulatory authorities on undertakings designated as having significant market power in fixed and mobile voice termination markets respectively in the Union.'

While some initial indicative rates are set out, these appear to be for illustration purposes only – with a maximum single voice call termination rate in mobile networks set at 1.23 €cent per minute and the single voice call termination rate in fixed networks set at 0.14 €cent per minute.

According to BEREC,[30] the weighted European average for mobile termination was 1.08 €cent while the weighted average fixed termination rate was 0.2355 €cent per minute. The lowest rates for termination were 0.4 €cent per minute for mobile and 0.043 €cent per minute in fixed networks. As can be seen from the graphs taken from the BEREC 2016 report, no discernible trend in terms of scale effects on the outcomes is obvious. Note that in Figure 2 below, Italy and Malta are the two lowest whilst Germany is above average. The same phenomenon can be observed in Figure 3 showing mobile termination rates, as Malta and the UK are amongst the lowest while Germany and Ireland are amongst the highest.

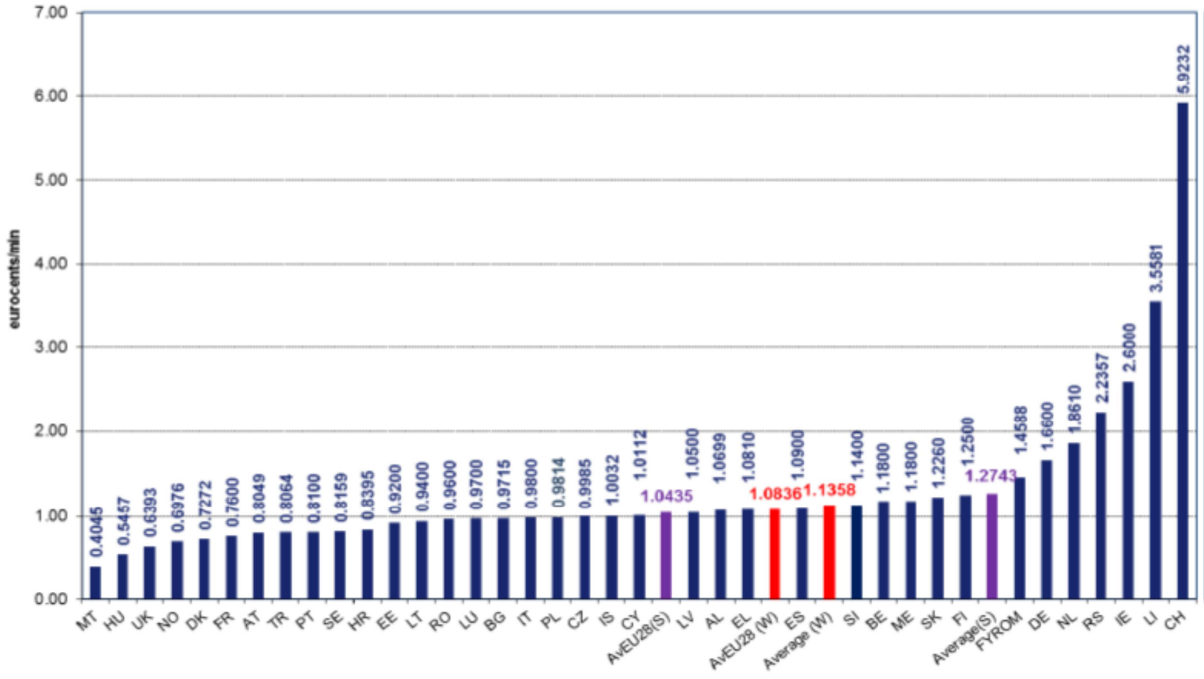
[29] Commission legislative proposal Com(2016) 590 final/2.
[30] See BEREC's Review of Termination Rates from July 2016 BoR (16) 218.

Figure 2: EU Fixed Termination Rates per Minute



Source: BEREC, 2016

Figure 3: EU Mobile Termination Rates per Minute



Source: BEREC, 2016

Under the current proposals from the Commission, the maximum rate determined should be reviewed every 5 years.

Article 73 therefore gives the Commission the ability to set termination rates directly and not only in terms of the methodology used but also in terms of the absolute level of these rates, should they choose to do so. The introduction of a termination rate which is non-zero but close to zero would certainly prod the market towards a Bill and Keep regime. As noted earlier, this is precisely what had been sought by NRAs in 2010 when BEREC sought to persuade the

Commission to mandate Bill and Keep. Such a mandated rate is very different from having a non-zero but very low rate, since it at least gives operators the possibility of punishing bad behaviour, such as hot potato routing, should it arise.

3.5. IP-Interconnection provisions

In the proposed EECC [COM(2016) 590 final/2], the EU Commission plans for a QoS-based interconnect might be read into Article 59 1(c), which provides for making a number of independent services interoperable, whether in the context of emergency services OR on request by BEREC. The text gives quite a broad approach:

'(c) in justified cases, obligations on providers of number-independent interpersonal communications services to make their services interoperable, namely where access to emergency services or end-to-end connectivity between end-users is endangered due to a lack of interoperability between interpersonal communications services.'

But the extent of the text is limited by the joiner:

'The obligations referred to in point (c) of the second subparagraph may only be imposed:

(i) to the extent necessary to ensure interoperability of interpersonal communications services and may include obligations relating to the use and implementation of standards or specifications listed in Article 39(1) or of any other relevant European or international standards; and

(ii) where the Commission, on the basis of a report that it had requested from BEREC, has found an appreciable threat to effective access to emergency services or to end-to-end connectivity between end-users within one or several Member States or throughout the European Union and has adopted implementing measures specifying the nature and scope of any obligations that may be imposed, in accordance with the examination procedure referred to in Article 110(4).'

Thus the Commission's proposals appear to suggest that for the purposes of emergency services OR interoperability, providers of number-independent interpersonal communications services (namely OTT providers) provided (a) it is necessary and (b) BEREC agree that it is necessary.

However, even if such an interpretation is possible, such an interpretation is unlikely, given that recent evidence in the market suggests the absence of problems. A number of national inquiries in the Netherlands,[31] in France[32] and at European level by DG Competition[33] and BEREC[34] all

[31] ACM (2015), IP interconnection in the Netherlands: a regulatory assessment, The Netherlands Authority for Consumers and Markets, October 2015.
[32] ARCEP (2017), L'état d'internet en France 2017, May 2017, https://www.arcep.fr/uploads/tx_gspublication/rapport-etat-internet-france-2017-mai2017.pdf
[33] http://europa.eu/rapid/press-release_IP-14-1089_en.htm
[34] DRAFT - BoR (17) 111 1 June 2017 BEREC Report on IP-Interconnection practices in the Context of Net Neutrality.

describe similar events and each concludes that no intervention is needed. The recent BEREC draft report describes the situations succinctly as follows:

'Prices for transit or CDN services continue to decline at a pace corresponding to this traffic increase. This is due to competitive pressures as well as technological progress. Given these price declines BEREC considers that the Internet ecosystem's ability to cope with increasing traffic volumes is still given. Typically, traffic asymmetries are a major factor in those instances where disputes emerged in practice. Often, these disputes are characterised by mutual recriminations between the parties involved. Even where it is possible to identify that congestion occurs, it remains a challenge to clearly identify its exact location across the value chain and even more who is responsible for the problem. This holds in particular because IP interconnection issues seem to involve complex relationships as well as economic/strategic considerations of the providers. Often providers have different options to overcome a problem (e.g. using transit, peering, CDNs, caching services in access networks etc.) So far, such disputes were typically solved in the market without regulatory intervention.'

Nevertheless, even if BEREC reports some observations that are suggestive of market power (for example where congestion problems disappear 'overnight' on foot of a commercial agreement (suggesting that the congestion was not real), there is no evidence of any major problem that would affect the functioning of the market and warrant regulation.

4. Conclusions and recommendations

A divergence is emerging between the EU and the US in how traffic is treated in the network core. While telecom operators in both markets are offering converged retail services, US network providers for the purposes of interconnect deal with voice as one entity (whether fixed or mobile); given the use of Bill and Keep by network owners, this is not so different from peering. Accordingly, manufacturers are reporting a level of cost-reducing convergence in US network orders for equipment that probably goes some way beyond that observed in Europe.

Such divergence in network development should be a concern for European policymakers if it leads to cost inefficiencies. But of greater concern to policy makers should be that these differences could affect European operators' ability to deliver new services quickly. Service innovation may be adversely affected if a silo approach to traffic classes in Europe persists.

Regulated voice call termination has not converged (at very low rates) as was initially anticipated in Europe. With very low and harmonised rates, a migration to Bill and Keep becomes possible, but we have noted that Bill and Keep is not without its problems, and a more natural and voluntary evolution to significantly lower (and symmetric) fixed and mobile termination rates could equally lead the market to an efficient solution.

Previous attempts to create the conditions for a single interconnect regime for all traffic classes were based on the creation of a regulated termination regime for data (ASQ) such that the sector would have moved to a regulated (and paid) termination regime for all traffic classes. The 2016 EECC proposal appears now to open up a path to a single interconnect regime for all traffic classes, not by regulating data termination, but by nudging the voice call termination regime to a system that approximates to the charging mechanisms at work for data interconnect.

Demand may emerge for services that need different QoS beyond local networks in the future (e.g. for 5G slicing or specific IoT applications). It appears that technological solutions are emerging to address these issues and it is not obvious that any specific intervention is warranted at this time to cater for variable QoS requirements.

NFV and SDN technology evolutions suggest that interconnect might not continue to be the gateway point to be considered by policy makers. These technologies suggest bilateral deals can allow networks to extend their network functionality and offerings beyond their physical networks. In the longer term, this has important implications for interconnect regimes, and in particular for the built-in controls on market power evident in IP-Interconnection to date. The provisions in the EECC do not address this issue, and given the uncertainty about how these network developments are likely to evolve, an *ex-post* approach may be more appropriate.

Further implications will arise from these technological developments concerning the current NN provisions, whose application stops at the network boundary.

Currently 99.9% of peering agreements are contract-free. However, it is quite possible that the 0.1% of peering agreements that have contracts cover a majority of the traffic. While (heavily) contracted SDNs could allow 'network extensions' to work for the 0.1%, something more structured and streamlined may need to be considered for the 99.9% of contractors which may seek to deliver comparable services.

5. Annex: ASQ provisions TSM proposals

Recitals

(1) 36. In a context of progressive migration to 'all IP networks', the lack of availability of connectivity products based on the IP protocol for different classes of services with assured service quality that enable communication paths across network domains and across network borders, both within and between Member States, hinders the development of applications that rely on access to other networks, thus limiting technological innovation. Moreover, this situation prevents the diffusion on a wider scale of efficiencies which are associated with the management and provision of IP-based networks and connectivity products with an assured service quality level, in particular enhanced security, reliability and flexibility, cost-effectiveness and faster provisioning, which benefit network operators, service providers and end users. A harmonised approach to the design and availability of these products is therefore necessary, on reasonable terms including, where requested, the possibility of cross-supply by the electronic communications undertakings concerned.

(2) 49. There is also end-user demand for services and applications requiring an enhanced level of assured service quality offered by providers of electronic communications to the public or by content, applications or service providers. Such services may comprise inter alia broadcasting via Internet Protocol (IP-TV), video-conferencing and certain health applications. End-users should therefore also be free to conclude agreements on the provision of specialised services with an enhanced quality of service with either providers of electronic communications to the public or providers of content, applications or services.

(3)

(4) Articles.

Article 2 – Definitions

(5) (12) "assured service quality (ASQ) connectivity product" means a product that is made available at the internet protocol (IP) exchange, which enables customers to set up an IP communication link between a point of interconnection and one or several fixed network termination points, and enables defined levels of end to end network performance for the provision of specific services to end users on the basis of the delivery of a specified guaranteed quality of service, based on specified parameters;

Article 19 – Assured service quality (ASQ) connectivity product

1. Any operator shall have the right to provide a European ASQ connectivity product as specified in paragraph 4.

2. Any operator shall meet any reasonable request to provide a European ASQ connectivity product as specified in paragraph 4 submitted in writing by an authorised provider of electronic communications services. Any refusal to provide a European ASQ product shall be based on objective criteria. The operator shall state the reasons for any refusal within one month from the written request.

It shall be deemed to be an objective ground of refusal that the party requesting the supply of a European ASQ connectivity product is unable or unwilling to make available, whether within the Union or in third countries, a European ASQ connectivity product to the requested party on reasonable terms, if the latter so requests.

3. Where the request is refused or agreement on specific terms and conditions, including price, has not been reached within two months from the written request, either party is entitled to refer the issue to the relevant national regulatory authority pursuant to Article 20 of Directive 2002/21/EC. In such a case, Article 3(6) of this Regulation may apply.

4. The provision of a connectivity product shall be considered as the provision of a European ASQ connectivity product if it is supplied in accordance with the minimum parameters listed in Annex II and cumulatively meets the following substantive requirements:

(a) ability to be offered as a high quality product anywhere in the Union;

(b) enabling service providers to meet the needs of their end-users;

(c) cost-effectiveness, taking into account existing solutions that may be provided on the same networks;

(d) operational effectiveness, in particular in respect of limiting to the extent possible implementation obstacles and deployment costs for customers; and

(e) ensuring that the rules on protection of privacy, personal data, security and integrity of networks and transparency in accordance with Union law are respected.

5. The Commission shall be empowered to adopt delegated acts in accordance with Article 32 in order to adapt Annex II in light of market and technological developments, so as to continue to meet the substantive requirements listed in paragraph 4.