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Technological principles for network regulation: a new lease of life for network operators?

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Technological principles for network regulation: a new lease of life for network operators?

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Abstract — This article assesses two key notions in the European Electronic Communications Code ('EECC'): connectivity and interoperability. These two technological influences are omnipresent in the EECC. The research focuses on the challenges and opportunities that lie ahead for the (de-)regulation of ECN operators in Society 5.0. Some of the questions raised in this working paper are: (1) What type of end-to-end connectivity measures are contained in the new framework? (2) Is infrastructure interoperability taking over as a crucial technological notion? (3) The final chapter offers a brief consideration on whether these two technological notions should be interpreted as fundamental principles of telecommunications law in times of disruption.

Key words – *Access regulation; Connectivity, European Electronic Communications Code (EECC); Electronic Communications Networks (ECN); 5G frequencies; Interoperability; Society 5.0; Technology Standards.*

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Connectivity & Interoperability in Society 5.0

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1. Introduction

1.1 Research scope and questions

This paper re-examines two key technological notions of the telecoms regulatory package that transform the digital society:[2] connectivity and interoperability. The EECC is a high-level harmonization and institutional piece of regulation. The research focuses on the challenges and opportunities that lie for the (de-)regulation of ECN operators.[3] It explores the considerations, technological principles and policy goals that underlie art. 61 EECC in Society 5.0. Is the regulation adequate to reach the policy goals? To what extent are do connectivity and interoperability soft law and do they complement each other? The EECC leaves much of the governance of ECN to national regulatory authorities (NRA's) and the Body of European Regulators for Electronic Communications (BEREC), who are relegated to pursue the EECC's objectives,[4] such as, where appropriate, ensure, adequate access and interconnection, and the interoperability of services. The NRA's must exercise their responsibilities in a way that promotes efficiency, sustainable competition, the deployment of very high capacity networks, efficient investment and innovation, and giving the maximum benefit to end-

[2] See, *e.g.*, Commission Communication "On the Mid-Term Review on the Implementation of the Digital Single Market Strategy – A Connected Digital Single Market for All", {SWD(2017) 155 final}, *COM* (2017) 228 (Commission Communication DSM 2017); Regulation (EU) 2019/115 of 20 June 2019 on promoting fairness and transparency for business users of online intermediation services, *OJ L 186, 11.7.2019, p. 57–79,* (the Online Intermediary Services Regulation); Regulation (EU) 2018/1807 of the European Parliament and of the Council of 14 November 2018 on a Framework for the Free Flow of Non-Personal data in the European Union, OJ L 303/59, 28 November 2018, entry into force May 2019 (Free Flow of Non-Personal Data Regulation), which alludes to the growth of data; European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)).

[3] The research for this paper circles around chapter III EECC (Access and Interconnection). Art. 61 EECC is the key provision for this analysis.

[4] Art. 1 and 3 EECC.

users.[5] The broader and expanding digital environment requires that an eye must be had for the – less regulated – cloudification of network elements, software and data. But this exposes old and new dilemmas & solutions (para. 2.1). This paper poses two sub-questions:

First, what type of end-to-end connectivity measures are contained in the new framework? Are we looking simply at a high-level stimulus to promote end-to-end connectivity, or does the current regulatory environment provide for a more holistic view on networks? (para. 2.2).

Second, where the focus has been on achieving and promoting services interoperability,[6] is infrastructure interoperability taking over as a crucial technological notion? ECN are not qualified as such in the EECC, but the option to appoint ECN elements as critical infrastructure is available in the ECI and the NIS Directives. Must interoperability be safeguarded better where it concerns access to networks? (para. 2.3).

The final chapter offers a brief consideration on whether the technological notions should be interpreted as fundamental principles of telecommunications law. The question is to what extent the EECC and accompanying regulation signal a new regulation holiday to drive innovation and investments (para. 3) and whether connectivity and interoperability requirements can contribute to the mega-important network continuity. To what extent should regulators fine-tune technological notions, and offer ECN operators a new lease of life?[7] In sum, this Paper attempts to align traditional telecoms with technological principles.

1.2 The digital society: should ECN operators care?

[5] This Paper does not address *ex ante* market analysis and significant market power, see art. 63*ff*. EECC.
[6] S.J.H. Gijrath, Services interoperability 2020, whereto, what for?" *Mediaforum* 2014 7/8, p. 186-195 (in Dutch), Gijrath 2014.
[7] The legal aspects concerning the evolution of ECN and ECS providers to digital platforms fall outside the scope of this paper. Standardization and interoperability are not the scope of this paper.

The long-awaited European Electronic Communications Code (EECC)[8] arrived by mid-December 2018, at the heels of the data economy hailed by the European Commission. Whilst the Commission was struggling to achieve political consensus on the scope and width of the connected continent, hyper-globalization made networks flourish.[9] The EECC came at a time where governments, companies and citizens alike were facing the up- and downsides of a much heralded fourth industrial revolution.[10] But industry 4.0 was overshadowed by a more human-centred fifth revolution.[11] Society 5.0 seeks to create a sustainable society for human security and well-being through cyber-physical systems (CPS).[12] These cyber-physical systems require a more open, flexible network infrastructure with different topology. This means that – as has been the case before – technological innovation is going to impact electronic communications networks (ECN) (de-)regulation.[13]

Disruptive services and network innovations, ranging from omnipresent mobile supercomputing to quantum communications infrastructure,[14] from artificially-intelligent robots to big data, from omnipresent autonomous vehicles to wireless inter vehicle communications, from IoT applications to European cloudification are sprouting at exponential speed. The uptake of new technologies is likely to increase network traffic exponentially. Many innovations require continuous real-time access to data

[8] Directive (EU) 2018/1972 of 11 December 2018, establishing the European Electronic Communications Code *OJ*, L 321/36 and the – institutional – recast BEREC regulation: Regulation 2018/1971 of 11 December 2018, establishing the Body of European Regulators for Electronic Communications (BEREC) and the Agency for Support for BEREC (BEREC Office), amending Regulation (EU) 2015/2120 and repealing Regulation (EC) No 1211/2009, OJ L 321/1.

[9] https://ec.europa.eu/commission/presscorner/detail/en/IP_16_3008. See: Internet Usage in Europe, Statistics and Facts. The report covers broadband growth as well; S. O'Dea, 20 May 2019. https://www.statista.com/topics/3853/internet-usage-in-europe/.

[10] The technological developments are occurring at the speed of sound. Industry 4.0 preceded Society 5.0 by just a few years; *cf.* Prof. K. Schwab, *The Fourth Industrial Revolution*, Random House USA, Inc. (2017).

[11] Y. Shiroishi, K. Uchiyama, N. Suzuki, IEEE, *Computer*, vol. 51, issue 7, p. 91-95, July 2018.

[12] CPS combines integration of computation, networking, and physical processes. Embedded computers and networks monitor and control the physical processes, with feedback loops where physical processes affect computations and vice versa.

[13] *E.g.* components that support connectivity such as coverage, quality of service, traffic, tariffs.

[14] Commission Press Release 4 December 2019, https://ec.europa.eu/digital-single-market/en/news/nine-more-countries-join-initiative-explore-quantum-communication-europe.

stored in various types of networks. Data traffic, which exceeded 19.01 exabytes per month in 2019, is expected to reach 77.5 exabytes per month worldwide at a compound annual growth of 46 percent.[15]

The insatiable data hunger requires very, *e.g.*, high-speed mobile networks that connect high speed Internet with glass fibre broadband networks seamlessly. Better interoperability enables a robust data flow. Adequate, sustainable and omnipresent bandwidth for ultra-dense coverage, 5G low latency networks[16] and super data centres are required.[17] The super data centres used to be the realm of cloud and other service providers. Data centres, IP networks and ECN are converging into mesh infrastructure systems.

Societal needs require close to 100% network availability and redundancy. Governments, business and citizens rely on available, secure networks.[18] ECN operators still rely on robust backhaul support. Connectivity and interoperability failure could have a root cause in the network – be it for technical, cybersecurity or other reasons.[19] Telco's business models have witnessed a helter-skelter for over a decade. Many ECNs have reinvented themselves or transformed into digital platforms that rely more on Internet Protocol (IP) technology. Some telco's have split-up their

[15] J. Clement, 2 December 2019, statista.com.
[16] Low latency means that the network is optimized to support operations that require near real-time access to rapidly changing data; lower latency enables faster package transports, see informatica.com.
[17] The state of the art is in constant flux and any description of network topology, data and applications is likely to stay fresh for a short period only.
[18] Under the EECC, operators of electronic communications providers (ECN) are incentivized to operate and manage seamlessly broadband infrastructures for computing purposes, data analysis, as well as tangibles ranging from buildings to traffic systems to whole smart cities.
[19] Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures (ECI Directive), *OJ* L 345/75. The ECI Directive establishes a common procedure for the identification and designation of European critical infrastructures (ECIs) within the energy and transport sectors, which have significant cross-border and/or cross-sector impact. The Directive also aims to establish a common approach to the assessment of the need to improve the protection of such infrastructures. Art. 1 of the ECI Directive aims at providing minimum harmonization for the implementation of security plans for the protection of important assets of the designated critical infrastructures. The Directive does not prescribe specific security requirements, but leaves this to the Member States. The ECI Directive does not focus specifically on network and information systems. This topic will be addressed in another paper.

infrastructure from the services businesses. ECN operators have also been incentivized to operate and manage seamlessly broadband infrastructures for computing purposes, data analysis, and tangibles, such as buildings, traffic systems and smart cities. ECN, like electricity grids are indispensable to society more than ever. ECNs are likely to become critical infrastructure.

Next to promoting innovation and access, the end-user's interests remain a key pillar.[20] The end-user's interests are visible in the ongoing transformation of ECN and electronic communications services (ECS) providers into digital platforms. The more or less completed liberalization of telecommunications markets in the EU is complemented by innovative network technology enhancing the digitization of society. Two examples are Software Defined Networks (SDN)[21] and Robotics. The European Parliaments' (EP) Resolution *on Civil Law and Robotics* expressed concerns regarding the consequences for ECN of technological advances.[22] The EP stressed that interoperability between systems, devices and cloud services, based on security and privacy by design is essential for real time data flows enabling robots and AI to become more flexible and autonomous. The EP called for the Commission to promote an open environment, with open standards, innovative licensing models, open platforms and transparency, and, in order to avoid lock-in, proprietary systems that restrain interoperability.

Access to various networks remains key in the digital society. However, current competitive dynamics in the digital ecosystem and customers' usage patterns clearly show that traditional telecom markets have fused with a much broader Society 5.0 digital environment. One of the challenges posed by the EECC is to find common ground for consistent principles/rules that cover the entirety of the Internet value chain.

End-to-end connectivity and various notions of interoperability are heard at the digital platforms' levels in terms of services continuity. The need for open and secure digital platforms is guiding the analysis of end-to-end connectivity and interoperability in

[20] Or concerned with the digital divide, see Recital (63) EECC.
[21] *Infra*, para. 2.2.
[22] European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), P8_TA(2017)0051.

Society 5.0.[23] Society may reach a new phase where numerous stakeholders are reaping the benefits from the gradual mesh or transformation of telecommunications networks to IP-driven electronic communications networks, and networks that connect and interoperate with nano-satellites, broadband and virtual networks.

2. Technological requirements in the EECC

2.1 Methodology = control?

The EECC exposes Collingridge's control dilemma.[24] The Commission chooses a reticent approach to hard law regulatory measures. A measured choice is made to influence network technology developments for which the impact on society is currently unknown. The regulatory approach to telecommunications is transforming gradually to a "*constantly-evolving sets of informal soft law governance mechanisms*." In a global context, what are the ramifications of such approach for the future of transnational law?

Clearly, there is no transnational approach to infrastructure. Globalized networks veer between full liberalization and monopoly. At the EU level, the EECC – more than before – aims at more flexible administrative regulation by the national regulatory authorities (NRA's) and – even more so – BEREC in the wake of the evolution of – partially regulated – mesh networks that must compete with a wide variety of unregulated technology sectors. Evidently, the multi-stakeholder processes that have been evolving since the new regulated framework in 2002 are shifting from vital Union-principles that used to be applied in the telecoms sector to holistic approaches to – often disruptive – network technology developments. A complicating factor is that, in terms of regulation or deregulation the EU chooses the middle ground.[25] The Commission is struggling to find a balance between unregulated techno-economic

[23] https://berec.europa.eu/eng/events/berec_events_2016/124-4th-berec-stakeholder-forum-meeting.
[24] R. Hageman, J. Huddleston, A.D. Thierer, "Soft Law for Hard Problems: the Governance of Emerging Technologies in an uncertain future", *Colo. Tech. L.J.*, 17.1, 2018, p. 40ff. (R. Hageman *et al.* 2018).
[25] See the Call for Papers, which describes the EU being "*caught in the middle, in search of a third route that could preserve the precious features of the Internet – its free and open character and innovative drive – but could also control the economic disruption and mitigate the risks for democracy and the fundamental rights of its citizens.*"

developments with competition and consumer interests. This is evident from the delegatory approach to market regulation; point in case: art. 61 EECC which leaves the protection of access and interconnection to the NRA's with coordinative input from BEREC.[26] But the set-up is very much institutional with added governance models.[27] It is left to NRA's and other authorities to be guided by BEREC guidelines on best practice to approach such a task. This reflects the desired ability to rely on the existing experience of NRA's, for instance, in conducting geographical surveys of networks roll-out.

2.2 Connectivity

Neither connectivity nor interoperability is defined in the EECC. The term 'connectivity' appears first in recital (18) EECC. The Code reiterates that the new definition of number-based interpersonal communications services (NICS) supports end-to-end connectivity. Earlier versions were alluding to IP-connectivity. Recitals (23) and (109) provide the broader interpretation of connectivity where the Commission asserts that the regulatory framework the widespread access to and take-up of very high capacity networks for all – which includes businesses. The EECC focuses on achieving connectivity through pushing for Union-wide wireless broadband coverage with a major role for radio local area networks (RLANs). Next to the imposition of appropriate coverage requirements, there should be limited proportionate burdens also – presumably these will be determined by the ECN operators themselves. Besides the improvement of very high capacity networks, the EECC envisages measures that will ensure the allocation of valuable frequencies for the cost-efficient deployment of wireless networks with universal coverage, especially indoors.

[26] *E.g.*, Scoping and proposal document for BEREC Guidelines on Very High Capacity Networks, BoR (19) 31, 7 March 2019; *BEREC Guidelines* on *Very High Capacity Networks,* BoR (19) 108, 13 June 2019; BEREC Guidelines for the notification template pursuant to article 12, paragraph 4 of Directive 2018/1972 of the European Parliament and of the Council, BoR (19) 259, 6 December 2019.
[27] Title II, Chapter I EECC.

Art. 3.2 EECC offers a lovely mixture of delegated competences and soft law provisions (*i.e*., the wording 'pursuing' and 'promoting'). The policy goals prescribed for NRA's include the development of common rules and predictable regulatory approaches. In these provisions connectivity and interoperability must connect and interoperate. Connectivity objectives are entailed in art. 3 (2) (a) (promotion of connectivity and access to very high capacity networks); art. 3 (2) (b) (promotion of competition in the provision of ECN and associated facilities – which includes both efficient infrastructure-based competition and at the services level; art. 3 (2) (c) facilitating convergent conditions investment both in ECN and ECS, open innovation and the establishment and development of trans-European networks. More in particular, the following provisions in art. 3 (2) (d) on the provision promoting the end-user's interests, which overlaps with art. 3 (2) (a): ensuring end-to-end connectivity (which perhaps could be considered a form of interoperability, *i.e.*, of networks) and the take-up of very high capacity networks. This is, however, not a Union-wide requirement. The take-up is left to the Member States. This could cause different approaches to connectivity by providers in a Member State, *e.g*., in the context of numbers necessary for seamless IoT.[28]

EU-wide and global connectivity may be indispensable, but as stated, the EECC delegates the pursuit of the connectivity objectives to the NRA's and BEREC. They are tasked with an efforts obligation to aim for the highest capacity networks and services. Moreover, the NRA's can impose obligations on relevant providers of number-independent interpersonal communications services which reach a significant level of coverage and user uptake, however, for the purpose of services interoperability. [29] There are two caveats: the providers have the freedom to provide networks and services that are economically sustainable in a given area, and, into pursuing territorial cohesion in the sense of convergence in capacity available in different areas. Hence,

[28] *Cf.* a decision where the Court had to opine on whether citizens in one Member State were entitled to access to non-geographic numbers in other Member States pursuant to – then – art. 28 Universal Directive, CJEU 14 April 2016, Case C-397/14 (*Polkomtel sp. Z o.o/ Prezes Urzędu Komunikacji Elektronicznej*), ECLI:EU:2016:256.
[29] Art. 61 (2) (a) and (c) EECC.

the ECN operators' commitment is not unlimited and entrepreneurship is encouraged to be sustainable.

The broad policy objectives anticipate on many overwhelming challenges that lie ahead. Something has to give, and it cannot be expected from ECN operators that they forfeit all profits in the interests of the ECS operators – who do not invest in innovative network configurations and the end-users. Where the Commission expressed its keenness on steering towards more convergence between fixed and mobile infrastructure, it must be observed that impact of regulation on fixed ECN operators is rather different from the impact on mobile ECN operators.

Fixed ECN operators continue to be subject to stronger regulatory scrutiny than mobile operators. Unlike the case for regulating fixed networks, *ex ante* market regulation of mobile ECN operators is less likely to occur.[30] This is due to the circumstance that (most) mobile players are not considered to have SMP (a past exception being the market for mobile terminating tariffs). Still, national governments have shown their desire to generate substantial income for 5G frequency licenses. Moreover, mobile ECN providers operate under a fixed term frequency license. Once an ECN or cable operator has obtained an authorization (art. 12 EECC) registration or license to operate in the EU, there is no predetermined end date or life span for exploitation of such authorization. Since there is no scarcity, the fixed operator's administrative fee is significantly lower than the price of a frequency lot – making the commercial differences between the fixed and mobile networks authorization (art. 13 EECC) evident.

Prospective measures are building on best national practices for operators' license obligations (art. 30 and Annex 1 EECC). Imposing roll-out obligations in frequency licenses issued after an allocation procedure is an effective legal tool that may help to reach the goal of high-quality terrestrial wireless coverage across the EU. However, it

[30] S.J.H. Gijrath, "Telecommunications Networks: Towards smarter contracts and regulation?" *Competition and Regulation in Network Industries (CRNI),* SAGE, 2017 Vol. 18 (3-4), p. 175-197, 2018.

is not clarified how the ECN operators are to deliver such super networks at a reasonable price and choice. Besides, the imposition of license obligations requires close scrutiny by the NRA's and BEREC as it would be counterproductive if there would be no consistency in the harmonization endeavours. Yet, no matter what harmonization measures are taken, it is likely that some national differences of coverage shall remain. One option the Commission is eyeing is the sharing of passive infrastructure used in the provision of wireless electronic communications services in compliance with competition law principles can be particularly useful to maximise very high capacity connectivity.[31]

The recast 2009 Universal Service Directive contained an amended provision art. 4 which provided both for a fixed, but not a mobile network connection right. This provision also provided for "sufficient data rates" to permit functional Internet access. The key addition is that Internet access must be state of the art. It must take into account prevailing technologies used by a majority of subscribers. Open Internet, devout of throttling is the goal.[32] But, the EECC does not formulate a universal right to connectivity for citizens, nor does it provide for minimum upload and download speeds and data amounts. Some jurisdictions – including EU member states, have legislated the right to Internet access in a more detailed manner. Where the regulation is still more concerned with telecoms infrastructure, it will make sense to harmonize an Internet – or broader – network access right for citizens across the Union.

How should the NRAs achieve the goals of connectivity in practice? NRA's must enable maximum benefits in terms of choice, price and quality on the basis of effective competition, by maintaining the security of networks and services, by ensuring a high and common level of protection for end-users through the necessary sector-specific

[31] Art. 61 (4) EECC.
[32] Regulation 2015/2120/EU 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, [2015] OJ L 310/1 (also known as the Net Neutrality Regulation).

rules;[33] evaluating future network or service developments that could have an impact on wholesale services made available to competitors, on territorial coverage, on connectivity available to end-users or on the designation of areas pursuant to art. 22 (clause (6)), which refers to information provision on actual connectivity.

Finally, what is the regulatory scope of end-to-end connectivity? From the clauses that were described in the preceding paragraphs, it is evident that the onus to achieve end-to-end connectivity is first left to the telecommunications market. The feeling is that there are many initiatives to promote or subsidize network innovation. The ECN operators are the gate keepers, but it is unavoidable for them to mesh their networks with different technologies from other service providers.

A relevant question is whether end-to-end connectivity becomes a legal requirement solely for the ECN operators or also for their business partners. This is interesting from an economic perspective. Where ECN morph into IP networks/digital platforms, economies of scale occur; but ultimately it is the network effects that yield the profits for the providers. Hence, a fierce competition between the reinventing ECN operators, their digital platforms on the one hand, and disruptive technologies such as network function virtualization (NFV) and cloudification and these service providers' own digital platforms on the other hand, is likely to occur.[34]

More than in the NRF, the EECC provides a flexible mix of measures. And it seems from art. 61 EECC that the Commission opts first for leaving end-to-end connectivity to the market. Some yardstick regulation can be found in the provisions of art. 61 (2) and (3). In addition, there is the threat of NRA intervention. It remains to be seen how effective the market perceives such prospective measures. But, the EECC is smart incentivizing ECN operators to behave well by anticipating what measures could be taken. For example, BEREC is to publish guidelines that set out the relevant criteria

[33] The NRA's must also address the needs, such as affordable prices, of specific social groups, in particular end-users with disabilities, elderly end-users and end-users with special social needs, and choice and equivalent access for end-users with disabilities. This is a very important universal service obligation.
[34] S.J.H. Gijrath, *(Re-)Defining Software Defined Networks*, 2020, forthcoming publication.

for determining: (a) the first concentration or distribution point; (b) the point, beyond the first concentration or distribution point, capable of hosting a sufficient number of end-user connections to enable an efficient undertaking to overcome the significant replicability barriers identified; (c) which network deployments can be considered to be new; (d) which projects can be considered to be small; and (e) which economic or physical barriers to replication are high and non-transitory. Added to this is the provision on infrastructure sharing or obligations to conclude localized roaming access agreements in art. 61 (4) EECC.

2.3 Interoperability: access and interconnection revisited

Art. 170 TFEU imposes an obligation on the EU to both promote interconnection, interoperability of, and access to networks.[35] But is interoperability subject to revision in the digital society?[36] Come what may, the market's understanding of the notion seems to shift. By way of an example, art. 2 (12) of the new Digital Content and Services Directive defines interoperability as the ability of the digital content or digital service to function with alternate hardware or software.[37] The emphasis is on services interoperability.

Services interoperability is often perceived as a collective of necessary measures which enable the end-users of different networks or services to communicate with each other and to purchase or receive services from other providers than their own network operator.[38] The uptake of new IP-driven services which includes the supplementary services defined and regulated in the EECC has brought a revival of ECS qualification,

[35] Art. 170 (2) regulates networks at the national level. Art. 171 (1) third bullet refers to standardization in this respect.

[36] U. Gasser, "Interoperability in the Digital Ecosystem", https://papers.ssrn.com/sol3/papers.cfm? abstract_ id=2639210, 2015; C. Marsden, R. Nicholls, "Interoperability: A solution to regulating AI and social media platforms", *Computers and Law*, p. 31-40, October 2019.

[37] *Directive* (EU) 2019/770 of the *European Parliament and of the Council* of 20 May 2019 on *certain aspects concerning contracts for the supply of digital content and digital services, OJ* L 136/1, 22 May 2019 (Digital Content and Services Directive). See also: W. Kerber, H. Schweitzer, Interoperability in the Digital Economy, 8 (2017) JIPITEC 39 https://www.jipitec.eu/issues/jipitec-8-1-2017/4531.

[38] *Supra*, para. 2.2. The criterion is bringing about end-to-end connections, See Gijrath 2014.

as can be seen in two recent cases from the EU Court.[39] The supplementary ECS include Internet access services,[40] interpersonal communications services, and IoT-like services.[41]

Just as important, interoperability promotes competition through interconnection of networks. The ways to interconnect the physical infrastructure is growing.[42] The where and how of interconnection will affect the effectiveness of the communications traffic and the cost thereof. Due to the rapid growth of IP networks - which can handle large amounts of data - and technological developments in the specifications of electronic communication networks, the importance of interoperability is increasing. In addition to the everchanging plurality of services, there is are the increasing diversity which bring more choices for network configuration, for example, with regard to the mode of transmission (5G, cable, glass, satellite) and convergence with broadcasting and IT. How is interoperability furthered through regulation? How are the network interoperability obligations be imposed and enforced?

In an era where connectivity and data access are ubiquitous networks must be available all the time. A longstanding and somewhat circular description of interoperability is the ability of two or more systems or components to exchange information that has been exchanged.[43] This broad notion is not concerned with enabling ECNs or IP-networks to transfer data in a standardized manner. The EECC is ambiguous in framing interoperability in the context of achieving the general

[39] CJEU, 5 June 2019 (*Skype Communications Sarl v. Institut Belge des services postaux et des télécommunications (IBPT*), ECLI:EU:C:2019:460; CJEU 13 June 2019 (*Google LLC v. Bundesrepublik Deutschland*) ECLI:EU:C:2019:498.
[40] Art. 2 (4) (a) EECC. See also art. 2 (2) Open Internet Regulation.
[41] "*Services consisting wholly or mainly in the conveyance of signals such as transmission services used for the provision of machine-to-machine services and for broadcasting, a*rt. 2 (4) (c) EECC.
[42] See S.J.H. Gijrath, *Interconnection Regulation and Contract Law*, Amstelveen, DeLex, 2006 (Gijrath 2006), p. 34ff.: the example of connecting the Internet backbone with ECN; and S.J.H. Gijrath, 2014. *Cf.* the definition of 'physical infrastructure' in art. 2 (2) of Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks, *OJ L 155, 23.5.2014, p. 1–14.*
[43] IEEE (1990). See also F. Lampathaki *et al*., "Infusing Scientific Foundations into Enterprise Interoperability", (2012) 63 (8) *Computers in Industry*, p. 858.

objectives in art. 2, which continues to mix access to and interconnection of ECN with services interoperability (ECS).

The broader notion of 'interoperability' should be seen as a collective of all measures, which enable the end-users of different networks or services to communicate with each other and to purchase or receive services from other providers than their own network operator.[44][45] Conversely, network interoperability – the focus of this paper – promotes competition through the interconnection of networks, as is reflected also in art. 61 (1). Still, art. 60 (1) EECC reiterates that the overall goal is tied only to ensuring *services* interoperability across the EU.[46] Where the emphasis is on services interoperability, it is interesting to reflect on whether it can be said that there is or should be a principle of network interoperability as an umbrella notion that captures access and interconnection.

Network interoperability is not defined in the EECC; access and interconnection refer to networks, though.[47] The definition is not singular. There are various descriptions of what interconnection entails. The EECC allows for conditions such as network interconnection and services interoperability on ECN and ECS which may be attached both to general authorizations, frequency rights and numbering resources (with one notable exception: number-independent interpersonal communications services ('NIICS') are not subject to such conditions).[48] But measures can be taken by the NRA if necessary.[49] This very specific list of prospective measures includes access to numbers (except the NIICS) and coverage and QoS requirements.[50]

Art. 2 (28) EECC reiterates that interconnection is a form of specific form of access that is to be implemented between public ECN operators. A connection is forged by

[44] Annex I sub C. and D. EECC.
[45] CBb (Appellate Board of Businesses) 20 March 2007, ECLI:NL:CBB:2007:BA1010 (Venus & Mercury Telecom/OPTA).
[46] Annex V EECC provides a detailed, minimum set of services for broadband access services.
[47] See the access provisions in Title III, art. 59*ff*.
[48] Annex I EECC.
[49] Art. 61 (2) (c) EECC.
[50] Art. 104 and Annex X EECC.

means of the physical and logical linking of an ECN with another ECN. Ultimately, the end-user interest is either communication and/or ECS. Defining access levels still rests on the Open Systems Interconnection (OSI) model.[51] The seven layers are often characterized similarly, although there are some nuances. The models distinguish between media and host layers. Clearly, the take-off of the IP and the use of the Transmission Control Protocol (TCP) in networks has impacted the network layers significantly. This is about to go even much further when the innovations mentioned in the introduction – think IoT, autonomous vehicles etc. – are introducing exciting new services that not only require services interoperability, but also full access to ECN's infrastructure.

With technological advancing at the speed of light, there are more ways to combine physical infrastructure.[52] The where and how of network access interconnection will affect the effectiveness of the communications traffic and the cost thereof.[53] A report by DG Competition identifies three types of interoperability that are required in the digital society.[54] First, and most relevant to this Paper, it mentions protocol interoperability. Protocol interoperability is aimed at ECS (and other, non-ECS, digital services). Protocol interoperability enables services to connect at the different network and applications levels in the OSI-model. These services require an application programming interface (API) with the different platforms on which they are delivered.[55] Second, DG Competition has come up with a definition on data interoperability – which

[51] Simply put, the OSI model functions as a universal language for computer networking. The OSI model partitions various communications systems into abstraction layers. The OSI model conceptualizes different standard protocols that enable various communications systems to interconnect and, thus, achieve network and functional interoperability. Hubert Zimmermann first defined the OSI Model in raw form in Washington, DC in February 1978. A refined standard was published by the ISO in 1984, ISO/IEC 7498. See, *i.a.*, "OSI: the Internet That Wasn't". *IEEE Spectrum*. March 2017.

[52] See S.J.H. Gijrath, *Interconnection Regulation and Contract Law*, Amstelveen, DeLex, 2006 (Gijrath 2006), p. 34*ff*.: the example of connecting the Internet backbone with ECN.

[53] Appellate Board of Businesses, the Netherlands, 15 January 2014 *Market Analysis decision on low quality broadband access*, ECLI:NL:CBB:2014:1.

[54] J. Crémer, Y.-A. de Montjoye, H. Schweitzer, "Competition Policy for the Digital Age, Report for DG Competition", ch. 5: *http://ec.europa.eu/competition/publications/reports/kd0419345enn.pdf.*

[55] *Cf.* on the penalties: CJEU 27 June 2012, T-167/08 (*Microsoft v. Commission*) ECLI :EU:2012:323; On the merits: CJEU 17 September 2007, T-201/04 (*Microsoft v. Commission*), ECLI:EU:T:2007:289.

is something else than data portability.[56] Third, and most relevant to this paper, there is what the author has labelled to be full network interoperability: full protocol interoperability. Roughly put, this means providing access to other ECN or ECS providers at any layer in the incumbent's network. Still, access to these layers still remains contentious between different operators; a recent example being a conflict on access to the local loop in Slovakia.[57] Unbundled access to the local loop allows new entrants to use the pre-existing telecommunications infrastructure belonging to the incumbent ECN operators in order to offer various services to end users, in competition with the incumbent operators.[58]

Access and interconnection occur at various network levels. At the bottom of the OSI model lies the physical layer. This network level provides for the transmission and reception of unstructured, raw data between the device and the physical transmission medium. Simply put: the physical layer converts digital bits into electrical, radio or optical signals. Each network layer provides for the functional and procedural means of transferring variable-length data sequences (packets) from one node to another in various networks.

A major shift in the configuration of ECNs has occurred. Simply put, it concerns NFV and the uncoupling of service layers. Software defined networks (SDN) is a new architecture where network control is logically centralized (decoupling of control and data planes), directly programmable and the underlying network infrastructure is

[56] Regulation 2017/1128/EU of the European Parliament and of the Council of 14 June 2017 on Cross-border Portability of Online Content Services in the Internal Market, [2017] OJ L 168/1 including corrigendum to regulation 2017/1128; and in its slipstream: Regulation 2018/302/EU of the European Parliament and of the Council of 28 February 2018 on addressing unjustified geo-blocking and other forms of discrimination based on customers' nationality, place of residence or place of establishment within the internal market and amending Regulations (EC) no 2006/2004 and (EU) 2017/2394 and Directive 2009/22/EC, [2018] OJ L 601/1.

[57] See, *infra*, consideration 6 of the *Slovak Telecom/Commission* case. The local loop is the physical twisted metallic pair circuit (also known as 'the line') connecting the network termination point at the subscriber's premises to the main distribution frame (MDF) in the fixed public telephone network. The local loop provides for "high bit-rate" data transmission services for fixed internet access and for applications based on digital subscriber line (DSL) technology.

[58] CJEU 13 December 2018, Case T-851/14, (*Slovak Telecom/Commission*), ECLI:EU:T:2018:929.

abstracted from the applications.[59] NFV uses software which can dynamically be moved to, or instantiated in, various locations in the network layers as required, without the need for installing new equipment.[60] Consequently, a wide variety of eco-systems emerges and network openness is enhanced. As such, SDN/NFV enhances innovative ECS. Does it also contribute to network interoperability? For one thing, the SDN controller makes the ECN programmable through an application programming interface (API) that is independent of the network topology and technology.[61]

NFV supports MVNOs in customizing user needs at all layers. They may compete directly with the ECN operator who will host them on the quality of service levels (QoS).[62] Consequently, the ECN operator will be able to consolidate its network infrastructure. Network functionality can be managed virtually. The MVNOs no longer need full access to an ECN. SDN enables access of third parties to network control functions, whilst controlling their own physical and virtual core network elements. Radio Access Network (RAN) equipment can be configured in new ways to allow for shared use, even though no active equipment is shared. It also enables the ECN operators to manage the various network traffic events. This way, the network control plane can be separated from the traffic control (voice, data). NFV's key innovation is that it enables certain network functionality to be translated into software, which can run on cheaper,

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[59] "BEREC Input paper on Potential Regulatory Implications of Software-Defined Networking and Network Functions Virtualisation*", BoR (16) 97* (BEREC 2016), Annex 1. Normally, a communications network is a medium to which many nodes can be connected, on which every node has an address and which permits nodes connected to it to transfer messages to other nodes connected to it.

[60] *Network Functions Virtualisation*, Introductory White Paper (ETSI 2012): http://portal.etsi.org/NFV/NFV_White_Paper.pdf; ETSI GS NFV 001, *Network Functions Virtualisation (NFV); Use Cases*, *V1.1.1*, Oct. 2013; (ETSI 2013); http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf ETSI GS NFV 002, *Network Functions Virtualisation (NFV); Architectural Framework, V1.2.1*, Dec. 2014 (ETSI 2014); http://www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.02.01_60/gs_NFV002v010201p.pdf ETSI GS NFV-EVE 005, *Network Functions Virtualisation (NFV); Ecosystem; Report on SDN Usage in NFV Architectural Framework, V1.1.1*, Dec. 2015 http://www.etsi.org/deliver/etsi_gs/NFV-EVE/001_099/005/01.01.01_60/gs_NFV-EVE005v010101p.pdf (ETSI 2015).

[61] *A survey of 5g technologies: regulatory, standardization and industrial perspectives*, Chongqing University of Posts and Telecommunications, Elsevier B.V. 2017.

[62] MVNOs do not operate their own network infrastructure. See also Wazir, F., *Can NL trust 5G? A conceptual model for of cybersecurity supervision in the Netherlands*, 2019.

generic, hardware elements which can be added to the ECN.[63] NFV uses various IT technologies to virtualize entire classes of network node functions, in order that the *same* infrastructure can run different systems and applications software functions for ECS providers (*e.g.*, the MVNOs discussed above).

Art. 61 EECC provides*, inter alia*, that NRA's in the case of points (b) and (c) of this subparagraph, shall be able to impose: (a) to the extent necessary to ensure end-to-end connectivity, obligations on undertakings subject to general authorisation that control access to end-users, including, in justified cases, the obligation to interconnect their networks where this is not already the case; and (c) in justified cases, where end-to-end connectivity between end-users is endangered due to a lack of interoperability between interpersonal communications services (ICS), and to the extent necessary to ensure end-to-end connectivity between end-users, obligations on relevant providers of number-independent interpersonal communications services which reach a significant level of coverage and user uptake, to make their services interoperable. But measures can be imposed only in case the Commission (having heard BEREC) finds that there is an appreciable threat to end-to-end connectivity between end-users throughout the Union or in at least three Member States.

In the event services are delivered over mobile networks and no interconnection can be achieved, a remedy could be ordered whereby the ECN must allow for sharing of passive infrastructure or obligations to conclude localised roaming access agreements. There is a way out in that the party seeking interconnection must demonstrate that there is no viable and similar alternative means of access to end-users is made available to any undertaking on fair and reasonable terms and conditions. Where access and sharing of passive infrastructure does not suffice, NRAs may impose obligations on sharing of active infrastructure.[64]

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[63] Alexiades, P., Shortall, T. 'The Advent of 5G: Should Technological Evolution Lead to Regulatory Revolution?' Paper, *Competition Policy International*, November 2016 (G. Alexiades, P., Shortall, 2016); Brownsword, R., Goodwin, M., *Law and Technologies of the Twenty-First Century*, Cambridge University Press, Cambridge, UK, 2012.

[64] S.J.H. Gijrath, "Negotiating and Performing Infrastructure Sharing Agreements under the European Electronic Communications Code", [2018] *CTLR* 4, p. 90.

To what extent are connectivity and interoperability tied to standardization? Setting aside network effects and vendor lock-in as undesirable side effects, art. 39 (2) contains a mix of interoperability and connectivity aiming at standardization. It provides that the Member States must encourage the use of the standards or specifications referred to in paragraph 1 for the provision of services, technical interfaces or network functions. Moreover, Member States are to encourage the implementation of standards or specifications adopted by the European standardisation organisations. These organisations tend to emphasize on the need to ensure interoperability of services. In addition, the clause also refers to end-to-end connectivity through the "*facilitation of provider switching and portability of numbers and identifiers, and to improve freedom of choice for users*." But this is a soft law provision. There is no network interoperability requirement in chapters I and II EECC.

In sum, although the EECC puts more detailed provisions than before to enhance access and interconnection to achieve services (and network) interoperability, the relegation to NRA's and BEREC, and the formulation point at a reticent, soft law approach. Clearly, ETNO does not agree and considers the provisions too onerous and running counter against the promotion of network innovation. But it is likely that network access and interconnection shall remain fundamental technological principles in the telecommunications law and regulation for the time being (and it is not very likely that the EECC is going to be withdrawn or rewritten soon).

3. Synthesis: a new lease of life for ECN?

As regards the first question posed in this paper (para. 2.2), the provisional answer is that the EECC has juggled to balance various stakeholder interests and society 5.0 requirements. Although the clauses on end-to-end connectivity, services interoperability, access and interconnection sometimes lean on yardstick regulation, the EECC also seemingly also applies a holistic view on networks. This may be smart where the Collingridge control dilemma is so evident in a market that is transforming constantly.

Do the reinvigorated notions of connectivity and interoperability entail a more fundamental approach to technological principles in the EECC? This means: are the screws tightened on the ECN operators or are they encouraged to have a new lease of life as gate keepers of infrastructure that is likely to become more and more important if not critical in the coming years?

A first answer to that question: connectivity and interoperability make themselves heard louder than ever.[65] The large operators have already implemented drastic measures to safeguard their economic survival when the dust on the 5G frequency allocations have settled. The providers of services are looking at splitting their companies into an infra and a services operation. And it is not only the offer of new services that they are looking at. Following the ultra-rapid growth of IP networks, the improvement of redundancy and other technological developments in the specifications of ECN, the increasingly diverse options for network configuration and convergence of different transmission modes (besides IP, NVF and SDN, 5G, cable, glass & nano-satellites); and convergence with broadcasting and IT advances, may allow for a new lease of life of ECN, who had almost become gate keepers rather than game changers. Applications that require network ubiquity, such as IoT, AI and autonomous vehicles may well contribute to the business cases for the various network operators. The danger for ECN operators lies in the fact that they may be less flexible in tweaking their infrastructure than mesh network providers. Another issue, that could be explored in more detail is whether the ECN operators may lose flexibility, *i.e.*, room to manoeuvre where they are required under the EECC to grant parties that are game changers – think of NFV and SDN providers – access to their networks at cost price plus a fair mark-up only.

Looking at connectivity and interoperability in isolation, *i.e.*, as applied in the EECC, it is fair to state that the new era is likely to lead to a stronger emphasis on end-to-end

[65] For an operator's perspective: *ETNO response to BEREC Consultation on Work Programme 2019*, https://etno.eu/datas/press_corner/ETNO%20response%20to%20BEREC%20WP%202019%20consultation_final.pdf.

connectivity more prominently (para. 2.3). In a way, access and interconnection levels offer building blocks for network operators (be it ECN or IP networks or mesh networks) to offer and warrant the required end-to-end connectivity in Society 5.0 that is likely to bring so much innovation, not only in services, but also in network elements. Conversely, it is fair to state that an explicit choice was made to not distinguish between services and network interoperability. From that perspective, protocol interoperability can be said to support or even be a condition to warrant end-to-end connectivity.

It is not all bad news for interoperability. The starting point remains the negotiation of access and interconnection between ECN operators; infrastructure sharing is promoted. To achieve end-to-end connectivity for end-users of networks, access and interconnection still are key. Finally, interoperability must indeed be safeguarded in the strongest manner where it concerns access to networks at different levels. Outside disruption may loom. This paper suggests further research into the role of ECN and all network elements that support the digital society, and which may be considered critical.

The Commission may have struggled between how to juggle hard and soft law measures – including self-regulation – which is evident from the several mandates bestowed on NRA's and BEREC. But it has also very much attempted to strike a balance between hard yardstick and soft incentive measures. The EECC tailors for flexible technological regulation for networks. Prospective analysis may result in some temporary targeted intervention.[66] The Commission displays the desired end-to-end connectivity that must be uniform across the Union – or at least interoperable. This is reflected also in the somewhat opaque desire to achieve the same type of network capacity in the Union, with special focus on rural areas.

In the global context, the EECC continues to walk the middle road, even if this means that much of the competition and innovation comes from outside the Union. This may not be a bad thing for governments, business and citizens in the Union. All and all, the reliance on coordinated measures by BEREC of NRA intervention bodes well, although

[66] See Recital (62) EECC.

it not entirely certain whether this regulation is going to offer a new lease of life for network operators.