The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

CESifo Working Papers
www.cesifo.org/wp

Will the U.S. and EU Telecommunications Policies Converge? A Survey

Ingo Vogelsang

CESIFO WORKING PAPER NO. 4843
CATEGORY 11: INDUSTRIAL ORGANISATION
JUNE 2014

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 4843*

Will the U.S. and EU Telecommunications Policies Converge? A Survey

Abstract

Currently, U.S. and EU telecommunications policies differ in many respects. For example, wholesale access to local loops is largely deregulated in the U.S. but continues to be regulated in the EU. Or, the U.S. has an elaborate universal service policy with a set of universal service funds and specific policies for high-cost regions and low-income users, while universal service policies in the EU are much more sporadic. Will the forceful technical and market developments that are associated with IP convergence, next generation access (NGA) and mobile broadband (4G) lead to a convergence of telecommunications policies in the U.S. and EU? Based on a survey of the relevant U.S. and EU related economics literature the current paper addresses this issue for the five policy areas of interconnection, wholesale loop access, net neutrality, spectrum policy and universal service. While IP convergence and the spread of 4G are likely to enhance policy convergence, NGA could have a different effect, because the penetration of and the competitive properties of NGA depend crucially on legacy infrastructures that differ between the two continents.

JEL-Code: L430, L860, L960, L980.

Ingo Vogelsang
Department of Economics
Boston University
270 Bay State Road
USA – Boston, MA 02215
vogelsan@bu.edu

Will the U.S. and EU Telecommunications Policies Converge? A Survey

Ingo Vogelsang, Boston University

1. Motivation and Overview[1]

Having lived in Germany for half of my life and in the U.S. for the other half, as a telecommunications economist I often ask myself what explains the cross-country differences and similarities in telecommunications policies and their successes and failures. For example, a common observation today is that people on both sides of the Atlantic complain about too little broadband expansion. In the U.S. it is claimed to be due to too little regulation that has led to monopoly power and collusion, while in the EU it is claimed to be due to too much regulation. For both statements to hold simultaneously policies must yield different results across the continents.[2] That must be due to other circumstances besides policies that differ between countries that affect policy outcomes.

Europe and the U.S. have many characteristics in common: a high standard of living, Western culture, a federal structure, moderate climate. There are also substantial differences: The heterogeneity between countries in Europe is stronger than between states in the U.S., e.g., language, political and legal system, and history. There are also differences in political attitudes towards the market system and social responsibilities of firms and governments. Antitrust traditionally has played a larger role in the U.S. telecommunications policy than in European countries, although Europe has been catching up recently, while the U.S. reduced the influence of antitrust in the regulatory arena.

My conjecture is that different policies and different policy outcomes are heavily influenced (1) by different legacy institutions that cannot easily be changed (different institutional endowments), (2) by different legacy infrastructures that also are hard to change because they present sunk investments, and (3) by different geographies, including physical environments, population densities, sector specialization, and levels of wealth. A fourth influence comes from the market environment, which is closely related to the three other influences.

The institutional endowment consists of the legal and political environment (North, 1990; for applications to telecommunications see Levy and Spiller, 1994 and 1996). It creates a path dependence for regulatory developments, just like sunk infrastructure assets. In particular, there are constraining effects of existing laws on efficient choices. Furthermore, there are political economy effects. For example, in the U.S. state regulatory commissions in some states are elected by popular vote, while in other states they are appointed by the governor. This difference is likely to lead to different decisions (Donald and Sappington, 1997). In both cases there can be bureaucratic effects having to do with career choices and ambitions of bureaucrats that are interested in their budgets and may therefore stand in the way of deregulation (Haucap and Kühling, 2006). Another very major difference between the U.S.

[1] The current paper expands on selective aspects of the much longer survey in Vogelsang (2014). I thank Carlo Cambini for helpful comments.

[2] See, however, Yoo (2014) who makes a comparison between the EU and U.S. in terms of NGA coverage, finding the U.S. to be significantly ahead. So, the statement above is not necessarily true.

and the EU is that in the U.S. the telephone networks were always privately owned, while in the current EU countries most telephone networks were until about two decades ago owned by PTTs and were part of ministries. However, once privatization occurred, there was no burden with regulatory traditions. This also implies that privatization, while hard to achieve in itself, enabled a fresh start. Thus, privatization of such state-owned entities provided for an opportunity to create new institutions and new regulatory rules.[3]

The institutional endowment also includes the due process rules applied to regulation and the independence and position of the regulators. The due process rules in American regulation (based on the Administrative Procedures Act) influence the way information enters the regulatory process. A large part of the information is provided by the affected parties. Due process rules help reduce capture of the regulator by the regulated firms. In part they do that by allowing other interested parties to present evidence.

Technical differences of legacy networks can derive from different architectures used in building the original infrastructure. For example, some copper access networks lend themselves more easily to DSL conversion than others. Or, an early split between telephone and cable networks can lead to the existence of two separate telecommunications networks serving the same neighborhoods or even the same buildings. In some countries, electric or gas utilities or water and sewer networks have duct facilities that can be used by optical fiber networks and help create NGA networks. Base stations for wireless networks can be erected on many types of infrastructures that vary from country to country.

There are two main differences in legacy infrastructures between the U.S. and the EU. First, the original U.S. telephone system was almost totally built by the vertically integrated Bell system, leading to a highly homogeneous network in spite of large geographic differences. In contrast, the European countries developed their own telephone systems with substantial variation.

The second difference in legacy infrastructures concerns the cable TV networks. Such networks in the U.S. are separate from the telephone networks and have developed via municipal franchise contracts. Starting in the 1960s they spread very quickly and now can serve 95% of the U.S. population. Again in contrast, the European countries followed a variety of approaches leading to a wide dispersion in penetration rates, which in most EU member states are well below the U.S. average, the Netherlands being the most notable exception.

Geographical differences include, in particular, general population densities and the degree of urbanization, which determine network densities and thereby the costs per user. Yoo (2014) argues convincingly that the percentage of rural households (urbanization) is a better determinant of overall network costs than average population density. A move by all households into a central city would not change the average density but would substantially lower network costs. Also relevant are differences in

[3] Nevertheless, some network operators in the EU are still partially state-owned, such as Deutsche Telekom. Cambini and Spiegel (2014) show empirically that more private ownership is ceteris paribus associated with more investment, higher prices and higher welfare.

terrain, such as rock vs. soft soil or dry vs. wet land. Differences in geography and national backgrounds may prevent the same regulations from being implementable or optimal in both regions.

Market environments depend on the types of users, such as financial centers, and structure and types of suppliers, including the degree of vertical and horizontal integration. They also depend on legacy institutions, legacy networks and geography.

Three comparatively new technology and market trends are determining the current and future telecommunications policies in both the U.S. and the EU. They are digital convergence of telecommunications networks, the spread of next generation access (NGA) networks and the rise of high-speed mobile networks (4G/LTE). Both the speed of these developments and their impacts on policies will depend on the above institutional, geographic, network-related and market factors. Will these developments eventually converge and will in turn the differences in policies between the U.S. and the EU vanish, or will the differences persist? We consider these developments for the five policy areas interconnection/termination monopoly, local access bottleneck, net neutrality, spectrum management, and universal service. While IP convergence and the rise of 4G networks have the potential to lead to policy convergence across continents, the spread of NGA could go the other way, since NGA policies will depend on the presence of zero, one or two NGA networks, which again depends on legacy networks and network densities.

Can there be cross fertilization between U.S. and EU on telecommunications regulation?[4] In principle, other country's experience can reduce information costs and mistakes and therefore can lead to efficiency improvement. However, because of the above-mentioned cross-country differences such a result is not assured. 75 years of U.S. experience with regulation of privately owned public utilities certainly provided a role model for countries privatizing their telecommunications carrier. This way, the idea of an independent commission took root in many countries. Also, the bad press of U.S.-style rate-of-return regulation gave rise to RPI-X or price-cap regulation (Littlechild, 1983), which in turn led to similar price regulation in the U.S. True cross-fertilization between the EU (mostly represented by the UK) and the U.S. seems to have occurred with respect to bottleneck access and interconnection regulation and cost modeling, represented by the LRIC standard (called TSLRIC in the US and LRAIC elsewhere).[5] A split, however, occurred in the first decade of the new millennium, when the EU pursued a path of rational slow deregulation, while the U.S. embarked on major sudden deregulation. Today, there seems to be a shift in the EU back to U.S. as a role model (Neumann, 2013a).

The following section will provide a description of distinguishing features of U.S. and EU regulation, followed by five sections on selected areas of current policy concern, the termination monopoly associated with interconnection, local access bottleneck, net neutrality, spectrum policy, and universal service. The last section concludes.

[4] For a more extensive discussion of cross-fertilization see Vogelsang (2002).

[5] LRIC stands for long-run incremental costs, LRAIC for long-run average incremental costs, and TSLRIC for total service long-run incremental costs.

2. Distinguishing institutional features of U.S. and EU regulation[6]

2.1. Federal structure

Both the U.S. and the EU exercise regulatory authority at two levels, central/federal and country/state. In the U.S. the Federal Communications Commission (FCC) and state public utility commissions (PUCs) represent separate regulators at federal and state level. In contrast, there is no central EU regulator corresponding to the FCC. Rather, at the EU level the European Commission (EC) has some regulatory power in directing and harmonizing the national regulatory authorities (NRAs), and the body of regulatory authorities (BEREC) - consisting of representatives of NRAs in the EU - has additional regulatory powers.

In the U.S. the disputes and coordination between the FCC and PUCs are achieved in Federal/State Joint Boards, through federal preemption by the FCC or through court decisions. Federal legislation has redefined the roles of the two regulatory levels under 1996 Telecom Act.

Federal preemption means that the FCC takes away an issue from PUCs. In particular, preemption can resolve ambiguities. Conditions for preemption are (1) that it has to be based on the FCC objectives as defined by Communications Act of 1934,[7] (2) there has to be a conflict between FCC objectives and PUC regulation, and (3) the FCC has to preempt as little as possible. Examples of Federal Preemption include in particular that deregulation by the FCC cannot be counteracted by the PUCs. This includes, for example, deregulation of customer equipment and enhanced services under the Computer II inquiry. Another example is the preemption of state regulation of interconnection for mobile services (1987). Some frustration of the FCC has to be accepted, such as under the 1986 Supreme Court decision ("Louisiana Public Service Commission versus FCC") denying preemption of state-specific depreciation rules in Louisiana.

There are two main legal bases for the division of labor between FCC and PUCs, the U.S. Constitution's Commerce Clause and the Supremacy Clause. The division of labor based on the Commerce Clause distinguishes between **inter**state vs. **intra**state commerce, emphasizing the geographic scope of activities ("markets"). This principle is hard to apply to telecommunications, because transactions there are not purely inter- or intra-state and carriers use common assets for both types of transactions. The U.S. approach of using accounting separations for dividing federal and state regulatory responsibilities proved cumbersome, misleading and artificial.

The division of labor based on Supremacy Clause allows Congress to pass legislation that assigns a regulatory activity to the federal level. The prime example here is the Telecommunications Act of 1996. While this legislation emphasizes local competition (an intrastate issue!), the Act has put the FCC in charge of implementation of the new rules but the PUCs keep some role. This division of labor between

[6] In this and the remaining sections we are predominantly interested in the economic rather than the legal aspects of the issues. As a result we do not cite the legal decisions in full. For a much more in-depth legal perspective on both sides of the Atlantic see Fetzer and Yoo (2014). For the U.S. perspective see Nuechterlin and Weiser (2013).
[7] The U.S. Telecommunications Act of 1996 is only an amendment to the 1934 Act, which continues to hold to the extent that it is not superseded by the 1996 Act.

the FCC and the PUCs is based on harmonization (standardization) and institutional capability. As a result, the FCC has moved into traditionally local issues. The resulting legal battle between the FCC and the PUCs was mostly resolved by Supreme Court in the 1999 decision in AT&T Corp. et al. *v.* Iowa Utilities Board et al., which confirms the expanded FCC role. In particular, the FCC provides general rules, while the PUCs do the details and adjudication. In the past two decades PUC regulation of the telecommunications sector has played a diminishing role, now largely restricted to universal service policy (with some remaining responsibilities for copper loop unbundling, and intrastate termination charges).

In the past EU policies have been quite heterogeneous between countries (Florio, 2013) and the division of labor between the EC and the NRAs has been similarly contentious as in the US. It is also characterized by attempts of the central level to achieve more control in order to actually regulate inter-country issues (international roaming) and to "harmonize" telecommunications regulation (and deregulation) throughout the EU (Haucap and Kühling, 2006). Harmonization goes under the appealing heading of the "EU single market". This, however, suggests that telecommunications markets geographically span the whole EU (Neumann, 2013b), whereas most empirical definitions in the EU have shown markets to be national or smaller.[8] Regulating inter-country issues is certainly legitimate, because NRAs can face conflicts of interest here and cannot regulate in other countries. Harmonization is also justified to the extent that inter-country differences are simply the result of different policies rather than the result of different geographic or market circumstances. At this point in time the NRAs have much more influence on telecommunications regulation in the EU than the state PUCs have in the U.S.

Haucap and Kühling (2006) hypothesize that under two-level regulation at the central/federal and the national/state level there will be (a) a tendency towards over-regulation, because both levels want to regulate, and (b) a shifting emphasis towards more centralized regulation. Since the U.S. has a longer history of telecommunications regulation but appears to regulate less than the EU, hypothesis (a) must be limited by other factors. Also, the EC has been quite successful in imposing deregulation in all member states via its market recommendations, although these are issued only about every 5-6 years. In contrast, hypothesis (b) seems to be on track for both regions.

2.2. Regulatory discretion

In both, the U.S. and the EU, regulators are political appointees, who have a broad regulatory mandate for rulemaking/adjudication, although the U.S. regulatory mandate has traditionally been broader. As a consequence American regulators follow a more procedures-oriented approach than their European counterparts. In both regions there are established procedures for judicial review.

2.3. Role of antitrust/competition policy

In the U.S. antitrust policy has played an important role in the regulated telecommunications sector, the prime example being the breakup of AT&T in 1984. However, the scope of antitrust involvement has

[8] These market definitions may, however, have been influenced by policies so that they might change if policies reduced cross-country barriers.

more recently been limited in the Supreme Court's 2004 Trinko decision, in which the court held that sector-specific regulation replaces antitrust remedies. The rationale for this decision was that any additional benefit of an antitrust remedy over the regulatory remedy is likely to be small, the danger of overreach and inconsistencies is large, and the antitrust courts are ill-suited for the kind of oversight required for the regulated sector (Fetzer and Yoo, 2014). Competition policy is now probably more restricted in the U.S. telecommunications sector than in the EU.

In the EU sector-specific regulation and competition policiy overlap just like they did in the U.S. before Trinko, when, for example, AT&T was broken up under antitrust law in spite of its excuse that it was regulated. Similarly, in the EU Deutsche Telekom was tried for price-squeeze that was the result of price regulation by the German regulator. Furthermore, regulation in the EU telecommunications sector was always seen as a transitory move between privatization and competition policy, while in the U.S. regulation was originally established as a permanent policy (Fetzer and Yoo, 2014). Geradin and Sidak (2005) observe that competition policies on both sides of the Atlantic have become more regulatory. From that perspective, a move from sector-specific regulation to competition policy appears to be smaller today than in the past. At the same time, the concerns of regulation have partially moved from consumer protection to the protection of competition.

A major role in the interaction between competition policy and sector-specific regulation play industry structure-related policies. The most famous of these has been the AT&T break-up in 1982/84. Since then a major amount of regrouping and consolidation has gone on in the U.S. The regulatory and antitrust policies have been favoring this development only to the extent that merger requests have been allowed to pass, although quite often under conditions of spin-off and behavioral commintments, such as acceptance of net-neutrality principles. This was possible in part, because both the FCC and the antitrust authorities (either the U.S. Department of Justice or the Federal Trade Commission) are jointly involved. While there are four mobile networks covering essentially the whole contiguous U.S. each, no fixed telephone or cable network covers even half of the U.S. There are currently four leading players in the fixed broadband market, and that number could shrink to three should the Comcast/Time Warner merger be approved, leaving Comcast, AT&T and Verizon as the leaders. Clearly, Comcast has the upper hand in content integration, while Verizon and AT&T have the upper hand in fixed-to-mobile integration (FMI), and AT&T may gain satellite coverage if its purchase of Direct TV goes through. In spite of these huge players smaller market participants can thrive locally and, like Google, could expand significantly.

In contrast to the U.S. the EU is now actively favoring the consolidation of carriers. Indeed, no European mobile or fixed network is even close to covering half of the EU. Most countries still have their domestic fixed and cable network champions. Vodafone has been actively expanding its fixed network base in Germany, but is still far away from having an FMI presence throughout the EU.

2.4. Standards for regulation

The standards for subjecting a market to regulation so far differ in subtle but discernable ways between the EU and the U.S. The EU relies on the three-criteria test, which requires for regulation the cumulative fulfillment of the three criteria (1) high and durable barriers to entry, (2) no expected increase in market competition, and (3) the inability of general competition law to deal with the market failures described

by criteria 1 and 2. For the purpose of the three-criteria test markets are defined according to competition law criteria. An enterprise with market dominance in a market fulfilling the three criteria is subject to ex ante regulation. There is some flexibility in the choice of regulatory remedies, but it appears that this flexibility has not been used to any major extent for the purpose of moving towards deregulation.

If applied judiciously the three criteria plus the market dominance test are fairly operational. Criterion 3 is hardest to apply and is actually brushed over in practice (by the EU Commission and by the NRAs). There is some danger of type I error (overregulation) against type II error (insufficient regulation). The suitability of competition law is not tested against suitability of regulation, and the development of competition law is not taken into consideration.

In contrast to the EU, the U.S. for most regulations uses a service-based and technology-based approach that, under the Telecommunications Act of 1996 differentiates between telecommunication and information services. In addition and comparable to the EU the U.S. has used a dominance approach related to the essential facilities doctrine. This has entered the 1996 Act in the necessary and impair standards for wholesale access provision. Those requirements hold if (a) access to such network elements as are proprietary in nature is *necessary*; and (b) the failure to provide such network elements would *impair* the ability of the telecommunications carrier seeking access to provide the services it seeks to offer. The soft interpretation of these standards by the FCC during the 1990s has been repudiated by the U.S. Supreme Court in the 1999 decision in AT&T Corp. et al. *v.* Iowa Utilities Board et al.. There is a general consensus now that the „necessary standard“ means that competition cannot survive without access and that the „impair standard“ means that competition is severely reduced without access. The standards have to be viewed for bottlenecks only and explicitly refer only to unbundling requirements of ILECs (incumbent local exchange carriers), which are largely obsolete now.

The Telecommunications Act of 1996 has given the FCC the power to forbear from enforcing any of the regulations of the Communications Act of 1934. It also required the FCC every two years to review all regulations of the Act and to determine if they continue to be in the public interest. It must then repeal or modify those regulations that fail the test. Today, over- or underregulation in the U.S. mostly depend on such FCC decisions, which, according to Fetzer and Yoo (2014), have been applied inconsistently.

Nevertheless, over time this has led to a significant reduction in day-to-day regulation in the U.S., while EU regulation has remained more interventionist and cumbersome.

2.5 Conclusions from the institutional differences

Since federal and state regulation in the U.S. have interacted for much longer than the EC has with the NRAs, telecommunications policies in the U.S. are generally more homogeneous than in the EU. However, privatizations in the EU allowed for a fresh start to adopt policies rationally, whereas the U.S. has been more muddling through. Even if new technical and market developments favor similar policies a policy convergence is not assured, as long as the U.S. and the EU use different standards for (de)regulation.

3. Policy issues

3.1. Termination monopoly in interconnection

3.1.1. Characterization

Interconnection between telecommunications networks has been both the basis for network competition and the source of positive externalities for telecommunications users. In both the EU and the U.S. telecommunications carriers have a right to be interconnected with other carriers. Typically, telephone and mobile networks pay each other for the termination of calls originating in one network and terminating in another. There are exceptions in some countries, where mobile networks terminate calls on a bill and keep (B&K) basis, and peering arrangements similar to B&K exist among a number of Internet backbone providers.[9] Termination charges (and some payments to Internet service providers = ISPs) have become a major policy issue because of the so-called termination monopoly, which arises from the fact that consumers usually single-home and therefore can only be reached on the network they subscribe to. Termination charges, if unregulated, can therefore be a major source of income to telecommunications carriers. They can also be a tool for large networks to raise their smaller rivals' costs. They have therefore been regulated for some time in both the EU and the U.S. However, the regulation has differed substantially.

3.1.2. Downward trend in termination charges

In the EU termination charges in fixed networks (fixed-to-fixed = FTF and mobile-to-fixed = MTF) have been regulated since the beginning of liberalization, mostly on the basis of LRAIC. In contrast, termination in mobile networks (mobile-to-mobile = MTM and fixed-to-mobile = FTM) has in many EU countries only been regulated for the last ten years because of the long-time held mistaken belief that competition between mobile carriers would keep mobile termination charges down. Another major difference between fixed and mobile termination is that mobile termination costs were deemed substantially higher than fixed termination costs. However, unregulated mobile termination charges were still substantially above those higher costs. Throughout the EU it took several years to lower MTM and FTM charges down to LRAIC, which simultaneously decreased substantially. In the last five years the EU has embarked on a further move from LRAIC to "pure LRIC" as the basis for mobile termination charges. Such "pure LRIC" do not include any common costs with other services using the same facilities (such as origination services). The result has been a substantial price reduction for mobile termination (and a lesser reduction for fixed termination).

For some time there were indications of a waterbed effect from strong charge reductions in mobile termination. Such an effect would mean that end-user charges would have been *increased* by mobile carriers as a result of the termination charge *reduction* (Genakos and Valletti, 2011a and b, 2012; Growitsch et al., 2010). However, new empirical results by Genakos and Valletti (2014) show that the waterbed effect has largely vanished after 2006. This seems to be due to the increasing effect of fixed to

[9] B&K means that a network A terminates traffic coming from another network B at no charge but the other network reciprocates by terminating incoming traffic from network A at no charge. Thus, the payment occurs in kind, like under a barter arrangement.

mobile substitution (FMS) that has led to a dominance of MTM calls over FTM calls. Building on theoretical models by Armstrong and Wright (2009) and by Hurkens and Lopez (2013) Genakos and Valletti show empirically that the waterbed effect vanishes if MTM calls dominate, provided FTM and MTM terminations are priced the same. What is still not clear from the new Genakos and Valletti results is if termination charge reductions lead to lower calling charges.[10]

The waterbed effect is usually seen as a cushion against profit reductions from termination charge reductions. However, Genakos and Valletti (2014) show that profits on average are not significantly changed as a result of termination charge reductions after 2006 (i.e., without waterbed effect). Thus, after FMS has gone on for a sufficiently long time mobile carriers should on balance no longer oppose termination charge reductions. While my conjecture is that for the EC the charge reduction to pure LRIC is only a stepping stone for a move to B&K, Genakos and Valletti (2014) see pure LRIC as a natural end point for termination charge reductions.

U.S. regulation of termination charges differs from the EU by two major features. First, from the 1970s onwards fixed termination charges were deliberately used as sources of cross-subsidies between local and long-distance calls and between urban and rural areas. This was politically justified as universal service policy. Second, under the receiving party pays principle (RPP) prevailing in the U.S. there was no perceived termination monopoly issue for mobile terminations. As a result mobile termination charges have always been low. MTF charges were even negative for a while. Today mobile termination charges in the U.S. are regulated to be no higher than fixed termination charges and are often voluntarily based on B&K.

In contrast, fixed termination charges in the U.S. continue to vary strongly between inter-state and intra-state. Intra-state charges, which are under state PUC jurisdiction, are much higher than inter-state, because such charges until now are used as subsidies for rural telecommunications. They can be up to 12 cents per minute. In contrast, inter-state charges (under FCC jurisdiction) are only fractions of a cent per minute, ostensibly not cost based.

Shortly after passing of the 1996 U.S. Telecommunications Act inter-state termination charges had been set at LRAIC level, presumed to just cover costs. Large incumbents claimed they were too low, while small entrants claimed they were too high. It turned out that the decision-relevant costs were substantially lower than LRAIC, which led to the ISP reciprocal compensation problem. Small entrants bled the large incumbents of several billion dollars per year by signing up dial-up ISPs as their customers, which received many more incoming calls than the outgoing calls they were making. This experience radically changed the attitude of U.S. incumbents towards low termination charges.

In 2011 the U.S. embarked upon an interconnection policy that is going to unify inter- and intra-state termination charges. The FCC used its power of state preemption to move regulated termination

[10] It would be interesting to find out if before 2006 the reduction in termination charges slowed down FMS of calls and if after 2006 it accelerated FMS of calls.

charges towards B&K for both inter-state and intra-state over a lengthy time period ending in 2019.[11] B&K is also envisaged for origination services.

The large termination charge differences across the U.S. have been sustainable because of a requirement for geographically averaged retail charges. Nevertheless, until the implementation of the new policy there has been a huge amount of arbitrage because of the large range in termination charges. The FCC currently tries to rule into these arbitrage schemes but expects them to vanish only after the move to B&K is completed. Although the implementation of the policy is spread out over almost a decade, it is so radical that it required compensation payments to rural carriers (for giving up excessive termination charges) via the universal service fund discussed in Section 3.5 below. Hence interconnection charges and universal service fund are combined in one FCC Order modifying universal service and intercarrier compensation systems (USF/ICC Order).[12] Before establishment of the new rules the small rural carriers on average received 30% of their revenues from end-user, 35% from termination charges and 35% from USF (Kwerel et al., 2012). Thus, 35% of their revenues have to be replaced in order to make the small rural carriers whole.

3.1.3. Conclusions on convergence of policies

Some of the same technology and market changes, such as digital convergence (IP telephony with IP interconnections, OTT, VoIP) and multi-homing, will likely make the termination issue go away both in the U.S. and the EU. Minutes of use lose their relevance as cost drivers. IP interconnection means that "termination" will start at the backbone level rather than be concerned with the last mile and that it will only be a (small) part of all Internet traffic that is subject to such interconnection. The trend away from minutes of use is already showing up in the tendency in both the U.S. and the EU to lower termination charges in the direction of B&K.[13] While B&K has become official future policy in the U.S., it has not yet in the EU.

In both regions deregulation of termination charges is not yet on the map. However, Internet terminations are largely unregulated. So, digital convergence may carry deregulation of termination charges to the extent that telephony becomes part of the Internet.[14] To the extent that the Genakos and Valletti (2014) result about the empirical profit neutrality of mobile termination charges after sufficient FMS holds more generally, mobile carriers should not generally want to see high termination charges. Thus, termination charges could be largely deregulated, with some reciprocity requirement and subject to antitrust scrutiny.

[11] Although in a different context this bears close similarity with the EC approach towards international roaming charges, which in several steps have been reduced substantially and are scheduled to potentially disappear.
[12] For an extensive analysis see Kwerel et al., 2012.
[13] Another potential move away from minutes of use is to charge for the capacity utilized (capacity-based charging = CBC). For CBC see Kennet and Ralph (2007).
[14] See Frieden (2013) and Werbach (2013) for some of the potentially difficult implications of this move for traditional consumer protection associated with telephony. These difficulties also relate to net neutrality discussed below in Section 3.3.

3. 2. Local access bottlenecks

3.2.1. Characterization

Wholesale access to the incumbent's local loop has been the classic bottleneck issue in telecommunications policy. While before the telecommunications reform movement that started in the U.S. in the 1970s the whole telephone network was viewed as an integrated natural monopoly, the natural monopoly property through technical and market developments soon thereafter shrunk to the local loop, and some maintain that it has vanished altogether.[15] The objective of providing wholesale local access has in recent years shifted from a policy emphasis on consumer welfare to one on broadband/NGA investment.

3.2.2. Unbundling requirements in the U.S. and the EU

In both the U.S. and the EU local access competition was jump-started with the help of regulators. In the U.S. this first took the form of resale of local services and unbundling of local copper loops (LLU). Under the rules of the 1996 Telecommunications Act resale was based on retail-minus (≈ ECPR) and LLU was based on TELRIC/TSLRIC.[16] However, the FCC expanded unbundling requirements beyond the local loop to include switching and other services, all of which could be purchased on a re-bundled basis thus creating the Unbundled Network Element Platform (UNE-P). UNE-P allowed entrants to provide the same services as the incumbent without owning any network, while paying only the costs incurred by an efficient incumbent. This was the opposite to the ladder-of-investment approach later suggested by Cave but not coherently applied by the EU, which called for wholesale access charges to be relatively higher the less network the access seekers own themselves.[17] The EU also restricted unbundling requirements to the local loops and sub-loops.

3.2.3. Different legacy networks lead to different policy trends

The EU is characterized by limited facilities-based access competition. The most meaningful competition until now comes from cable TV networks, but their share varies substantially between member states and mostly is well below that of telephone incumbents. Like in most industrialized countries 4G (LTE = long-term evolution) is capturing increasing parts of the broadband market, but it is not (yet) a close substitute for fixed broadband access. Thus, broadband competition is in most EU countries largely depending on ULL and bitstream access to legacy telephone networks.[18] Although the number of such wholesale access-dependent competitors is large in most EU countries, their combined market share usually is below that of the telephone incumbent. There are, however, a few countries like France, Portugal and Spain that depend more on regulated duct and unlit fiber access. In those countries

[15] For a highly critical assessment of the U.S. regulatory developments see Hausman and Taylor (2013).
[16] TELRIC stands for total element long-run incremental costs. ECPR stands for efficient component pricing rule. An explanation and discussion of both is given in Vogelsang (2003).
[17] See Cave (2014) for the suggested and the actually implemented approaches.
[18] As a result of the weak market position of the cable TV networks and of difficulties in providing unbundled services on cable TV networks regulated wholesale access to cable TV networks is viewed as unrealistic (Hou et al., 2013). However, in locations where cable is present it often commands a high market share. Thus, under a more local market definition cable could well be a dominant supplier, justifying cable access regulation.

alternative carriers have gained significant market shares in the emerging NGA market, mostly with their own FTTH access networks (Cave, 2014).

Most incumbents in the EU continue to be vertically integrated (local access and long-distance/backbone networks), although the EU now provides rules for NRAs to request vertical separation, a possibility used by the UK (on a "voluntary" basis). Interestingly, this happened 10 years after the U.S. carriers re-integrated.

Wholesale access charges in the EU have mostly been regulated on the basis of LRAIC (see Neumann and Vogelsang, 2013, for details). However, contentious pricing issues have been associated with the upcoming shift from copper to fiber access. In its assessment of the tradeoff between static efficiency and investment incentives the EC (2013a) has decided on little or no price regulation for wholesale access to FTTH, rather relying on the provision of input equivalence for wholesale access, with some protection against price squeeze.[19] Currently this policy does not differentiate regions by the availability of other inter-modal competition. Instead, the approach just relies on competitive pressure on NGA from regulated copper access charges. On the other hand, it reverts to cost-based regulation of NGA wholesale access if there is neither inter-modal nor copper-based competition. In that sense it resembles the optional policy developed in Briglauer and Vogelsang (2011). The lack of sharp price regulation will leave cable and other non-incumbent fast access networks as beneficiaries besides the incumbents.[20]

The EC is also embarking on policies that would allow for more "consolidation of broadband providers across borders, reduce costs through economies of scale, and create a better business case for operators to invest in broadband infrastructure" (EC, 2013c). Layton (2014) lauds this approach, emphasizing the importance of economies of scale. However, in the same paper she describes the success of Danish broadband policies, which ostensibly has been reached without cross-border consolidation and without use of economies of scale. This is because economies of scale in the provision of broadband access are not particularly strong. They may derive from economies in financing of large-scale investments, from exercising buying power vis-à-vis input suppliers and the like, but are not specific to the sinking of broadband networks. There can also be brand-name economies (FIOS or U-verse in the U.S.), but all these economies are mostly pecuniary rather than real. In contrast, to the extent that innovations are important and cannot fully be appropriated in intellectual property rights, there could also be economies of scale through the fixed/sunk cost nature of innovations (Haucap and Kühling, 2006) but, to the best of my knowledge, these have not yet been demonstrated for broadband access. Even under the current policy such economies could have been reaped through trans-border mergers, but those have either not happened or have been unsuccessful (Neumann, 2013b).

[19] Due to the deregulation of wholesale access and of end-user prices in the U.S. price squeezes are not seen here as a serious anti-competitive issue.

[20] While most of the literature cited in Vogelsang (2014) comes to the conclusion that high bottleneck access charges lead to higher retail prices and a larger geographical footprint (tradeoff between affordability and coverage), Bender and Götz (2011) show in a theoretical model that higher wholesale access charges can increase facilities-based competition and thereby lead to lower retail prices and higher coverage, provided there are uniform retail charges across regions with different population densities.

In contrast to most of the EU the U.S. is characterized by facilities-based duopolies throughout most of the country. In fact, the telephone incumbents continue to have a substantially lower share in the broadband market than the cable companies, and that even holds in regions where FTTH is available.

Since 2005 the U.S. has had no effective unbundling requirements for fixed telecommunications networks. This development has two roots. The first root is a reaction to excessive unbundling that the FCC had imposed until then. When UNE-P was no longer required, the largest unbundlers, MCI and AT&T left the business and merged with Verizon and SBC. Competition based on wholesale access was thereby almost eliminated. The second root of U.S. wholesale access deregulation was that because of a federal court decision DSL became an "information service" with less regulatory obligation, just like cable. Through this deregulation the U.S. initiated the interesting policy experiment, whether a (largely uncontested) duopoly would be enough competition to substitute for regulation.

Deregulation of wholesale access was originally seen as providing investment incentives. This seemed to work well for several years. In particular the FTTH build-out by Verizon under the brand name FIOS appeared to be a big success of deregulation. However, the FIOS build-out has effectively been suspended for the last few years.[21] Two reasons are probably responsible. First, Verizon went for the low-hanging fruits, meaning high-density areas. This worked, but even here its market share against the cable companies grew only slowly and did not make Verizon the larger broadband provider in those areas. Second, and related, in less dense areas the cable companies had a decisive cost advantage that could only be overcome by a larger market share for FIOS. After the experience with the low-hanging fruits this seemed to be unrealistic. Thus, Verizon's decision is rational and probably efficient even from a social (rather than private) perspective.

In contrast to Verizon, AT&T has embarked mostly on a VDSL build-out, using FTTP only for new housing developments and in selective cities (under the brand name "GigaPower"), where it competes with Google for the market. These build-outs support AT&T's triple play U-verse system, which has recently gained market share against DOCSIS 3.0.[22]

The deregulation of broadband networks in the U.S. in the 2002/05 period was based on the view that two major competitors are now deemed to be enough (because it means that access is not an essential facility) to avoid wholesale access regulation if infrastructure investment is a major concern. As argued above, some success on the investment front can be claimed. However, prices for large bandwidth remain high,[23] a possible result of joint market dominance, and there are some hints at potential collusion. For example, Verizon and cable firms have joint marketing agreements that were restricted by the Department of Justice on the occasion of a spectrum sale by cable companies to Verizon. Marketing agreements were only allowed, where Verizon offers no FIOS (FTTH), meaning that there is no direct

[21] FIOS uses the GPON technology, which is shared between users. As a result promised speeds are often less than those for DOCSIS 3.0.

[22] Discussion by Christopher Yoo at Mannheim conference on Fetzer and Yoo (2014).

[23] See, however, Yoo (2014), who demonstrates that U.S. prices for connectivity are lower than in the EU for low bandwidths and higher only for high bandwidths.

competition at eye level. This, however, assumes that the agreements have no negative investment effect on the build-out of FIOS.

The experience so far with de facto deregulation of bottleneck access in the U.S. has thus shown some downsides, potential collusion and soft price constraints. However, these downsides have to be weighed against the downsides of regulation in terms of interference with market outcomes. It is therefore questionable if the current level of competition can be called “effective” in the sense of Hausman and Taylor (2013), meaning that “regulation would be economically inefficient”. (p. 205)

A somewhat surprising aspect of the U.S. deregulation policy has been that it applies nationwide, meaning that even in low-density areas without facilities-based competition fiber lines have been deregulated. This can be understood from three perspectives. The first is that access-based competition has never made such a big difference in those regions. Second, large carriers have uniform pricing policies across large areas. Third, rural carriers receive universal service subsidies.

In contrast to the U.S. in the EU wholesale access regulation persists and is now gradually retreating from some high-density areas in some countries. This can have beneficial effects on these high-density areas. However, it deprives the remaining low-density areas of the cost averaging and therefore can lead to price increases in low-density areas in spite of continuing regulation. At the same time, it may benefit mobile broadband carriers who can then play out their natural advantages.

3.2.4. Effects of EU and U.S. policies

Among others due to the stagnation of FIOS, doubts have arisen about U.S. international ranking in broadband penetration. While the U.S. broadband penetration lags behind some of the most advanced nations in Asia and Europe, it is well ahead of the EU average. It is therefore no surprise that no re-regulation can be expected in the U.S. One of the main questions for future increases of average broadband speeds in the U.S. is if GPON FTTH can expand against fully penetrated cable networks with DOCSIS 3.0. DOCSIS 3.0 can deliver 100MB to 100 million people well before the FCC target of 2020. It would be very expensive for Verizon to do the same with FIOS. There are, however, also incentive issues. The slow take-up of FIOS could be due to Verizon’s comparatively high price policy, something that probably would not have happened if Verizon had been forced to sell bitstream access to entrants. Interestingly in Japan P2P FTTH crowded out cable before it gained broadband market. This at least initially happened because of low ULL charges for P2P (Minimahashi, 2012). A very different development is the emerging competition between AT&T and Google for FTTH build-out in cities across the country. This could end in an investment race that could cover substantial portions of the U.S. population.

Yoo (2014) has shown that NGA coverage (as opposed to NGA user penetration) in the U.S. is well above the EU average. He also shows that this is mainly due to the very high DOCSIS 3.0 coverage. On the other hand, non-cable-based NGA coverage in the U.S. also exceeds non-cable-based NGA coverage in the EU. Thus, while most of the coverage advantage of the U.S. can be explained by its exceedingly high cable coverage (and by the strong cable backbone build-out in the 1990s), the U.S. advantage in non-cable-based NGA could well be the result of the newer policies.

There is some empirical work assessing the effects of the unbundling requirements in both the U.S. and the EU. The results from the U.S. are surveyed in Cambini and Jiang (2009) and in Crandall et al. (2013). Based on a reading of the empirical literature unbundling regulation leads to low prices for DSL services but hinders investment in NGA. In particular, entrants would promote DSL more strongly than the incumbent, who did, for example, protect its second line business for narrowband ISPs. Thus, unbundling could potentially increase broadband penetration in the short run but would hinder it in the long run.

Empirical results on the effects of wholesale access regulation in the EU show that entrants move on the ladder of investment from resale to ULL, but not beyond (Nardotto et al., 2013; Bacache et al., 2014). However, ULL and/or bitstream access and/or a high level of DSL penetration tend to be associated with less follow-up investments in NGA networks (Briglauer, 2014). Thus, empirical results for the EU by Briglauer et al. (2013) and Briglauer (2014) are fairly similar to those found for the U.S.[24] However, as Cave (2014) argues for the different countries in the EU, the policy interpretation of the empirical results on unbundling requirements may have to differ distinctly, depending on the most likely policy counterfactual.[25] In the U.S. a state of the world without wholesale access to local loops would from the late 1990s onwards have led to an unregulated DSL/Cable TV duopoly as the most credible counterfactual for broadband access for almost the entire nation. The econometric results then demonstrate that this counterfactual could actually have been associated with better policy outcomes than the wholesale access regulation that governed until 2002/2005. In contrast, the same counterfactual would have been correct only for the part of the EU with good cable coverage, while for the rest of the EU the most likely counterfactual would have been uncontested unregulated monopoly that would have defaulted into end-to-end regulation (Cave, 2014).[26] In comparison to that counterfactual the actual wholesale access regulation looks much better, given the empirical results.

The question is if the cable/DOCSIS 3.0 success story in the U.S. could and should be repeated in the EU under appropriate policies. Historically, the U.S. success in cable first of all goes back to decades in cable growth in a TV hungry society. This success was substantially enhanced by an enormous expansion of cable backbone networks in the 1990s in the hope of providing 500 TV channels to every home. While the latter did not materialize, the expansion provided for the common capacity necessary to supply broadband connections to many households. This led to a consistent 60:40 advantage of cable over

[24] It has to be kept in mind that the unbundling in the U.S. has been distinctly different from that in the EU. The results are therefore not directly comparable. While unbundling in the EU has been restricted to local loops and sub-loops (including access to ducts and unlit fiber), the U.S. has (until 2002) used the UNE-P approach, which included essentially all network elements needed to assemble a network (common assets that cannot be offered on an unbundled basis, such as switches).

[25] Cave's (2014) use of counterfactual also suggests that the econometric analysis of policies should keep a keen eye on the relevant counterfactual. Thus, separate econometric analysis for areas with or without broadband cable TV would have been in order.

[26] In contrast, a large number of theoretical papers assume that the relevant counterfactual involves potential infrastructure competition from entrants. See, for example, Bourreau et al. (2013, 2014). The realism of this assumption as applied to the EU context is, in my view, restricted to very densely populated areas and assumes large market shares of entrants. See, for example, Hoernig et al. (2012). In some countries, such as Denmark, competition from cable is likely to be weak, because the cable and telephone networks are jointly owned.

other (DSL) broadband connections. The next step was that a move from regular cable broadband to DOCSIS 3.0 was substantially cheaper than a move from DSL to VDSL or even to FTTH. Cable could therefore upgrade much more easily than the legacy telephone networks. Thus, for the U.S. the investment delta for DOCSIS 3.0 was small relative to the investment required to build DOCSIS 3.0 from scratch, which would be much higher and probably not worth the effort. Building DOCSIS 3.0 from scratch would be substantially higher than the incremental investment for European legacy telephone networks to upgrade to VDSL with vectoring (or possibly even to FTTH). Thus, having already converted most of its cable TV networks to DOCSIS 3.0 the EU could realistically only reach the high U.S. NGA coverage by concentrating more efforts on VDSL/FTTH plus possibly on LTE (Yoo, 2014).[27] Here, the VDSL/vectoring route appears to be much more successful, at least in the short run (Yoo, 2014). Overall, the real problem from the perspective of the investment goal appears to be that the EU is behind the U.S. on coverage not just for DOCSIS 3.0 but rather for VDSL, FTTH and LTE as well.

How large a problem is this? Achieving high coverage is great under the motto of the "Field of Dreams": "If you build it they will come." However, worldwide there are ample examples of NGA build-out with low customer take-up. The question therefore is if much welfare is lost by slower rather than faster build-up of NGA coverage. The answer depends on whether the strong results, for example, by Czernich et al. (2011) on the external benefits of broadband infrastructure extend to the incremental move from broadband to NGA.

3.2.5. Conclusions on convergence between U.S. and EU policies

In both the U.S. and the EU the emphasis on infrastructure investment in NGA has led to softer regulation of copper and NGA access. In the U.S. that has meant deregulation of fiber infrastructure already in 2002/05, while the EU has only now partially followed suit by softening price regulation of NGA wholesale access (see EC, 2013a). The EC leaves the door open for more stringent regulation if inter-modal competition and the competition from copper access prove to be insufficient. Given the highly uneven distribution of inter-modal competition in the EU (as long as 4G/LTE is not yet effective), the new policy means a strong reliance on competition from copper. However, the more successful NGA penetration the less pressure can be expected from copper competition. Since efficient regulation in this area depends on the degree of urbanization, population density and prior infrastructures, it is not clear if this is the right general policy, given that most residents of the EU do not have access to broadband cable. The question here is if copper upgrades through VDSL/vectoring will be both competitive against cable and a robust NGA where cable is not available. Since vectoring does not allow for ULL, the question is if alternative suppliers move down the ladder of investment towards forms of bitstream access.[28] In contrast, in countries/regions with only the incumbent legacy network provider the only infrastructure competition comes from 4G/LTE. In rural regions without land-based NGA only 4G/LTE

[27] However, Spain started most of its cable network as late as 1998 (Yoo, 2014). So, starting from scratch is not impossible.

[28] Since shared access under vectoring is not possible, countries like Germany allow alternative suppliers the same access option as the incumbent. It remains to be seen, how many alternative suppliers will invest in vectoring ahead of the incumbent. In any case this possibility could create a "race" towards vectoring. This cannot happen in the U.S. where no such duct access is required. See, however, the potential race for FTTH between AT&T and Google mentioned above.

will exist as a competitive force for ultra-fast broadband. This suggests implicit or explicit geographical differentiation of one-way access regulation.

While it is therefore quite likely that wholesale access policies in the EU and the U.S. will become more and more similar, differences due to geographical differences and different legacy infrastructures are likely to remain.

3.3. Net neutrality

3.3.1. Characterization

The net neutrality problem emerged in the U.S. about 15 years ago without affecting policy discussions in the EU for quite a while. The original net neutrality definition (= a bit is a bit is a bit) has among economists morphed into a differentiated policy issue, consisting of a zero price rule and a non-discrimination rule. The former would disallow termination fees for the access of content service providers (CSPs) to end-users, while the latter meant no quality of service (QoS) differentiation, no degradation of traffic, blocking, throttling (vertical foreclosure) and no exclusive contracts (Schuett, 2010; Krämer et al., 2013). A caveat was always that reasonable network management would be exempt.

3.3.2. Policies in U.S. and EU

In the U.S. the FCC codified Internet freedoms in December 2010 (Open Internet Order),[29] stipulating that ISPs have to treat all Internet traffic equally, cannot deliberately slow or block traffic depending on who created the content and where it is going, and have to fulfil a transparency requirement. There were partial exemptions for reasonable network management, for mobile carriers and for special services (Fetzer and Yoo, 2014). The non-discrimination and no-blocking rules were turned down in January 2014 by the Federal Court of Appeals of the DC Circuit, because the FCC had previously classified the Internet as an "information service", meaning that it is not subject to the same stringent common carrier regulation as telecommunications services are. The Court conceded that the FCC could make new rules that are less regulatory. The FCC decided not to appeal the decision and has started new ongoing net neutrality proceedings, so far based on the definition of the Internet as providing information services.[30] Under the currently proposed new rules ISPs can't block, can't degrade, can't arbitrarily favor certain applications, and can't favor their own traffic. However, the proposed rules move away from generally prohibiting fixed broadband providers from offering "paid prioritization" to explicitly permitting fixed line providers to offer paid prioritization subject to conditions designed to guard against anti-competitive and anti-consumer conduct. Under the old rules, the FCC did not explicitly prohibit such deals, but said it was skeptical they would meet its discrimination test. In the new proposal, the FCC

[29] In 2005 the FCC had issued an Internet Policy Statement with similar content but no binding legal powers. The FFC tried to implement the 2005 statement in a 2008 order against Comcast but was struck down in court.

[30] Some comments submitted in the proceeding have urged the FCC to change the classification of Internet services instead, notably by the Benton Foundation (2014) and by Narechania and Wu (2014). A re-classification from information to telecommunications services would not pacify ardent net neutrality supporter, because it would not abolish all discrimination but only discrimination that is unjust and unreasonable.

would mandate that paid prioritization offerings be "commercially reasonable."[31] This standard ostensibly offers less protection than the previous Open Internet Rules. Additionally, the FCC's call to approach discrimination on a case-by-case basis creates uncertainty, and could disadvantage small businesses and entrepreneurs. This, however, has been built into the January 2014 DC Circuit Court decision.

In contrast to the U.S., after a weaker net neutrality policy in place since 2009, which required transparency and allowed NRAs to impose minimum QoS standards, the European Parliament has recently approved much sharper net neutrality regulations.[32] Here "'Net neutrality' means the principle according to which all internet traffic is treated equally, without discrimination, restriction or interference, independently of its sender, recipient, type, content, device, service or application" (ALDE Amendment 234 to the proposal in EC, 2013b). The regulations in particular forbid ISPs from throttling/blocking Internet content or from entering into anti-competitive commercial agreements.[33] Exceptions include illegal content that may be blocked and "specialized services" that may receive priority over other services. A fairly similar exemption had been part of the voided 2010 FCC regulations. The problem with specialized services is the fuzziness in defining requirements for allowing priority or dedicated capacity. IPTV may qualify for such capacity but it is not easily differentiated from similar TV-like services. However, in the proposed EU net neutrality rules a "specialized service" is narrowly defined "as an electronic communications service optimized for specific content, applications or services, or a combination thereof, provided over logically distinct capacity, relying on strict admission control, offering functionality requiring enhanced quality from end to end, and that is not marketed or usable as a substitute for internet access service" (ALDE Amendment 235). Furthermore, "[p]roviders of internet access, of electronic communications to the public and providers of content, applications and services shall be free to offer specialized services to end-users. Such services shall only be offered if the network capacity is sufficient to provide them in addition to internet access services and they are not to the detriment of the availability or quality of internet access services. Providers of internet access to end-users shall not discriminate between functionally equivalent services and applications" (ALDE

[31] FCC Chairman Wheeler (2014b) explained the "commercially reasonable" approach as follows: "Something that harms consumers is not commercially reasonable. For instance, degrading service in order to create a new 'fast lane' would be shut down. Something that harms competition is not commercially reasonable. For instance, degrading overall service so as to force consumers and content companies to a higher priced tier would be shut down. Providing exclusive, prioritized service to an affiliate is not commercially reasonable. For instance, a broadband provider that also owns a sports network should not be able to give a commercial advantage to that network over another competitive sports network wishing to reach viewers over the Internet. Something that curbs the free exercise of speech and civic engagement is not commercially reasonable. For instance, if the creators of new Internet content or services had to seek permission from ISPs or pay special fees to be seen online such action should be shut down."

[32] Whether all these regulations will be approved by the Council of the European Union will depend on the success or failure of the lobbying activity of the telecommunications industry, which will emphasize potential negative effects of net neutrality on network investment. Even so, once approved, they will most likely be stronger than corresponding U.S. regulations if any.

[33] The proposed EU provisions on net neutrality also include transparency requirements that allow customers to check if they get the QoS they contracted for.

Amendment 236).[34] Essentially, specialized services will have to be provided outside the normal Internet.

Another potential "special service" could be telephony, which in the future will be dominated by VoIP and therefore will be an Internet service. In the U.S. there is an ongoing discussion about the future of telephony, both from the point of view of the infrastructure being used for it and from the point of view of rights and obligations associated with the service. If telephony is only one among many Internet applications, does it justify receiving special treatment and, if so, in what form? Narechania and Wu (2014) have argued in favor of a net neutrality solution based on the property of Internet connections as two-way connections, where typically an end-user sends a message to a content provider, who in response delivers the content (and who is also a customer of the network provider). They argue (in my view correctly) that this response message is solely a telecommunications service and could/should therefore be subject to the rules governing for telecommunications services rather than for information services. This same argument would hold for telephone services that migrate to the Internet.

3.3.3. Main policy issues

Termination fees

Termination fees for content service providers (CSPs) without QoS differentiation are not currently on the EU or U.S. policy agenda, although they appear quite natural to economists familiar with two-sided markets. Such fees could be covered by a common carrier rule if they apply to all CSPs. However, CSPs are not easily identifiable as such, because potentially all Internet users provide content. The most likely net neutrality violation in the form of termination fees would be for capacity requirements for specific types of content. This will be hard to differentiate from QoS differentiation discussed next. Capacity increases can be expensive. So, the question is who should pay for those expansions. There are three potential sources: all subscribers without capacity limitations (to some extent what we see today, although payment for connection speed includes that), subscribers for the capacity they actually use,[35] or the CSPs in lieu of their customers.

In the net neutrality proceedings currently before the FCC AT&T brought up a feature of net neutrality violations in the form of termination fees (with or without QoS differentiation) that before had escaped much of the public's attention. It is that initiating termination charges for CSPs would lower an ISP's charges for end users. This phenomenon is well known from the literature on two-sided markets (see Rysman, 2009) and from the waterbed effect discussed above. It has also been brought out in the net neutrality literature (see Krämer et al., 2013, and Gans, 2014). The question remains how large is the effect going to be and how much does it depend on an absence of market power?

Gans (2014) introduces a feature to the net neutrality literature that has been largely neglected so far, and that is the ability of ISPs to introduce price differentiation into the ISP/end-user relationship. In particular for CSPs that charge their consumers (rather than depend on advertising revenues) this

[34] All citations on ALDE amendments are from Meyer (2014).

[35] This could take the form of maximum demand tariffs, peak load pricing or real time pricing, the latter suggested by MacKie-Mason and Varian (1995).

neutralizes net neutrality policies so that only net neutrality that also outlaws end-user price discrimination can be effective. He calls such a policy "strong net neutrality" in contrast to "weak net neutrality" that only outlaws either CSP discrimination or end-user discrimination. Gans shows that for advertising-based CSPs weak net neutrality regulation can be harmful because there is already one missing price (between CSP and consumer) so that suppressing another missing price signal can be welfare reducing.

QoS Differentiation

The most pressing policy issue under net neutrality is if ISPs should be allowed to differentiate Internet QoS for different applications/types of contents ("specialized services") and if they should be allowed to charge differently depending on the QoS contracted by CSPs.

The issue was widely publicized in the U.S. after the recent private deal, in which Netflix agreed to pay Comcast (and later Verizon) for direct interconnection and for improved QoS. This arrangement shows that arbitrage opportunities could emerge if net neutrality policies tried to block QoS differentiations for CSPs. The Netflix/Comcast agreement does not violate any net neutrality principles, because it is a paid peering arrangement between ISPs. However, it shows that large CSPs can achieve ISP status and thereby use transit or peering agreements with other ISPs in order to influence the quality of their content transmission to end-users. Small CSPs with similar QoS problems may not be able to disguise as ISPs. At least some such CSPs may therefore welcome QoS differentiations in their favor that would give them the opportunity to purchase fast-lane services from their ISP. On the other hand, Netflix can be a champion of net neutrality and at the same time benefit from the advantages of QoS differentiation.[36]

Economists are generally in favor of QoS differentiations provided they follow objective criteria, such as free selection between different QoS/price combinations by CSPs (for a survey see Krämer et al., 2013). Given that QoS mostly depends on the available capacity relative to (peak) traffic there is the danger that ISPs use the permission of QoS differentiation for a deterioration of low QoS tiers (best-effort traffic). While the proposed EU legislation will allow QoS differentiation under specific circumstances and with the stipulation that no services suffer QoS deterioration, the FCC had been less open to QoS differentiation until after the January 2014 Appellate Court decision. In the current FCC proceedings AT&T suggests a safe harbor approach, only targeting those QoS differentiations that are "commercially unreasonable" and that "threaten Internet openness and the virtuous cycle of innovation and investment".

It appears that both the U.S. and the EU may treat priority services with higher QoS than the best-effort Internet as individual exceptions from net neutrality. From an economist's perspective such exceptions resemble 3rd degree price discrimination with its potentially negative welfare consequences rather than policies that would resemble much less controversial 2nd degree price discrimination. Such "2nd degree"

[36] At the peering level the Netflix/Comcast deal raises concerns that ISPs use better access to their end-use subscriber base as a lever for paid peering arrangements as a substitute for slower transit arrangements via content distribution networks. Because of the large number of peering partners throughout the world peering has for the last few years not been viewed as a major market power issue. However, the recent stronger emphasis of ISPs, such as Comcast and AT&T, as gatekeepers for end-users may be changing that.

policies could consist of higher QoS options that would be available under the same conditions to all interested parties.

Competition among ISPs

In the U.S., mobile services were partially exempt from the net neutrality provisions of 2010. In contrast, the proposed new rules for the EU are technology neutral and do not distinguish between mobile and fixed line services. Thus, in the EU mobile carriers would no longer be able to block competing services such as Skype. Past violations of net neutrality for mobile services in the U.S. and the EU raise the question if net neutrality is a termination monopoly issue or an issue of capacity costs and capacity limits. As a termination monopoly issue it would be somewhat independent of competition in the ISP market, because – in spite of competition between ISPs – customers can only be reached by CSPs on the ISP they have subscribed to.[37] Njoroge et al. (2013) formally model CSP access to ISP customers as a termination monopoly in a "walled-gardens" model, where an ISP will only deliver content to its subscribers if a CSP buys the access. CSPs not buying such access are blocked. In a second non-neutral regime CSPs can choose between free basic access and a priority-lane access for an extra fee. In contrast, in the neutral regime each ISP only supplies one basic quality, but this may differ between ISPs.[38] In fact in their model of neutrality the ISPs differentiate their QoS strongly from other ISPs. In contrast, in the non-neutral regimes the ISPs differentiate themselves less but provide higher average QoS. In their two-sided market framework the non-neutral regime therefore leads to higher ISP investments in QoS. However, CSP participation may be curtailed by higher prices they have to pay for (preferred) access. Njoroge et al. (2013) find that the non-neutral regime generates higher welfare in the "walled-gardens" model, while the neutral regime can be superior in the "priority lanes" model if there is a large heterogeneity among CSPs. This contrasts slightly with the results in Bourreau et al. (2012). In their two-sided market model with two competing internet platforms and a continuum of heterogeneous CSPs a discriminatory regime with priority pricing always yields higher network investment and more content innovation, and welfare is increased compared to a net neutrality regime. Increased competition among CSPs resulting from discrimination may make CSPs worse off, though.[39] From these two papers it appears that competition among ISPs both increases the incentives for net neutrality violations and for QoS investments associated with such violations. As a policy consequence, if there is competition between ISPs, then at the very least "special services" should be exempted from prohibitions on QoS differentiation against pay.

The motives for net neutrality violations include the necessity for networks to manage capacity constraints (especially for mobile networks), the incentive to extract content rents and to reduce

[37] As Gans (2014) shows, this termination monopoly property has two consequences. One is that ISPs become gate-keepers for access to end-users, which allows ISPs to charge monopoly prices from CSPs. The other is that end-users are valuable to ISPs and therefore can reap monopsony conditions from them. Thus, ISPs compete away the advantages of the termination monopoly (the waterbed effect).

[38] Note that, in contrast to Choi et al. (2011), the individual ISPs control their QoS over the entire path. So, there is no interconnection/termination issue between ISPs.

[39] Overall, the formal literature on net neutrality is diverse and theoretical. There are no empirical estimates on the effects of net neutrality violations. This is highly problematic, because most theoretical results show tradeoffs that require empirical evaluations.

network competition (especially for fixed networks under convergence). While IP convergence induces competition between formerly non-competing networks (telephone vs. cable), net neutrality violations can lead to network differentiation through vertical integration, exclusivity arrangements between CSPs and ISPs and preferential treatment of ISP-associated CSPs. This helps network providers to soften network competition, which in turn can lead to enhanced network investment.

Blocking/Throttling

Blocking and throttling of Internet services is seen by net neutrality proponents as a way to kill unwanted competition for ISPs from CSPs and by net neutrality opponents as a tool for network management or as an incentive for network investment. This discrepancy in views suggests that both motives/outcomes are possible, which again suggests that a per se policy rule may be dominated by a rule of reason. This in turn could favor a competition policy approach or a case-by-case regulatory approach over a per-se regulatory approach to the issue. The main unwanted policy result from blocking/throttling would be a fragmentation of the Internet. A lover of sports and movies may get the preferred sports channels only on one network and the preferred movie channels only on the other network. This is a problem that competition policy may have a hard time dealing with, because the outcome may depend less on market power than on externalities. In fact, a monopoly ISP may be less likely to generate such fragmentation than several competing ISPs.

3.3.2. Conclusions on Policy Convergence

The effects of net neutrality violations depend on the type of violation. For example, priority service creates the potential for a deterioration of best-effort QoS. If that is a pervasive danger minimum QoS standards and transparency requirements may be in order. All types of net neutrality violation involve externalities potentially leading to Internet fragmentation. The policy response to that could be interconnection policy (common carrier rule). Net neutrality violations can also lead to foreclosure or a network tipping, which would require competition policy interventions.

If moved from regulation to competition policy the net neutrality issues would fall under the rubric of "vertical restraints", something the U.S. antitrust policy cares very little about today. Thus, an effective pursuit of net neutrality under antitrust might require a reversal towards more stringent antitrust policies. This appears to be different in the EU, where therefore competition policy might be more effective. In general, competition policy is unable to deal with externalities and discriminatory practices in the absence of market power. It should therefore be complemented with lower levels of regulation, such as transparency requirements, about QoS in particular, or minimum quality regulation for a basic service. Given the weak empirical incidence of net neutrality violations it would, in my view, be advisable to give priority to competition policy and put the burden of proof on regulation that competition policy has not worked. Externality-related beneficial outcomes could also, potentially, be achieved by strengthening the consumer protection bureaus in competition policy agencies, such as the FTC in the U.S.

Because net neutrality policy in the U.S. is currently in limbo, it is uncertain where it is going. Quite possibly the net neutrality policy envisaged by the FCC in 2010 will totally vanish and be replaced by a

case-by-case regulatory approach and an ex post non-discrimination policy. However, the old policy may also be revived under a different legal approach. Most likely, there will be less net neutrality policy than under the 2010 approach. In contrast, the EU is on its way to a quite stringent net neutrality policy that will even include mobile carriers equally as fixed networks. In both regions specialized services will play major roles in the future, replacing current cable TV and POTS. Should, as expected, the U.S. and the EU embark on quite different net neutrality policies for the foreseeable future, the question will arise if such differentiated approaches will prove feasible given the international nature of the Internet. "Special services" with superior QoS can only be delivered internationally if ISPs across countries are capable and legally allowed to deliver such services.

Net neutrality policies definitely remain work in progress. Experiences with these new policies will have to be gained before they can be expected to converge.

3.4. Spectrum policy

3.4.1. Policies in the U.S. and the EU

The aim of spectrum policy is to maximize the economic value of spectrum use.

U.S. policy

The U.S. has a renewable license system for spectrum that is not assigned to government uses or that is unlicensed. Another feature of U.S. spectrum licenses is that they are handed out for local areas, although a carrier can acquire contiguous licenses for potentially the whole U.S. The primary method of assigning licenses in the U.S. is by auction.

In principle, license holders in the U.S. can sublease spectrum to concurrent secondary users (private commons) and can trade licenses. The potential role of such secondary markets is shown by the fact that Nextel (now Sprint) assembled its nationwide spectrum through secondary trades in the 1980s. However, new applications for secondary markets have been slow to develop (see Telecommunications Policy, 2013) and are currently pushed by the FCC. The PCAST (2012) report to the U.S. president in particular suggested ways for sharing government spectrum by secondary users. This would substantially increase the use of such spectrum without the necessity for government authorities to give up their rights. The government would still be the primary users with priority usage rights and private users would only come in to the extent that they do not interfere with the primary rights. This can, for example, be achieved through very low power usage (femto cells) over large contiguous spectrum bands.

Unlicensed spectrum users require no licenses but must use certified radio equipment and comply with technical requirements. The traditional use of unlicensed spectrum has been for low-power local communication (incl. Wi-Fi). Now unlicensed spectrum also includes white spaces on unused spectrum of TV channels. Planned incentive auctions will also increase the amount of unlicensed spectrum by setting aside guard bands safeguarding against harmful interference between adjacent licensed spectrum bands. All this would increase the availability of unlicensed spectrum incrementally. However, the PCAST (2012) report had suggested a quantum increase in unlicensed spectrum, and the new FCC

chairman Tom Wheeler appears determined to follow through with the PCAST recommendations. As part of this initiative he also wants to "explore ways to drive not only efficient transmission, but also efficient reception, in the band" (Wheeler, 2014a).

What is missing in the literature is a comparative evaluation of the advantages and disadvantages of licensed versus unlicensed spectrum that would allow informed decisions on the appropriate sphere for each. While "commons" have a bad reputation among economists, they can save on transaction costs and can lead to greater spectrum use and to the development of devices that avoid interference. Fetzer and Yoo (2014) suggest that open access regimes need a large degree of control, while the complex sources of potential interference make defining rights in a licensed regime difficult. In my view, in an unlicensed regime the tragedy of the commons can be avoided, because neither senders nor receivers have an interest in interference and because innovations in new radio equipment technologies help find such spectrum, easily travel from one wavelength to another or are otherwise robust against interference. However, there could be the issue of free riding. Foremost, a regulator has to establish technology standards for senders and receivers. The advantages of unlicensed spectrum include low transactions costs and an absence of gate keepers, leading to the fullest possible use of spectrum, and high flexibility. In contrast, the advantages of spectrum licenses include reliable availability (at a price), economic use of spectrum (spectrum conservation, no over-use), incentives for sharing, but that is restricted by transaction costs and market power. A strengthening of property rights (liberalization of uses) can lead to a sizable reduction in spectrum scarcity and lessening of market power of large players in the spectrum market.

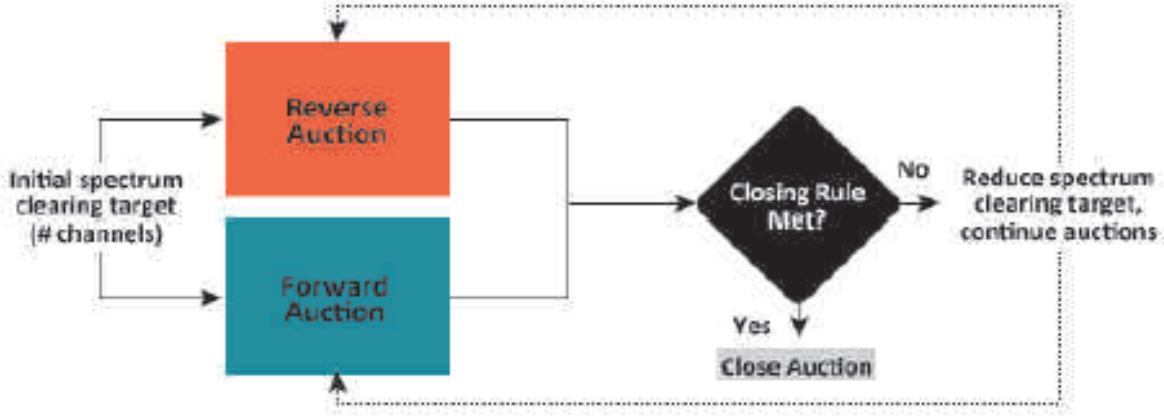
In the U.S. market power issues in mobile markets have led to policies of curbing market shares for spectrum. Currently there are four nationwide mobile competitors with an HHI of about 2570 (2013). That is in the range of most EU countries. The failed AT&T/T-Mobile merger shows that the U.S. policy institutions continue to be sensitive to the market power issue. It is therefore unclear if even a Sprint/T-Mobile merger would pass antitrust and regulatory scrutiny. In the past the control of market power in spectrum markets occurred through spectrum caps, which were, however, replaced in 2003 by more flexible spectrum screens. The current FCC spectrum holdings docket, however, again raises the issue of restrictions on spectrum acquisitions by the largest two mobile carriers. Thus, AT&T and Verizon may face restrictions in the upcoming incentive auctions. Spectrum caps for large players increase their costs/lower QoS relative to smaller players with the same amount of spectrum. Another way of curbing market power is through an open access requirement, as it has been imposed in the 700MZ spectrum auctions in 2008.

Given the huge demands of mobile telecommunications for additional spectrum the main current policy task on both sides of the Atlantic is to free up and repurpose spectrum. For example, due to earlier spectrum availability the U.S. got a significant head-start over the EU in LTE coverage (Yoo, 2014). Similarly, individual EU countries are ahead of others because of earlier spectrum auctions for LTE bands. The currently planned U.S. incentive auctions will in addition try to repurpose existing spectrum rights by encouraging existing broadcast television licensees to voluntarily give up spectrum in exchange for a share in the revenues generated from new licenses auctioned off for this spectrum. This appears to be the first time that a market approach is used to allocate spectrum between different uses rather than

predetermining the use for certain spectrum bands and then running auctions among the members of a predetermined user group. Although the FCC cannot take away spectrum rights from broadcasters, it can move them into other bands ("repacking"). This facilitates auctions based on generic spectrum rights within the UHF spectrum range.

Figure 1: Flow diagram of upcoming incentive auctions

Source: FCC Staff Summary: *The Broadcast Television Spectrum Incentive Auction*



The incentive auctions will consist of a complicated set of two types of auctions, one to relinquish spectrum ("reverse auction") and one to acquire spectrum ("forward auction"). The amount to be sold in the forward auction depends on the result of the reverse auction, as shown in Figure 1 above. The auction design is being created but the incentive auctions will be run at an as of yet unspecified date in 2015.

The broadcast TV licensees in the reverse auction can decide either (1) not to participate, or (2) to bid to leave the market, or (3) to bid to share UHF spectrum with other broadcast TV stations (which requires prior coordination), or (4) to bid to move to VHF spectrum. The success of the auction will particularly depend on a broad participation of broadcasters who offer enough spectrum for the mobile carriers to pick up. The broadcaster participation will, however, be influenced by the amount and price of spectrum they expect to be taken up by mobile carriers. The latter could be influenced by spectrum caps imposed on mobile carriers, if any. For the planned incentive auctions the value of spectrum per MHz-pop has some time ago been estimated with 1.28 $ for mobile services vs. 0.11-0.15 $ for broadcasting (FCC, 2008 and 2010). If these FCC evaluations for the value of spectrum to broadcasters and to mobile carriers remain correct the incentive auctions should lead to a large amount of trades that leave a substantial amount of money for the government and provide substantial additional unlicensed spectrum. However, the auction format is going to be complicated and the decision making for the broadcasters is going to be very difficult. Broadcasters have to value the four options described above before deciding whether to bid, at what level and at what price. Because these decisions are so unusual,

broadcasters expect guidance and valuations from the FCC who cannot know the broadcasting business and its future as well as the broadcasters.

EU policies

In initiating and implementing market-based spectrum policies the EU countries have been largely followers rather than leaders of U.S. policies. There is limited harmonization of spectrum allocation at the central EU level. The EC (2013b) is taking initiatives for international coordination of spectrum policies and spectrum allocations. This is particularly important in light of the small size of European countries and the amount of spectrum held unused in order to avoid interference across borders (PCAST, 2012).

The UK has developed some new approaches independent of the U.S. For example, spectrum in bands with scarcity but no auctions is subject to administered incentive pricing (AIP) based on the opportunity cost of spectrum. Measuring the opportunity cost of spectrum has been done for Italy by Cambini and Garelli (2011) and for the UK by Ofcom, but this turns out to be a daunting task so that woefully crude approximations have been used (Cave, 2013). This makes AIP a highly imperfect pricing method that nevertheless could be applied in cases where auctions are inappropriate, such as for spectrum used by state agencies.

The UK has also pioneered new definitions of usage rights, where the rights of license holders are defined by maximum interference levels rather than maximum power levels (Cave and Webb, 2011).

In contrast to the U.S., licenses in the EU countries are often handed out for a specific time frame. When it comes to the end of this time frame, current license holders are in danger of losing their licenses in new auctions. This can influence their investment behavior during the run-up to the new auctions. Now that the first round of licenses is coming to the end of their lives regulators have to determine the succession process for the future. In principle they can either extend the current licenses (which would renege on the original contracts) or start a new licensing regime, most probably via new auctions. Since the current license holders have made considerable, largely sunk, investments, they would be formidable competitors in such auctions. Without an increase or decrease in the number of licenses the auction results would therefore most likely be a foregone conclusion. But that need not be such a bad outcome if a simple extension of licenses is viewed as illegitimate but economically sensible. The new licenses could then be made permanent in a way similar to the U.S.

One reason why EU countries have not yet contemplated an approach like the proposed U.S. incentive auctions to new spectrum allocation is that member states have the power to reallocate spectrum when licenses expire, something the UK has done in the past.[40] However, EU law otherwise limits the ability to reallocate spectrum to other than its current uses (Fetzer and Yoo, 2014).

Again in contrast to the U.S., spectrum licenses in the E.U. generally cover a whole member state, but contiguous licenses for all member states currently are almost impossible to accumulate. As a result,

[40] Discussion by Martin Cave at Mannheim conference on Fetzer and Yoo (2014).

spectrum ownership is geographically fragmented (Fetzer and Yoo, 2014). This could lead to interference issues (and therefore less than full spectrum utilization) between small countries, and it can hinder the creation of international fully integrated carriers. One result of this lack of integration is that international (intra-EU) roaming has been a major issue in the EU, while inter-state roaming has largely disappeared in the U.S.[41] The EC is now pursuing a harmonization of the various member country policies towards licenses that cover larger parts of the EU. Facilitating international roaming has been interpreted as a substitute for such harmonization (EC, 2013b).

3.4.2. Conclusions on convergence of policies

In both the U.S. and the EU the spectrum license regimes become more market-oriented and are expanding the use of property rights. Since the market power of large players in spectrum markets is likely to lessen the more versatile spectrum becomes, this should make the market power issue subside somewhat. In both the U.S. and the EU the methods of assigning spectrum to individual users have become very much market-oriented, while the methods for allocating spectrum between different uses have so far been done administratively and much slower, because of complexity and vested interests (Minervini (2014). The U.S. is now moving to market mechanisms via the planned incentive auctions.

There is an expanded use of unlicensed spectrum on both sides of the Atlantic. In the U.S. this has been a polarizing issue (Fetzer and Yoo, 2014). Since both regimes have their advantages and their drawbacks, the main question is how one can best combine regimes in such a way that each can play out its specific comparative advantages. There is a move towards spectrum harmonization in the EU, something the U.S. has had from the beginning. Convergence of policies within the EU could take quite a long time.

At this point the EU does not seem to have any plans for policies like the U.S. incentive auctions or the PCAST proposals for unlicensed spectrum. That does not mean such policies would not materialize if the U.S. successfully pursues them. Being an imitator may be an insurance against policy failure.

In my view, regulations are here to stay because of multi-party issues that require coordination. There is no basic reason why policies between the U.S. and the EU should not converge. However, it may take different amounts of time, based on prior property rights that have to be moved to make room for efficient policies. In particular, spectrum in public hands is likely to be subject to different rules for change.

3.5. Universal service

3.5.1. Characterization

Under a narrow interpretation universal service refers to the connectivity of the poor and high-cost areas to traditional networks. The traditional universal service policies therefore have included cross-subsidies (from business to residential, from long-distance to local and from urban to rural) and direct subsidies in order to achieve 100% telephone penetration. There has been a tendency both in the U.S. and the EU to get away from cross-subsidies. In fact, the U.S. 1996 Act requires universal service

[41] However, the exceedingly high charges under international roaming have been quite embarrassing for U.S. carriers.

subsidies to be explicit. However, rebalancing was a harder and greater issue in the U.S. than in the EU, potentially caused by the larger discrepancy in densities and the more entrenched policy tradition in the U.S.

Since the U.S. universal service policy was long time viewed as bad policy, the EU tried not to copy it. Newer U.S. policy puts additional emphasis on education and healthcare and on modern technology (and global competitiveness), and it uses more and more direct subsidies. Such subsidies for in-kind transfers to disadvantaged populations have some tradition in the U.S., a country otherwise not known for excessive social policies. The best-known such transfers are food-stamps, used by millions of Americans to reduce food spending. Thus, the stronger and longer U.S. tradition of universal telephone service compared to Europe may be explained by the different practices of social welfare by the two regions. [42] It is therefore unlikely that universal service subsidies in the U.S. will be abolished anytime soon. This holds in particular, because they are financed by surcharges (taxes) on other telecommunications services (meaning that cross-subsidies de facto persist).

A broad interpretation of universal service also includes policies that increase the desired penetration of advanced services (NGA). Examples of this are the FCC broadband plan and the EU digital agenda. Any new definition of universal service has to take into consideration the move from telephony to broadband and from fixed to mobile networks.

3.5.2. Narrow interpretation of universal service

The Universal Service Fund (USF) created by the U.S. under the narrow interpretation of universal service includes $ 1.75bn for low-income subscribers, $ 2.23bn for schools and libraries, $ 81.5mn for rural health care, and $ 4.03bn for high-cost areas (2011, Kwerel et al., 2012). All these amounts come from universal service fees collected from telephone companies on their long-distance revenues. These fees may but do not have to be passed on to end users.

The FCC's USF/ICC Order (2011) limits the high-cost fund to $ 4.5bn and allocates it to certain types of areas. Only single fixed or mobile providers can qualify for subsidies per area.

An innovative procurement (reverse) auction for mobile universal service (3G/4G) was held in September 2012 (Mobility Fund Phase I auction). It allocates subsidies based on cost-effectiveness measures (Wallsten, 2013). The difficulty in generating participation (none by the largest two mobile providers participated) was overcome by simultaneously awarding multiple areas that compete against a fixed total dollar amount (only 300 million $). Bidders bid in a discriminatory auction against bidders in other areas. 97% of the areas received only a single bid. Road-miles were used as the measuring rod for subsidies. The FCC therefore first identified biddable roads. The resulting highly skewed bidding distribution meant that very high-cost areas received no subsidies.

[42] However, countries like Germany ("Daseinsvorsorge") and France ("contrat social") have used similar arguments for the ubiquity of basic services (Fetzer and Yoo, 2014).

In Phase II mobile networks will receive $ 500mn per year for extension of 3G, while fixed networks will receive $ 1.8bn per year for fixed broadband, based on a new FTTP cost model with an all-or-nothing support offer. If that offer is declined competitive bidding will be used.

In contrast to the U.S., with the exception of some funding mechanisms in the U.K. (Florio, 2013), France and Italy, the EU has little to show under the narrow interpretation of universal service policies. European universal service policies are usually much weaker and, as a result, potentially less distorting. For example, in Germany, universal service policy only becomes effective if the policy goals are not achieved through competition, respectively by the universal service provider. So far regulatory intervention has never become necessary. As a result, in contrast to the U.S., the European policies have not stood in the way of rebalancing of end-user prices. After the introduction of competition the rebalancing of cross-subsidized telephone charges proved to be harder and a greater issue in the U.S. than in the EU (Cherry and Bauer, 2002).[43] While European countries generally have geographically uniform rates within each country, the U.S. has local service prices that often geographically vary inversely with costs (Rosston and Wimmer, 2001). Should the EU move towards a geographic differentiation in one-way access regulation, universal service problems could emerge because of the potentially resulting geographic differences in end-user prices.

3.5.3. Broad interpretation of universal service

The broad interpretation of universal service is largely about broadband build-out. The tools include regulatory relief, regulatory holidays, and subsidies.

In the U.S. the FCC has published plans for broadband build-out but has not become very concrete. Investment subsidies have come from the universal service funds and from economic stimulus programs. There is a state-by-state fight over the ability of cities to build their own FTTH networks. Some states have passed laws to forbid municipalities from building their own NGA networks. A counter-movement wants the FCC to preempt states from enforcing such laws. In a number of cases Google has stepped in to help build municipal networks. Cities have become more aggressive and more sophisticated in pursuing broadband plans and have started to collaborate with the likes of AT&T.[44] They have also stemmed the tide of state laws putting up barriers to municipal broadband (Levin, 2014). Overall, there is not the same level of planning and determination in the U.S. as in the European digital agenda, but there are substantial subsidies available from the USF and the stimulus program, and there are substantial local initiatives.

Some of the goals of the EU digital agenda could potentially be achieved with mechanisms under the EU Universal Service Directive (Fetzer and Yoo, 2014). They include the requirement of availability and affordability. In the EU state aid to communications carriers for build-out is controversial as a de facto subsidy to the incumbent. However, there is quite a large diversity between countries. For example, France is subsidizing NGA infrastructure of communities and others under the name Le Très Haut Débit

[43] However, as early as 1996-2002 the U.S. has successfully made efforts of rebalancing in order to accommodate competition (Rosston et al., 2013).

[44] My second home town, Santa Monica, being a prime example where fiber cables are laid, whenever the city digs up streets that do not yet carry fiber.

(Col, 2014) and Sweden has subsidized its ventures into FTTH (Yoo, 2014). The EC has established rules for subsidization according to regions within each country which are classified as white, gray or black. White areas have no NGA investment without subsidies. Here subsidies are generally allowed. In gray areas with one investor subsidies can be allowed, while in black areas with more than one investor subsidies cannot be allowed. This classification was first developed for general fixed access networks and has been extended to NGA. This extension is problematic at the beginning of NGA developments, where all areas would appear to be white or gray and none black.

Both in the U.S. and the EU the risk is seen that state aid may crowd out private investments. In the U.S. this fear has led to restrictions on municipalities to finance their own NGA infrastructure, while in the EU it has taken the form of the black, gray and white classification.

3.5.4. Conclusions on Policy Convergence

The ubiquity of mobile telephone access around the world has obviated traditional universal service policies. In contrast to the U.S., the European policies have not stood in the way of rebalancing of end-user prices. Under the broad interpretation there is likely to continue a move towards subsidies for the build-out of NGA for low density areas both in the EU and the U.S. In the U.S. a lot of this could be achieved through an appropriate interpretation of the USF, although new revenue sources may have to be found, once conventional long-distance phone services vanish.

4. Overall Conclusions

Table 1 captures my view of the current U.S. and EU policies and their likely convergence or not. Except for termination and, to some extent wholesale access there appears to be little expectation of policy convergence in the foreseeable future.

Cross fertilization between the U.S. and EU countries has improved their policies in the past. For example, the bad experience in the U.S. with rate-of-return regulation triggered price cap regulation in the UK. Price cap regulation in the UK influenced price cap regulation in the U.S. The EU has done well not to emulate U.S. cross-subsidizations for universal service, and the U.S. has done well not to switch from RPP to calling party pays (CPP) in mobile services. More dubious are lessons from the U.S. of deregulation of local bottlenecks and the regulation of net neutrality.

When it comes to deregulation the fallback is always competition policy. Using the three-criteria test the EU has moved towards deregulation in a number of areas. However, the test is likely to favor regulation over deregulation, because the relative advantages and disadvantages of competition law are not tested against regulation. In particular, regulation is more subject to political economy influences than competition law and therefore likely to deviate further from its theoretical ideal than the practice of competition law.[45]

When considering the issue of policy convergence in the future, the differences in approaches to deregulation have to be kept in mind. The EU moves towards deregulation by means of the market

[45] Discussion by Roger Noll at Mannheim conference on Fetzer and Yoo (2014).

recommendation, which are issued about every 6 years and which force NRAs to reconsider and justify regulations on a market-by-market basis. In contrast, the U.S. has given the FCC some discretion to deregulate on its own, something the FCC has done in the past.

Table 1: Current policies and the potential for convergence

Policy issue	Current U.S. policy	Current EU policy	Convergence of policies?
Termination	Large diversity of charges between intra-state and inter-state; mobile and fixed terminations with same rates; common move towards B&K for all until 2019	Mobile termination charges above fixed terminations; move towards pure LRIC lowers termination charges and should lead to convergence between countries within the EU; no current further plans	Likely convergence to B&K, even without a switch of the EU towards RPP; deregulation should happen in the long run, when conventional telephone services vanish.
One-way access	Vanishing importance of regulated wholesale access unbundling of copper access and of unregulated fiber wholesale access	Wholesale copper access on LRAIC cost basis; wholesale NGA access required but at non-regulated charges; only non-discrimination	Convergence of policy will depend on the types of legacy networks. Deregulation in U.S. will stay; deregulation in EU unlikely in regions without broadband cable.
Net neutrality	No established policy; ongoing proceedings may produce weaker policy than the 2010 FCC Order; a case-by-case approach is likely.	Weak existing policy likely to be replaced by strong policy; narrow exemption for specialized services	Any convergence is far too early to predict. Specialized services will play major role in the future, replacing current cable TV and POTS.
Spectrum management	Renewable license regime with trading possibilities; auctions well established; wide use of unlicensed spectrum; spectrum sharing not widespread; incentive auctions for reassigning spectrum expected next year	Limited harmonization of spectrum allocation at central EU level; limited reassignment of spectrum through direct interference; spectrum availability more important in EU for broadband competition	Spectrum license regime moving in direction of ownership; expanded use of unlicensed spectrum in both regions; harmonization in EU; convergence will take long time, due to differences in legacy regulations;
Universal service	Narrow policies continue based on USF; focus on broadband investment in rural areas	Weak narrow policies likely to continue; uneven use of subsidies for broad policies in rural areas; state aid in the EU varies a lot.	Reduction in narrow policies due to FMS; broad policies to continue, but may be influenced by different approaches to subsidies

U.S. has been a consistent role model in spectrum allocation. The EU may now learn from U.S. on incentive auctions and private commons. This could help fixed-to-mobile substitution in broadband.

Net neutrality and wholesale termination are also closely related policies. The main difference is that net neutrality concerns one-way termination by CSPs via ISP networks, while wholesale terminations are generally two-way. However, the recent debate in the U.S. about peering arrangements surrounding Netflix has demonstrated the close relationship between Internet interconnection policy and net neutrality, due to the power of some ISPs as gate keepers of the end-user access. The planned new EU market recommendation foresees the inclusion of OTTs in the market definition and the determination of market dominance. An interesting feature of this influence is its potential dependence on net neutrality policies.

One-way wholesale access regulation and broad universal service policies are often seen as substitutes or complements. They both aspire to increase NGA penetration, wholesale access regulation through its influence on competition and on the price level, broad universal service through investment subsidies for rural areas and price subsidies for disadvantaged consumers and public goods (schools, libraries, hospitals).

Overall, policy convergence can only be expected in certain areas, such as termination charges. Institutional and infrastructure differences will in other areas keep policy differences alive. The current net neutrality discussions even show that new policy differences may emerge.

5. Bibliography

Armstrong, M., and J. Wright (2009), "Mobile Call Termination", *Economic Journal* 119*,* Issue 538, pp. F270-F307.

Bacache, M., Bourreau, M., and G. Gaudin (2014), "Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Fixed Broadband Industry", *Review of Industrial Organization*, pp. 179-209.

Bender, C., and G. Götz (2011), "Coexistence of Service- and Facility-Based Competition: The Relevance of Access Prices for the 'Make-or-Buy' Decision", mimeo, September.

Benton Foundation (2014), "Comments of the Benton Foundation" submitted to the FCC in GN Docket No. 14-28 (Open Internet Remand).

Bouckaert, J., Van Dijk, T., and F. Verboven (2010), "Access regulation, competition, and broadband penetration: An international study", *Telecommunications Policy* 34, pp. 661-671.

Bourreau, M., Cambini, C., and P. Doğan (2012),"Access pricing, competition, and incentives to migrate from "old" to "new" technology", *International Journal of Industrial Organization* 30, pp. 713-723.

Bourreau, M., P. Doğan, and R. Lestage (2014), "Level of Access and Infrastructure Investment in Network Industries", *Journal of Regulatory Economics*, forthcoming.

Bourreau, M., Kourandi, F., and T. Valletti (2012), "Net Neutrality with Competing Internet Platforms", May 17, available at: http://ssrn.com/abstract=2061571.

Briglauer, W. (2014), "The Impact of Regulation and Competition on the Adoption of Fibre-Based Broadband Services: Recent Evidence from the European Union Member States", *Journal of Regulatory Economics*, forthcoming.

Briglauer, W., and I. Vogelsang (2011), "The Need for a New Approach to Regulating Fixed Networks", *Telecommunications Policy* 35(2), pp. 102-114.

Briglauer, W., G. Ecker, and K. Gugler (2012), "The impact of infrastructure and service-based competition on the deployment of next generation access networks: Recent evidence from the European member states", *Information Economics and Policy*, Forthcoming.

Briglauer, W., Schwarz, A., and C. Zulehner (2011), "Is Fixed-Mobile Substitution high enough to de-regulate Fixed Voice Telephony? Evidence from the Austrian Markets", *Journal of Regulatory Economics* 39, pp. 50-67.

Briglauer, W., Götz, G., and A. Schwarz (2010), "Can a Margin Squeeze Indicate the Need for De-regulation? The Case of Fixed Network Voice Telephony Markets", *Telecommunications Policy* 34, pp. 551-561.

Cambini, C., and N. Garelli (2011), "Evaluation of the opportunity cost of the spectrum: Application to the digital dividend", *Telecommunications Policy* 35, pp. 633-649.

Cambini, C., and Y. Jiang (2009), "Broadband investment and regulation: A literature review", *Telecommunications Policy* 33, pp. 559-574.

Cambini, C., and Y. Spiegel (2014), "Investment and capital structure of partially private regulated firms", January 21, available at: www.tau.ac.il/~spiegel/papers/CS-Jan-21-2014.pdf.

Cave, M. (2013), "Extending competition in network industries: can input markets circumvent the need for an administered access regime?", *Utilities Policy* 7, pp. 82-92.

Cave, M. (2014), "The Ladder of Investment in Europe, in Retrospect and Prospect, unpublished manuscript.

Col, P. (2014), "Le Très Haut Débit avance : la moitié des départements a un projet de Réseau d'Initiative Publique en fibre optique", ZDNet, February 16, available at http://www.zdnet.fr/actualites/le-tres-haut-debit-avance-la-moitie-des-departements-a-un-projet-de-reseau-d-initiative-publique-en-fibre-optique-39797854.htm.

Crandall, R., J.A. Eisenach, and A.T. Ingraham (2013), "The long-run effects of copper-loop unbundling and the implications for fiber", *Telecommunications Policy* 37, pp.262-281.

Czernich, N., Falck, O., Kretschmer, T. and Woessmann, L. (2011), "Broadband Infrastructure and Economic Growth", *Economic Journal* 121, pp. 505-532.

Donald, S.G., and D.E.M Sappington (1997), "Choosing Among Regulatory Options in the United States Telecommunications Industry," *The Journal of Regulatory Economics* 12, pp. 227-243.

EC (2013a): "Commission recommendation of 11.9.2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment", Brussels, C(2013) 5761 final.

EC (2013b), "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 (EC) No 531/2012", Brussel, COM(2013) 627 final.

EC (2013c), Commission Adopts Regulatory Proposal for a Connected Continent", September 11, http://europa.eu/rapid/press-release_MEMO-13-779_en.htm.

Economides, N., K. Seim, and V.B. Viard (2008), "Quantifying the benefits of entry into local phone service", *RAND Journal of Economics* 39, pp. 699-730.

FCC (2010), "Connecting America: The national broadband plan", available at http://www.broadband.gov/plan/.

Fetzer, T., and C. Yoo (2014), Presentation on "Comparing Telecommunications and Internet Policies in the United States and Europe", MaCCI & CTIC Telecommunications Workshop 2014, ZEW, Mannheim, Germany, April 29-30.

Florio, M. (2013): *Network Industries and Social Welfare – The Experiment that Reshuffled European Utilities*, Oxford: Oxford University Press.

Gans, J. (2014), "Weak versus Strong Net Neutrality", University of Toronto, May 20, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2439360.

Genakos, C., and T. Valletti (2011a), "Testing the 'Waterbed' Effect in Mobile Telephony", *Journal of the European Economic Association* 9(6), pp. 1114-1142.

Genakos C, and T. Valletti (2011b), "Seesaw in the air: Interconnection regulation and the structure of mobile tariffs", *Information Economics and Policy* 23, pp. 159-170.

Genakos C, and T. Valletti (2012), "Regulating prices in two-sided markets: The waterbed experience in mobile telephony", *Telecommunications Policy*36, pp. 360-368.

Genakos C, and T. Valletti (2014), "Evaluating a decade of mobile termination rate regulation", CEIS Tor Vergata Research Paper Series Vol. 12, Issue 1, No. 303 – January 2014.

Geradin, D., and J. G. Sidak (2005), "European and American Approaches to Antitrust Remedies and the Institutional Design of Regulation in Telecommunications", in S. Majumdar, I. Vogelsang und M. Cave (Eds.) *Handbook of Telecommunications Economics: Volume 2*, Amsterdam etc.: North Holland/Elsevier, pp. 517-553.

Grajek, M., and L.-H. Röller (2012), "The Effect of Regulation on Investment in Network Industries: Evidence from European Telecoms", *Journal of Law and Economics* 55, pp. 189-216.

Growitsch, C., Marcus, J. and Wernick, C. (2010), "The Effects of Lower Mobile Termination Rates (MTRs) on Retail Price and Demand", *Communications and Strategies*, No. 80, Fourth Quarter, pp. 119-140. Available at SSRN: http://ssrn.com/abstract=1813687.

Gruber, H., and P. Koutroumpis (2013), "Competition enhancing regulation and diffusion of innovation: the case of broadband networks", *Journal of Regulatory Economics* 43 (2), pp. 168-195.

Grzybowski**,** L. (2005), "Regulation of Mobile Telephony across the European Union: An Empirical Analysis", *Journal of Regulatory Economics* 28, pp. 47-67.

Haucap, J., and J. Kühling (2006), "Eine effiziente vertikale Verteilung der Exekutivkompetenzen bei der Regulierung von Telekommunikationsmärkten in Europa", *Zeitschrift für Wirtschaftspolitik* 55, pp. 324-356.

Hausman, J., and W.E. Taylor (2013), "Telecommunication in the US: From Regulation to Competition (Almost)", *Review of Industrial Organization* 42(2), pp. 203-230.

Hausman, J., T. Tardiff, and A. Belifante (1993), "The effects of the breakup of AT&T on telephone penetration in the United States", *American Economic Review*, Papers and Proceedings 83, pp. 178-184.

Hoernig, S., S. Jay, K.-H. Neumann, M. Peitz, T. Plückebaum, and I. Vogelsang (2012), "The impact of different fibre access network technologies on cost, competition and welfare", *Telecommunications Policy* 36, pp. 96-112.

Hou, L., Valcke, P., and D. Stevens (2013), Can open access be imposed upon European CATV networks?", *Telecommunications Policy* 37(10), pp. 970-980.

Hurkens, S., and A. Lopez (2013), Mobile Termination, Network Externalities and Consumer Expectations", *Economic Journal*, forthcoming.

Jay, S., Neumann, K.-H., and T. Plückebaum (2013), "Comparing FTTH access networks based on P2P and PMP fibre technologies", *Telecommunications Policy*, forthcoming.

Jullien, B., P. Rey, and W. Sand-Zantman (2013), "Mobile call termination revisited", *International Journal of Industrial Organization*, available at http://idei.fr/doc/by/rey/termination.pdf.

Kennet, D.M., Ralph, E.K. (2007), "Efficient interconnection charges and capacity-based pricing", *International Economics and Economic Policy* 4, pp. 135-158.

Kourandi, F., J. Krämer, and T. Valletti (2013), "Net Neutrality, Exclusive Contracts and Internet Fragmentation", mimeo, February 4.

Krämer, J., and D. Schnurr (2013), "A Unified Framework for Open Access Regulation of Telecommunications Infrastructure: Literature Review and Policy Guidelines", mimeo, August 2.

Krämer, J., Wiewiorra, L., and C. Weinhardt (2013), "Net neutrality: A progress report", *Telecommunications Policy*, forthcoming.

Kwerel, E., P. LaFontaine, and M. Schwartz (2012), "Economics at the FCC, 2011-2012: Spectrum Incentive Auctions, Universal Service and Intercarrier Compensation Reform, and Mergers", *Review of Industrial Organization* 41(4), pp. 271-302.

Layton, R. (2014), "The European Union's Broadband Challenge", Tech Policy Outlook, American Enterprise Institute for Public Policy Research, February.

Levin, B. (2014), "Surprises, Lessons, and Still in Beta", Information Technology and Innovation Foundation Forum, Benton Foundation, March 19.

Levy, B., and P. Spiller (1994), "The institutional foundations of regulatory commitment: A comparative analysis of telecommunications regulation", *Journal of Law, Economics and Organization* 10, pp. 201-246.

Levy, B., and P. Spiller (Eds.) (1996), *Regulations, Institutions and Commitment: Comparative Studies of Telecommunications*, Cambridge: Cambridge University Press.

MacKie-Mason J., and H. Varian (1995), "Pricing the Internet", in B. Kahin and J. Keller (eds.), *Public Access to the Internet*, Cambridge, MA: MIT Press, pp. 269-314, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=980791.

Marcus, S. (2002), "The potential relevance to the United States of the European Union's newly adopted regulatory framework for telecommunications", Federal Communications Commission, OPP Working Paper 36, July.

Meyer, D. (2014), "European Parliament passes strong net neutrality law, along with major roaming reforms", GIGAOM, April 3, available at http://gigaom.com/2014/04/03/european-parliament-passes-strong-net-neutrality-law-along-with-major-roaming-reforms/.

Minamihashi, N. (2012, "Natural Monopoly and Distorted Competition: Evidence from Unbundling Fibre-Optic Networks", mimeo.

Minervini, L.F. (2014), "Spectrum management reform: Rethinking practices", Telecommunications Policy 38, pp. 136-146.

Nardotto, M., Valletti, T., and F. Verboven (2013), "Unbundling the incumbent: Evidence from UK broadband", mimeo, February 27.

Narechania, T.N., and T. Wu (2014), "Sender-side Transmission Rules for the Internet", Draft Paper submitted to the FCC in GN Docket No. 14-28 (Open Internet Remand).

Neumann, K.-H. (2013a), "Paradigmawechsel in der europäischen Telekommunikationspolitik", wik Newsletter 90, Bad Honnef, Germany, March.

Neumann, K.-H. (2013b), "Der dynamische Investitionswettbewerb als neues Leitbild für den TK-Markt", wik Newsletter 93, Bad Honnef, Germany, December.

Neumann, K.-H, and I. Vogelsang, (2013), "How to price the unbundled local loop in the transition from copper to fiber access networks?", *Telecommunications Policy* 37(10), pp. 893-909.

Njoroge, P., Ozdaglar, A., Stier-Moses, N.E., and G.Y. Weintraub (2013), "Investment in Two Sided Markets and the Net Neutrality Debate", *Review of Network Economics* 12(4), pp. 355-402.

North, D. (1990), *Institutions, institutional change, and economic performance*, Cambridge: Cambridge University Press.

Nuechterlin, J.E., and P.J. Weiser (2013), *Digital Crossroads*, Cambridge, Mass., and London: MIT Press, Second Edition .

Parsons S., and J. Bixby (2010), "Universal service in the United States: A focus on mobile communications", *Federal Communications Law Journal* 62, pp. 119-152.

PCAST (2012), "Report to the President - Realizing the Full Potential of Government-held Spectrum to Spur Economic Growth", President's Council of Advisors on Science and Technology, July, available at http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports.

Rosston, G.L., and B.S. Wimmer (2001) "From C-to-Shining-C: Competition and Cross Subsidy in Telecommunications." In Compaine, B. and Greenstein S. (eds.), *Selected Papers from the Telecommunications Policy Research Conference,* Cambridge, MA: MIT Press.

Rosston, G.L., Savage, S.T., and B.S. Wimmer (2013), "Effect of Network Unbundling on Retail Prices: Evidence from the Telecommunications Act of 1996", *Journal of Law and Economics* 56(2), May, pp. 487-519.

Rysman, M. (2009), "The Economics of Two-Sided Markets", *Journal of Economic Perspectives* 23, pp. 125-143.

Schuett, F. (2010), "Network Neutrality: A Survey of the Economic Literature", *Review of Network Economics* 9(2), pp. 1-15.

Telecommunications Policy (2013), Special Issue on "Cognitive Radio: Regulation and Markets" and "Dynamic Spectrum Assignment".

Vogelsang, I. (2002), "Cross-Fertilization Between the U.S. and European Telecommunications Regulation," *ifo Studien* 48, pp. 5-21 [Reprinted in G. Illing and U. Klüh (eds.), *Spectrum Auctions and Competition in Telecommunications*, Cambridge, MA: MIT Press, 2003, pp. 19-40].

Vogelsang, I. (2003), "Price Regulation of Access to Telecommunications Networks", *Journal of Economic Literature* XLI, pp. 830-862.

Vogelsang, I. (2014), "The Endgame of Telecommunications Policy? A Survey", *Review of Economics* 64(3), pp. 193-270, available at http://www.cesifo-group.de/ifoHome/publications/working-papers/CESifoWP/CESifoWPdetails?wp_id=19103089.

Wallsten, S. (2013), "Two Cheers for the FCC's Mobility Fund Reverse Auction", April 1, Technology Policy Institute, Washington.

Werbach, K. (2013), "No dialtone: The end of the public switched telephone network", paper for the 41st annual TPRC, September 27-29.

Wheeler, T. (2014a), "Prepared Remarks of FCC Chairman Tom Wheeler", "Wireless Spectrum and Future of Technology Innovation" Forum, The Brookings Institution, Washington, D.C., March 24, 2014.

Wheeler, T. (2014b), "Finding the Best Path Forward to Protect the Open Internet", Official FCC Blog, April 29, 2014.

Yoo, C. (2014), "U.S. vs. European Broadband Deployment: What Do the Data Say?", unpublished manuscript.