A Technology-Informed Theory of Exclusion in the Wireless Telecommunications Market

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1 . Introduction and Summary

A few years ago a movement under the name “Wireless Carterfone” surfaced advancing the claim for network neutrality in wireless networks.[1] The movement was motivated by the “highly concentrated market” and the high entry barriers resulting from the “multi-billion dollar investments” required to join the market.[2] With every incident of blocking or discrimination (i.e. exclusionary practices)—and there were a few notable ones, like Skype, Google Voice and later FaceTime—the movement gained renewed traction,[3] because it raised familiar fears about carriers abusing their position to exclude competitors, innovation being stifled, and consumers being denied of meaningful alternatives to the traditional voice and text services offered by mobile carriers.[4] It therefore asked that a ban on blocking and discriminatory practices be instituted.[5]

One has to regard the argument with sympathy. After all, if indeed the business decisions of carriers could dictate the terms under which services, applications and content compete for consumers, and if there was no good justification for the blocking, there should be mechanisms

1 Tim Wu, *Wireless Carterfone*, 1 INTERNATIONAL JOURNAL OF COMMUNICATION 389, 389-391 (2007).

2 *Id*. at 393-394.

3 *See* Erica Ogg, *Apple Blocks Google Voice App for iPhone*, CNET, July 28, 2009; *Mobile Carriers Seek to Block Skype on iPhone, BlackBerry*, APC, April 6, 2009; Ryan Singer, *AT&T Relents, Opens iPhone to Skype, VoIP*, WIRED, October 6, 2009.

4 On the potential dangers *see* In the Matter of Preserving the Open Internet, Broadband Industry Practices, GN Docket No. 09-191, ¶ 13-43 et seq. (2010) (Report and Order) [hereinafter referred to as 2010 Open Internet Order]; BEREC, A View of Traffic Management and Other Practices Resulting in Restrictions to The Open Internet In Europe, BoR (12) 30, at 3-4 (2012).

5 *Supra* note 1, at 389-391.

in place to curb that power. The issue was not so much about one particular application being excluded from the marketplace, but about the principle that no one player along the value chain should have the power to pick winners and losers (including own affiliates) by exercising bottleneck power. This is a fair principle and one supported by antitrust law, which also—much like telecommunications regulation—concerns itself with the efficient operation of the market.

Unfortunately, this same rationale has been abused to justify unnecessarily strict policies against exclusion. It is not that the argument lacks merit, but rather that the competitive conditions of the wireless industry today—we submit—do not support the application of Wireless Carterfone-like regimes that stand for a categorical ban on exclusion. Just to take one, but prominent, example the recent Open Internet rules show almost zero tolerance towards exclusionary practices, and these are just the latest iteration in a long line of anti-exclusion policies.[6]

Such policies wouldn't be a problem if exclusion was a consistently pernicious practice for the wireless industry. But we believe this condition does not hold up, especially today: in the presence of heightened competition and reasonable pro-competitive justifications for exclusion, as we attempt to show in this thesis, exclusionary practices not only are not uniformly harmful, but they may also be beneficial for the industry. We believe that one of the main reasons why this has failed to be noticed in the wireless industry is that the theory and structural preconditions of exclusion have not been studied and considered in the particular context of the highly technical nature and properties of that industry, which create qualitatively different conditions in the market. While as a general matter exclusion has been extensively studied in industrial

6 In the Matter of Protecting and Promoting the Open Internet, GN Docket No. 14-28, ¶ 104 et seq. (2015) (Report and Order on Remand, Declaratory Ruling, and Order).

organization, we are missing an adaptation of the general exclusion theory to the particular circumstances of the technology-driven industry that wireless telecommunications is.

In undertaking this analysis here we advocate for a framework informed of the technological properties of the wireless communications industry, which steers away from any legal regime that approximates categorical bans (or unconditional permissibility for that matter), and propose what such framework can look like. The framework will show that today's technology-intensive nature of the wireless communications industry in many ways limits the potential for anti-competitive exclusion both because it creates competitive dynamism and because it can make good business sense that results in gains for the industry and consumers.

Now, whether this is a goal worth pursuing depends on the validity of the underlying assumptions we are making here: that telecommunications policy is unjustifiably hostile towards exclusion, and that accounting for the high technology environment in which wireless telecommunications operate can provide a better way to approach the issue by illuminating exclusion's true dimensions in the modern wireless industry. If these conditions hold then the analysis undertaken in this thesis (the “better way”) becomes necessary.

In the following pages we will attempt to make the case for this thesis and summarize the main points. First, we will show that (past and present) telecommunications policy has almost uniformly rejected exclusion as an acceptable business practice. We will also argue that this treatment is inapposite for today's wireless industry conditions, in no small part because of the (new) technological advancements and their implications for the industry's organization. The description of the problem will pave the way for the development of the proposed framework. In lieu of black and white regulation that either uniformly permits or rejects exclusionary behavior

in the wireless industry, this thesis supports a flexible approach that considers the particular conditions of the wireless telecommunications industry and illuminates the relevant parameters to be taken into account when adopting and applying rules.

1.1 What Problem Does this Thesis Attempt to Solve

Our starting point in this thesis is the identification of the problem. We believe that the right of market actors to choose their partners, and as a logical extension their right to shut some out, is overly restricted by extensive no-blocking and no-discrimination obligations that come in various forms. We say “overly” because our proposition is that, while the anti-exclusion rules have good theoretical foundations, they go over and beyond what the modern structure and competitive conditions of the wireless communications conditions seem to justify, if one considers the many options technological progress has created for market players to develop and offer and for consumers to access services and products.

To establish the problem we move in the following steps: first comes a listing of relevant policies which adopt broad-brush bans on exclusionary conduct, and which taken together demonstrate a hostility against exclusionary policies. Then, we present and acknowledge the theoretical underpinnings of these policies to show the merit behind those policies. However, and this comes as the last subpart, we proceed to explain why unqualified and generalized bans are ill-suited to effectively regulate the modern wireless industry largely because technological progress has and continues to create structural conditions that hinder the emergence of anti-competitive exclusion. We will then spend the remainder of this thesis detailing a possible

solution to this problem.

1.1.1 Premise: Telecommunications Policy Is Too Fearful of Exclusion

Policy debates around exclusion seem to never go out of fashion, and there is no indication that the issues raised by exclusionary practices will lend themselves to a definitive answer any time soon. In the telecommunications sector exclusion has been particularly controversial, and a brief look at the regulatory history is enough to show the struggles of policy-makers and stakeholders to find the appropriate strategy toward exclusionary practices.

But while different views about the Commission's policy choices, institutional competence and biases abound, and for every decision the Commission makes criticism will and has ensued, there is little disagreement, as shown below, that the Commission's regulatory history has been one of attempting to limit exclusionary practices and inviting an all-inclusive participatory broadband ecosystem.[7] Exclusion was and is feared because it can result in a complete inability of competitors to access an essential neighboring market, product or service, or a hindrance that places competitors at an unfairly disadvantageous position.[8] However, at the same time, imposing non-exclusion obligations limits business freedom and experimentation and precludes efficiencies that can arise from partnering with some actors but not others.[9] While it is common

7 For a good summary see JONATHAN E. NUECHTERLEIN & PHILIP J. WEISER, DIGITAL CROSSROADS: TELECOMMUNICATIONS LAW AND POLICY IN THE INTERNET AGE 40-62, 133-158 (2014).

8 PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THEIR APPLICATION, at ¶756b7 (2006); W. KIP VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 248-253 (2005). EU Guidelines on the Assessment of Non-horizontal Mergers Under the Council Regulation on the Control of Concentrations Between Undertakings, 2008/C 265/07, at ¶ 29-30; LAWRENCE A. SULLIVAN & WARREN S. GRIMES, THE LAW OF ANTITRUST: AN INTEGRATED HANDBOOK 642 (2000).

9 *See* Christopher S. Yoo, *Beyond Network Neutrality*, 19 HARVARD JOURNAL OF LAW AND TECHNOLOGY 1, 48 et

knowledge that these two sides ought to be weighted against each other, our observation is that the scale consistently tips against exclusion.

Of the voluminous evidence that exclusionary practices are not well received in the industry consider the following cases. The point here is not that they are misguided; taken separately and individually some may have even served the industry well. But taken together they seem to demonstrate a clear stance of inhospitality against exclusion, which has found many applications in the policymaking sphere.

The 2010 Open Internet Order on network neutrality was adopted with the goal "to preserve the Internet as an open platform for innovation, investment, job creation, economic growth, competition, and free expression,"[10] and in that direction it imposed broad no-blocking, non-discrimination obligations that applied in a generalized manner to the industry without regard to specific circumstances.[11] These rules were an extension of the pre-existing four principles that advocated for similar limitations.[12] In 2014 the Commission proposed an updated network neutrality package that expanded the limitations both in substance and in the scope of applicability (doing away with the previous distinction between fixed and mobile Internet).[13] In the meantime, the Commission also imposed no-blocking, non-discrimination obligations the spectrum licenses in the C band of the 700MHz frequency block auctioned in 2008.[14]

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seq. (2005); DANIEL F. SPULBER & CHRISTOPHER S. YOO, NETWORKS IN TELECOMMUNICATIONS: ECONOMICS AND LAW 146-151 (2009).

10 2010 Open Internet Order, *supra* note 4, at ¶ 1.

11 Although a lighter version of the rules applied to mobile broadband Internet, the no blocking of competing applications rule applied and it did not distinguish between different circumstances. *See* 2010 Open Internet Order, *supra* note 4, at ¶ 99 et seq.

12 *See* Broadband Industry Practices, 22 FCC Rcd. 7894 (2007) (Notice of Inquiry).

13 In the Matter of Protecting and Promoting the Open Internet, GN Docket No. 14-28 (2014) (Notice of Proposed Rulemaking) [hereinafter referred to as 2014 NPRM].

14 In the Matter of Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, 22 FCC Rcd. 15258 et seq.

Further, the unbundling obligations contained in the 1996 Telecommunications Act also aimed to create a level playing field for entry in the local exchange market by requiring ILECs to grant under non-discriminatory terms access to individual parts of their network.[15] The unbundling regime imposed a general obligation to all ILECs alike without regard to specific economic or technical considerations.[16]

Moreover, some of the major mergers announced over the past few years received suspicious and even negative treatment for fear of vertical exclusion. For example, the Commission opposed the proposed AT&T/T-Mobile merger expressing fears that, among others, the merger would pose an increased risk of discriminatory behavior in the roaming and wholesale markets.[17] The Commission was also negative to the prospect of T-Mobile merging with Sprint.[18] These concerns are not new. For instance, when Ameritech merged with SBC in 1999, the Commission imposed several conditions aimed at limiting the possibility of foreclosure, including the obligation to create a separate affiliate for advanced services

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(2007) (Second Report and Order). ("[W]e will require only C Block licensees to allow customers, device manufacturers, third-party application developers, and others to use or develop the devices and applications of their choosing in C Block networks, so long as they meet all applicable regulatory requirements and comply with reasonable conditions related to management of the wireless network (i.e., do not cause harm to the network). Specifically, a C Block licensee may not block, degrade, or interfere with the ability of end users to download and utilize applications of their choosing on the licensee's C Block network, subject to reasonable network management," at 15365).

15 Telecommunications Act of 1996, 47 U.S.C. §§ 251(c)(3).

16 United States Telecom Association v. FCC, 290 F.3d 415, 422 (2004) (where the court notes: "As to almost every element, the Commission chose to adopt a uniform national rule, mandating the element's unbundling in every geographic market and customer class, without regard to the state of competitive impairment in any particular market. As a result, UNEs will be available to CLECs in many markets where there is no reasonable basis for thinking that competition is suffering from any impairment of a sort that might have the object of Congress's concern.").

17 In the Matter of Application of AT&T Inc. and Deutsche Telekom AG for Consent to Assign or Transfer Control of Licenses and Authorization, WT Docket No. 11-65, at ¶ 99-111 (Bureau Staff Analysis and Findings).

18 Alina Selyukh & Sidead Carew, *FCC Tells Sprint Chair He Is Skeptical on T-Mobile Deal*, REUTERS, February 3, 2014.

(:broadband Internet), and access to loop information.[19]

It is also interesting to note that outside the frames of regulatory action, the public at large and public interest organizations also seem to be suspicious of exclusionary practices. To illustrate, a study that analyzed almost a million comments submitted at the 2014 Open Internet proceeding, concluded that 99% of the comments were in favor of network neutrality.[20] A similar study showed that 81% of survey participants opposes discriminatory treatment on the Internet,[21] and another one that "public opinion was overwhelmingly pro net neutrality."[22] And when the T-Mobile/AT&T merger was announced, the two companies faced a significant backlash from the public.[23]

What the above chronicle shows is that there is a generalized skepticism against the merits of exclusionary practices in the telecommunications market, and as a result of that that a strong regulatory response. Exclusion is seen as way to disadvantage competitors in the market while favoring own affiliates, and it is this sort of inequality that telecommunications policy has difficulty accepting. To be sure, this is not an unsupportable view, and in fact several theories have substantiated the value of equal treatment in telecommunications. Those theories that favor anti-exclusion measures regard telecommunications networks as comprising successive

19 SBC Communications Inc./Ameritech, Memorandum Opinion and Order, 14 FCC Rcd. 14712, Appendix C – Conditions, at ¶ 1 et seq., 19 et seq. (1999).

20 Press Release, Sunlight Foundation, What Can We Learn from 800,000 Public Comments on the FCC's Net Neutrality Plan? (September 2, 2014), *available at* http://sunlightfoundation.com/blog/2014/09/02/what-can-we-learn-from-800000-public-comments-on-the-fccs-net-neutrality-plan/.

21 Press Release, University of Delaware Center for Political Communmication, National Survey Shows Public Overwhelmingly Opposes Internet "Fast Lanes" (November 10, 2014), *available at* http://www.udel.edu/cpc/research/fall2014/UD-CPC-NatAgenda2014PR_2014NetNeutrality.pdf.

22 Knight Foundation, Decoding the Net Neutrality Debate: An Analysis of Media, Public Comment and Advocacy on Open Internet, *available at* http://www.knightfoundation.org/features/netneutrality.

23 For a summary *see* Wikipedia, Attempted Purchase of T-Mobile USA by AT&T, *available at* http://en.wikipedia.org/wiki/Attempted_purchase_of_T-Mobile_USA_by_AT%26T#Reception.

platforms on which inputs flow. The combination of inputs creates value, and therefore the more inputs and the more combinations are available, the more value is generated for innovators and for consumers.

We summarize those theories below, because it is important to show what policymakers deem so important to protect.

1.1.2 The Theoretical Underpinnings of Rules Against Exclusion

Probably the theory most associated with indiscriminatory open access in broadband telecommunications, is that of end to end. It is traced back to an article by Saltzer, Reed, and Clark and it represents the idea that the core of the network (and therefore the middlemen that control it, such as network operators and access providers) should not interfere with the transmission of data; instead what type of data and how it flows should be left to the ends.[24] A necessary corollary is that the core cannot exert admission control nor reserve preferential or discriminatory treatment, which logically makes exclusion unacceptable. While the end to end theory was not meant to categorically preclude any type of admission control or discriminatory treatment,[25] it has been used as the spearhead argument to support the view that open networks result in maximum innovation and participation. In the words of two of its most fervent supporters

24 Jerome Saltzer et al., *End-to-end Arguments in System Design*, 2 ACM TRANSACTIONS ON COMPUTER SYSTEMS 277 (1984).

25 For a summary of the engineering literature discussing the relativity of the end-to-end principle *see* Christopher Yoo, *Would Mandating Broadband Network Neutrality Help or Hurt Competition? A Comment on the End-To-End Debate*, 3 JOURNAL OF TELECOMMUNICATIONS AND HIGH TECHNOLOGY LAW 23, 43-46 (2004).

> "end to end expands the competitive horizon, by enabling a wider variety of applications to connect and use the network. It maximizes the number of entities that can compete for the use and applications of the network. As there is no single strategic actor who can tilt the competitive environment (the network) in favor of itself, or no hierarchical entity that can favor some applications over others, an end to end network creates a maximally competitive environment for innovation, which by design assures competitors that they will not confront strategic network behavior."[26]

This same sentiment, that open unobstructed network access levels the playing field, maximizes entry, ensures fair competition and empowers consumers by leaving the choice to them, underlies the expectation for network neutrality. As Wu noted in the article that popularized the term, "absent evidence of harm to the local network or the interests of other users, broadband carriers should not discriminate in how they treat traffic on their broadband network on the basis of inter-network criteria."[27] The Commission on several occasions since has reiterated its strong faith that the openness flowing from network neutrality through the general prohibition of discriminatory or blocking practices "promotes competition ... [and] enables a self-reinforcing cycle of investment and innovation in which new uses of the network lead to increased adoption of broadband, which drives investment and improvements in the network itself."[28]

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26 Mark Lemley & Lawrence Lessig, *Open Access to Cable Modems*, 22 WHITTIER LAW REVIEW 3, 9 (2000).

27 Tim Wu, *Network Neutrality, Broadband Discrimination*, 2 JOURNAL OF TELECOMMUNICATIONS AND HIGH TECHNOLOGY LAW 141, 171 (2003).

28 2010 Open Internet Order, at ¶ 3. *See also* Appropriate Framework for Broadband Access to the Internet Over Wireline Facilities et al., 20 FCC Rcd. 14986 (2005) (Policy Statement); In the Matter of Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers and Other Providers of Mobile Data Services, WT Docket No. 05-265 (2011), at ¶ 13 ("We conclude that adopting a roaming rule tailored for mobile data services will best promote consumer access to seamless mobile data coverage nationwide, appropriately balance the incentives for new entrants and incumbent providers to invest in and deploy advanced networks across the country, and foster competition among multiple providers in the industry, consistent with the National Broadband Plan.")

This reinforcing effect seems to particularly characterize the communications industry because it is built in layers and the end result comes through a sequential and complementary process. Every step along the way, then, serves as a platform for the upstream and downstream markets to connect. Communications networks as platforms are "means, not ends; it is what those connections enable that matters."[29] Seen under this light the network itself is of little value without the complements it enables, and for this reason, the more open and inclusive the network the greater the economic value it generates. Weiser, for example, who has adopted the term information platforms to characterize the functionality of communications networks to serve as conduits of general purpose data, notes that "for an information platform to become successful, a sponsor of the technology must ensure a critical mass of adopters and a critical mass of complementary software (and sometimes other components).[30] And Wu continues stating that "[a] communications network ... can be seen as a platform for a competition among application developers. ... It is therefore important that the platform be neutral to ensure the competition remains meritocratic."[31]

Even if open platforms are not always superior to closed ones,[32] telecommunications policy seems to favor open platforms because they engender greater variety and differentiation due to the heightened entry and recombinability of inputs.[33] Assuming heterogeneous demand, the more

29 Federal Communications Commission, Connecting America: The National Broadband Plan, at 3, *available at* http://www.fcc.gov/national-broadband-plan.

30 Philip J. Weiser, *Law and Information Platforms*, 1 JOURNAL ON TELECOMMUNICATIONS AND HIGH TECHNOLOGY LAW 1, 3 (2002)

31 Wu, *supra* note 1, at 146.

32 *See, e.g.*, Kevin Boudreau, *Open Platform Strategies and Innovation: Granting Access vs. Devolving Control*, 56 MANAGEMENT SCIENCE 1849 (2010)

33 Thomas Eisenmann et al., *Opening Platforms: How, When and Why?*, HBS Working Paper 09-030 (2008); National Broadband Plan, *supra* note 29, where: "Like railroads and highways, broadband accelerates the velocity of commerce, reducing the costs of distance. Like electricity, it creates a platform for America's

open platforms are, the more inputs they attract, and the more consecutive interactions they enable resulting in greater diversity (although not necessarily greater quality).[34] Moreover, scholars such as Scotchmer, Besen, and Maskin, have argued that in industries where innovation is sequential and complementary, meaning that "each successive invention builds on the preceding one … and each potential innovator takes a different research line and thereby enhances the overall probability that a particular goal is reached within a given time"[35] broader access to the constituent parts of the innovations increases their value because they can be used and re-used multiple times, and produces greater value overall because more innovations will result from them.

Frischmann, building on this concept of communications networks as platforms of sequential innovation, makes the broader related argument that if innovation commons is what maximizes the social utility of the underlying infrastructure, then the commons regime (:open, unobstructed access) should characterize the infrastructure as well.[36] Frischmann sees broadband networks as "a mixed commercial, public, and social infrastructure,"[37] and "infrastructure resources are fundamental … [in] generat[ing] value when used as inputs into a wide range of

creativity to lead in developing better ways to solve old problems. Like telephony and broadcasting, it expands our ability to communicate, inform and entertain."

34 *See* Melissa A. Schilling, *Factors Driving the Adoption of Increasingly Modular or Increasingly Integrated Forms* , Association for the Advancement of Artificial Intelligence Spring 2003 Symposium, Technical Report SS-03-02, *available at* http://www.aaai.org/Papers/Symposia/Spring/2003/SS-03-02/SS03-02-027.pdf; Melissa A. Schilling & H. Kevin Steensma, *The Use of Modular Organizational Forms: An Industry-level Analysis*, 44 ACADEMY OF MANAGEMENT JOURNAL 1149 (2001)

35 James Bessen & Eric Maskin, *Sequential Innovation, Patents and Imitation*, 40 RAND JOURNAL OF ECONOMICS 611, 612 (2009).

36 Brett M. Frischmann, *An Economic Theory of Infrastructure and Commons Management*, 89 MINNESOTA LAW REVIEW 917 (2006).

37 *Id*. at 1006.

productive processes."[38] He goes on to note that because "the outputs from these processes are often public and nonmarket goods that generate positive externalities that benefit society … [t]he debate must broaden its focus from the merits of sustaining an innovation commons to the merits of sustaining an infrastructure commons—that is, of sustaining open, public access to infrastructure."[39]

Similar conclusions have been reached with regard to the spectrum as a resource in particular. Benkler, for example, calls for the creation of spectrum commons, which he understands as "a set of resources necessary to the production and exchange of information, which will be available as commons."[40] Werbach expands on the spectrum commons debate and advances a more moderate proposal of a mixed commons-property regime, where "the commons would be the baseline, with property encompassed within it."[41] The idea is to make non-exclusion the rule for access to spectrum, and tort-like rules and safe harbors would be used to address conflicts among users.[42]

There is a common thread connecting all these theories: the firm belief that neutral networks, open access, and non-discrimination, all of which are in principle threatened by exclusion, are good for the industry because they maximize input participation, provide a level playing field and prevent favoritism between vertically affiliated companies. There is no denying

38 *Id*. at 974.

39 *Id*. at 1020.

40 Yochai Benkler, *Lecture, Freedom in the Commons: Towards a Political Economy of Information*, 52 DUKE LAW JOURNAL 1245, 1251 (2003). *See also*, *generally*, Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment*, 11 HARVARD JOURNAL OF LAW AND TECHNOLOGY 287 (1998).

41 Kevin Werbach, *Supercommons: Toward a Unified Theory of Wireless Communication*, 82 TEXAS LAW REVIEW 863, 930 (2004).

42 *Id*. at 930-931.

that these theories and the policy decisions they underpin have a lot of merit. As various reports have documented, broad access non-discriminatory regimes can have a significant positive impact on the economy, labor market and human rights.[43]

But at the same time, these theories seem to take a somewhat absolutist view and leave little margin for any form of exclusion. It is as if they reject exclusion altogether, which may be too strong of a position in such a technologically dynamic and diverse industry. This is a fundamental problem in regulation, because it makes it rigid, and unless the vast majority of cases comfortably falls under the enacted ban, regulation will treat unfairly and unnecessarily harshly a large number of industry practices. This problem, which largely motivates the thesis at hand, is further discussed below.

1.1.3 The Problem: Regulation of Exclusion is Rigid and Does Not Account for the Industry's Technological Dynamism

It seems that a general skepticism against exclusion permeates telecommunications regulation. We need to ask ourselves whether, given the current state of the industry, the skepticism is still justified. Is exclusionary behavior in the modern wireless communications market so uniformly pernicious as to be virtually banned? Is the modern wireless market

43 SCF Associates, Perspectives on the Value of Shared Spectrum Access, Final Report for the European Commission (2012); ITU, Exploring the Value and Economic Valuation of Spectrum, Broadband Series Report (2012); Institute for Policy Integrity, Free to Invest: The Economic Benefits of Preserving Net Neutrality, Report No. 4 (2010); CoE Steering Committee on Media and Information Society, Protecting Human Rights Through Network Neutrality: Furthering Internet Users' Interest, Modernising Human Rights and Safeguarding the Open Internet, CDMSI(2013)misc 19E (December 2013). *See contra*, The Brattle Group, The Employment and Economic Impacts of Network Neutrality Regulation: An Empirical Analysis (2010); Frost & Sullivan, Net Neutrality: Impact on the Consumer and Economic Growth, Consumer Communications Services Report 4.13 (2010).

structured in a way that allows those negative effects of exclusion to arise and persist?

The arguments and policies traced previously seem to suggest so. But they have not escaped criticism and for good reason. Besides any localized flaws and loopholes that have been pointed out separately,[44] the above-mentioned theories and arguments suffer two major weaknesses that are critical for our analysis of exclusion: first, they advocate for rules that are almost uniformly in favor of inclusion, neutrality and openness. As such, by nature, they disregard the specific technological and economic conditions that characterize the industry, because these rules don't distinguish between good exclusion and bad exclusion, they are not open to the possibility that the application of such rules in one situation can be good public policy, whereas in other situations can be welfare-reducing, and they are oblivious to the dynamism of the industry and the frequent changes technological change brings along. In other words, these rules, no matter how good their theoretical underpinnings and benign motivation, are inflexible and apply equally to unequal situations.[45]

Second, because the above theories altogether reject exclusion, they are more likely to support the creation of relevant anti-exclusion rules *in the first place*. That is to say, they tend to support over-regulation of exclusionary practices in the market. Theoretically, it is possible that,

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44 *See, e.g.,* on end-to-end: Yoo, *supra* note 25; on network neutrality: Gregory Sidak, *A Consumer-Welfare Approach to Network Neutrality Regulation of the Internet*, 2 JOURNAL OF COMPETITION LAW AND ECONOMICS 349 (2006); Christopher Yoo, *Beyond Network Neutrality*, 19 HARVARD JOURNAL OF LAW AND TECHNOLOGY 1 (2005); James Speta, *Handicapping the Race for the Last Mile: A Critique of Open Access Rules for Broadband Platforms*, 17 YALE JOURNAL ON REGULATION 39 (2000); on the platform theory see the limitations proposed in Joseph Farrell & Philip J. Weiser, *Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age*, 17 HARVARD JOURNAL OF LAW AND TECHNOLOGY 85 (2003); on spectrum commons: Gerald Faulhaber & David Farber, *Spectrum Management: Property Rights, Markets and the Commons*, *in* RETHINKING RIGHTS AND REGULATIONS: INSTITUTIONAL RESPONSES TO NEW COMMUNICATIONS TECHNOLOGIES 193 (Lorrie Faith Cranor & Steven S. Wildman eds., 2003).

45 James B. Speta, *Unintentional Antitrust: The FCC's Only (and Better) Way Forward with Net Neutrality after the Mess of Verizon v. FCC*, 66 FEDERAL COMMUNICATIONS LAW JOURNAL 491 (2014); Verizon v. Federal Communications Commission, 740 F.3d 623, 633 (2014).

because of certain technological and economic developments, the type and degree of exclusion in the industry does not rise up to the level that a broad-sweeping rule would be actually necessary; and yet, because there is nevertheless *some* risk of exclusion, such a rule would be instituted and apply to (:prohibit) even those cases that do not present a danger, which could even be the majority. To put it differently, these theories are guided primarily—if not exclusively—by the principle of maximization of inputs and interactions thereof, and not also by the technological and economic needs and realities of the industry. If one accounts for those needs and realities, the maximization of inputs and interactions becomes less crucial, and so does the regulation that imposes it.

Consider the following cases where one-size-fits-all rules have proven problematic. By virtue of the 1996 Telecommunications Act local exchange carriers were required to make individual parts of their network available to competitors.[46] The parts of the network that the Commission declared should be made available were the same on a national scale, which meant that any entrant could request access to those elements without having to prove any qualifying conditions or necessity, technical or other.[47] In other words, the obligation remained even if denial of access to certain requested network elements would not effectively exclude the entrant. The unbundling obligations were heavily litigated, and eventually invalidated.[48] The D.C. Court of Appeals deemed the Commission's access rules too broad and noted that the Commission's analysis failed to limit unbundling obligations only to those network elements that accorded to

46 Telecommunications Act of 1996, 47 U.S.C. §§ 251(c)(3).

47 For a summary *see* Commission Adopts Rules to Implement Local Competition Provisions of Telecommunications Act of 1996, CC Docket No. 96-98, NEWSReport No DC 96-75 (1996); In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, CC Docket No. 96-98 (2005) (Order on Remand).

48 United States Telecom Association v. FCC, 299 F.3d 415 (2002), cert. Denied, 123 S. Ct. 1571 (2003).

ILECs the necessary market power that would allow them to effectively exclude entrants, on the grounds that without those elements the operation of entrants would be impaired.

The generality and expansive breadth of rules that aimed to limit exclusionary practices within broadband providers' networks was also the reason behind the invalidation of the 2010 Open Internet Order in early 2014.[49] The rules imposed a general no-blocking, no-discrimination obligation without regard to the specific circumstances of possible blocking or discriminatory measures a broadband provider might want to enact. The D.C. Court of Appeals noted that a ban of this scope was not appropriate for the broadband Internet, given the light touch regulation that accompanied the characterization of the broadband Internet as an information service. Instead the court hinted to rules that do not attempt to uniformly interfere with how broadband providers manage their networks.[50] This would leave the door open for certain cases of permissible discrimination against certain inputs over others.

One could argue that this is the nature of regulation: it describes in abstract terms what the prohibited conduct is, and it is meant to apply to an undetermined number of perhaps similar but not identical cases. In the process, over-inclusion and under-inclusion are almost certain to arise.

But it doesn't have to be so. Regulation can and should adapt to the specific circumstances of the industry it aims to regulate. This entails enacting rules only when the structural conditions of the industry make unwanted business behavior likely and harmful, and rules that are open to a variety of parameters, that leave a margin of appreciation, and that are structured in a way that allow for the taking into account of the specifics of each case that will fall under the scope of the

49 Verizon v. FCC, *supra* note 45.

50 *Id*. at 657 (“Moreover, unlike the data roaming rule in Cellco—which spelled out 'sixteen different factors plus a catchall ... thus building into the standard 'considerable flexibility—the Open Internet Order makes no attempt to ensure that its reasonableness standard remains flexible.” (internal citations omitted)).

rule.[51]

In the case of the wireless telecommunications industry it is hard to see how this can be done without taking into account the prominent role technology plays in the industry. To a large degree technology forms the underlying playing field on which business relations are built.[52] The technical capabilities of mobile networks both enable and constrain business practices and opportunities, including exclusionary ones, and the idea that one can form a complete picture of the dangers exclusionary practices may pose without accounting for the effect of technology on the competitive conditions in the market is arguably an incomplete analysis.[53] In every design various considerations -technical and non-technical- are embedded and serve as influential determinants of whether a design will be accepted or rejected.[54]

A look at the modern wireless market shows indeed how new options stemming from technological progress change the positioning of players in the market. Compare for example only a few years ago when Wireless Carterfone first emerged to today. Mobile calling and messaging applications like Skype have proliferated opening up new options for consumers;[55]

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51 *See, e.g.*, Philip J. Weiser, *Towards a Next Generation Regulatory Strategy*, 35 LOYOLA UNIVERSITY CHICAGO LAW JOURNAL 41, 60-63 (2003); Christopher S. Yoo, *What Can Antitrust Contribute to the Network Neutrality Debate*, 1 INTERNATIONAL JOURNAL OF COMMUNICATION 493, 504-409 (2007); Speta, *supra* note 45.

52 David D. Clark, *Tussle in Cyberspace: Defining Tomorrow's Internet*, 13 IEEE/ACM TRANSACTIONS ON NETWORKING 462 (2005) (where the author describes how the infrastructure of communications networks is seen by engineers as designing the playing field, not the outcome).

53 ROBIN MANSELL, THE NEW TELECOMMUNICATIONS 4 (1994) (where the author explains that very design consists of rules that forge the relationships among the partaking actors, and even seemingly neutral decisions change the constellation of interactions and redefine the distribution of power among actors).

54 *Id*. at 35 (“The production of products and services within the communication environment is the concrete manifestation of the dynamic processes at work in the generation and implementation of the public telecommunication infrastructure. In this sense, the telecommunication system is much more than a technical system composed of hardware and software, transmission links and switching apparatus. It is a technological system which embraces the technical artefacts and the institutions which shape its development, diffusion and use.”).

55 Among its recent competitors *see* Viber, Whatsapp, Telegram, and Kik.

one of them, Whatsapp, is now available on its own SIM card as a telecommunications service and not merely as an application that can be blocked;[56] Apple also launched a SIM card that allows users to connect to different carriers, thus minimizing switching and substitutability costs;[57] some wireless carriers are dropping the traditional phone calling function altogether and replace it with over the top software that was once considered a competitor, including Skype;[58] Google is about to enter the wireless operator market, providing yet another alternative provider;[59] Cablevision, a cable company, just started offering mobile services over a network of Wi-Fi hot-spots, adding to the list of other similar companies that offer communications services without relying on traditional cellular carriers.[60]

These developments create a radically different environment. If the traditional model to describe the wireless industry has been the hourglass architecture, with the entire transmission path between service and application developers and consumers forming a slim waist,[61] today's industry state and immediate future prospects have definitely made that waist wider, and have added to the upper services and applications too. Moreover, the power dynamics among players and their interests in the market have also shifted. Consumers can now choose from more applications, more modalities of access, and more operators. Some operators and application providers are experimenting with new ways to offer mobile communications that were

56 Archibald Preuschat, *New SIM Card Offers Global Access to WhatsApp*, WALL STREET JOURNAL, January 21, 2015.

57 Daniel Thomas, *Apple Plan to Embed iPad Sim Cards Challenges Mobile Networks*, FINANCIAL TIMES, October 17, 2014.

58 *See*, *e.g.*, Scratch Wireless, and TextNow. See http://www.scratchwireless.com and http://www.textnow.com. Republic Wireless is another example of a "Wi-Fi first" operator. See http://www.republicwireless.com.

59 David Goldman, *Google Is Becoming a Wireless Carrier*, CNN, January 23, 2015.

60 Ben Fox Rubin, *Freewheel, Cablecision's Wi-Fi-only Phone Service Goes on Sale*, CNET, February 5, 2015.

61 Wu, *supra* note 1, at 392.

technically unavailable a few years ago. Traditional rivals (mobile operators vs. Skype) that were involved in controversies over exclusionary practices turn into mutually-dependent partners and complements. In this environment, exclusionary practices such as blocking or discrimination may well inconvenience individual applications, like Skype, but at the same time the modern structure of the industry enables more ways for developers to bypass bottlenecks, and for consumers to access services, applications and content, thus mitigating the likelihood and the effect of blocking and discrimination on the market.

None of this of course by itself means that blocking Skype is acceptable (and an application of the framework to be developed in this thesis would mostly confirm this), but at a minimum these developments show how much less of an effect blocking an application on a network has in the market. Technical progress has given rise to those new ways to develop, deploy and access services, which in turn have affected the interrelations and power dynamics among market players. It is only fair, then, to ask that these changes in industry structure and the role of technology be reflected in the regulation of the blocking, discriminatory, or exclusionary practices in general. We need to reconsider what exclusion means in an industry dominated by technology, and whether the regulations in place are still fit for the job.

This inquiry is more timely than ever. The wireless industry is undergoing a paradigm-shifting transformation and is becoming the epicenter of communications. Mobile subscriptions outnumber fixed lines at a 5:1 ratio, while mobile broadband outnumbers fixed broadband at a 2:1 ratio.[62] There are now more mobile Internet users than desktop users,[63] and Ericsson reports

62 ITU, ICT Facts and Figures 2014, *available at* http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf.

63 ComScore, The U.S. Mobile App Report, *available at* http://www.comscore.com/Insights/Presentations-and-Whitepapers/2014/The-US-Mobile-App-Report.

that total mobile data traffic was 2 exabytes per month in 2013, 3,2 exabytes in 2014, and projected to reach 25 exabytes in 2020.[64] Legacy services are also replaced by new IP-based services. In 2012 some 8.6 trillion SMS messages were sent compared to about 5.8 trillion OTT messages, but by 2016 SMS messages are expected to marginally increase to 9.5 trillion as opposed to a significant increase to 20 trillion of OTT messages.[65] In a recently announced deal Verizon sold in a $20 billion deal another massive part of its fixed-line network, the second such deal in the last five years,[66] indicative of just how much Verizon is prioritizing its wireless operations over fixed-line operations. The truth is that wireless communications have now become the norm and all evidence shows that the trend will continue.

One last issue that we think is important here refers to what we mean by wireless communications. Given the cross-cutting nature of today's communications solutions and the approximation of traditional telephony services with Internet services, wireless communications should be understood more broadly that just cellular networks, which have been and may largely continue to be the primary mode for accessing voice and data on the move. Wi-Fi has made tremendous progress in becoming a reliable alternative, and in fact more and more wireless operators offer Wi-Fi as a back-up or complementary solution.[67] WiMAX is also a viable alternative although its popularity waned compared to LTE over the past few years, whereas other modes of access are beginning to surface too, as for example the mixed-license 3.5 GHz

64 Ericsson Mobility Report, *available at* http://www.ericsson.com/mobility-report.

65 Portio Research, Mobile Messaging Futures 2012-2016, *available at* http://www.portioresearch.com/en/reports/current-portfolio/mobile-messaging-futures-2012-2016.aspx

66 Karl Bode, *Frontier To Buy All Verizon Wired Customers in FL, TX and CA*, DSL REPORTS, February 5, 2015.

67 *See supra*, note 58.

spectrum bands.[68] An analysis of wireless communications should not been confined in the licensed or unlicensed part of the spectrum, nor in particular technologies, because these classifications are not future-proof. For example, recently a few carriers have experimented with LTE over Wi-Fi, a scheme that brings together a typical licensed spectrum technology and a typical unlicensed spectrum mode of access,[69] whereas wireless operators are also experimenting with seamless transitions from one technology to another (e.g. from cellular to Wi-Fi).[70]

It is crystal clear that the future belongs to wireless, and significant transformations are taking place that need to be addressed. Although the antitrust literature in particular has attempted to examine the interface of high technology industries and competition, it has not gone farther than simply questioning the applicability of antitrust dogmas to the high technology sector.[71] We hope that this thesis will partly fill that gap with regard to exclusion in wireless networks.

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68 *See* In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket FCC 12-354 (2014) (Further Notice of Proposed Rulemaking).

69 *See, e.g.,* Jon Brodkin, *T-Mobile to Offer LTE over 5GHz Wi-Fi Airwaves to Boost Data Rates*, ARS TECHNICA, December 19, 2014. *See also* Colin Neagle, *Wi-Fi Calling and Volte Might Eventually Change the Way Voice Calls Are Handled in the Enterprise*, NETWORK WORLD, September 17, 2014.

70 *See, e.g.,* Mark Sullivan, *T-Mobile Announces Seamless Wi-Fi to VoLTE in All Phones, Free Router Device*, VENTURE BEAT, September 10, 2014.

71 *See, e.g.,* Robert Pitofsky, *Antitrust Analysis in High-Tech Industries: A 19th Century Discipline Addresses 21st Century Problems*, 4 TEXAS LAW REVIEW AND POLICY 129 (1999); Lawrence A. Sullivan, *Is Competition Policy Possible in High Tech Markets?: An Inquiry into Antitrust, Intellectual Property, and Broadband Regulation as Applied to "The New Economy,"* 52 CASE WESTERN RESERVE LAW REVIEW 41 (2001); John Temple Lang, *European Community Antitrust Law: Innovation Markets and High Technology Industries*, 20 FORDHAM INTERNATIONAL LAW JOURNAL 717 (1996);

1.2 TOWARDS A SOLUTION FOR THE PROBLEM: A FLEXIBLE FRAMEWORK ADAPTED TO THE TECHNOLOGICAL REALITIES OF THE WIRELESS TELECOMMUNICATIONS INDUSTRY

In the preceding pages we identified a problem: that the near absolute ban on exclusionary practices in the wireless telecommunications industry restricts the freedom of actors to choose their partners and the conditions of transacting with them (and by extension to exclude some), and that considering the modern technology-dominated environment of wireless telecommunications, which, we proposed, makes such exclusionary practices less likely to be anticompetitive, anti-exclusion policies may be excessively strict and misguided. For this reason we suggest that the solution lies in constructing a framework which moves away from absolute restrictions or permissions and instead considers the conditions under which exclusion can be harmful in the industry and suggests action only when the answer is positive.

These conditions, we submit, need to be adapted and considered in the specific context of the wireless telecommunications industry, meaning that they cannot simply reflect a general theory of exclusion as formulated by industrial organization and antitrust law, but must further account for the specific technology-intensive nature of the industry, because, as we attempt to show, it changes the competitive conditions amidst which actors operate. While industrial economics can well be the starting point, as the branch that studies the industry's organization and structure and therefore how the actions of firms (including exclusion) affect other market participants and the market as a whole,[72] in highly technical industries the technological

72 FREDERIC SCHERER & DAVID ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 7 (1990) ("Many aspects of industrial organization analysis are controversial, but none excite economists' disputative juices more than questions of appropriate public policy. At bottom, the debate turns on ideological value judg ments as to the proper role of government. Here, analysis is futile; *de gustibus non est disputandum.*" (emphasis in original)).

characteristics of it largely co-determine its organization and performance as well.

These parameters become relevant only as a part of a flexible framework, which will then be used to determine the suitability of regulatory action. A literature review of the determinants of the effect of exclusion points a selection of factors that can be grouped in three sets: factors that affect the ability of market players to exclude, factors that affect their incentives to exclude, and factors that give rise to efficiencies that can potentially offset the negative effects of exclusion.[73]

These factors have been used at varying degrees, but not always in methodologically sound way. For example in the 2010 Open Internet Order, the Commission expressly addressed two of them—ability and incentives—in assessing the need to adopt rules that would prevent blocking and discrimination. But despite the wealth of literature on how to determine ability and incentives, which we will adopt in this thesis, the Commission's analysis was rather superficial. The only argument on the ability to exclude was the limited number of last mile providers, without any mention to the actual competitive dynamics and power distribution between the last mile providers and the edge providers or other intermediaries, whereas in terms of incentives, the Commission also only discussed the positive incentives to vertically exclude, passing up the entire body of literature on incentives not to exclude.[74]

Further, the problem with the treatment of exclusion is not only the partial implementation of the set of factors identified previously, but more so that they have also not fully considered the particular context of wireless communications, which may explain why the adopted rules have come out almost unconditionally against exclusion. No matter how good the economic analysis is, in industries dominated by the very pervasive presence of technology, such as wireless

73 *See infra*, Chapter 2.

74 *See* 2010 Open Internet Order, ¶ 20-34.

telecommunications, it is imperative that the analysis be adapted to the specific characteristics of that industry, otherwise the application of generic rules and formulas might still not accurately reflect the actual conditions under which the industry operates.[75] The technology-intensive nature of wireless telecommunications qualitatively changes the way market actors relate to each other and to their assets, and this in turns affects their ability to exclude, their incentives to do so, and the efficiencies they draw from exclusion. In no small part, new business propositions in the market rely on technical evolution, and it is only by understanding them, that one can see whether the industrial organization of the market is healthy or not.

We can now stitch the pieces together: (a) we submit that exclusion is regarded with unnecessary suspicion in the wireless telecommunications industry; (b) we believe that telecommunications policy must therefore adopt a more flexible and nuanced approach that considers exclusion's actual effect on the market; (c) we propose that to assess correctly the effect of exclusion the framework should adapt the general set of parameters on exclusion to the highly technical nature and properties of the wireless telecommunications industry.

This is where this thesis comes in. It aims to present a technology-informed framework of the conditions that need to hold for exclusion to be anti-competitive in the wireless market, and by doing so, it accordingly provides guidance as to the necessity of adopting relevant rules, and assuming that flexible rules are put in place allowing a margin of appreciation, it provides guidance as to when the rules should be triggered.

The framework shows that the technology-intensive nature of mobile telecommunications reduces the ability of market players to effectively exclude rivals, it dampens their incentives to

75 Cf. Mark Lemley, *Industry-specific Antitrust Policy for Innovation*, 2011 COLUMBIA BUSINESS LAW REVIEW 637 (2011).

do so, and it creates an environment wherein exclusion can generate important efficiencies. Taken together, these three considerations mean that exclusionary practices with anticompetitive impact on the market may be harder to emerge than commonly assumed, which points to an elevated standard for the adoption of anti-exclusion rules, and to the necessity for flexible rules capable of distinguishing between harmful and innocuous exclusion considering the technological dynamism of the industry.

The thesis is structured and summarized as follows: We have already established the motivation behind the thesis, namely that exclusion is regarded with unnecessary suspicion in the wireless telecommunications industry. In the next Chapter we begin by explaining what exclusion is and what its potential ramifications are. This is useful to understand the reasons behind telecommunications policy's negative treatment of exclusionary practices and why ability, incentives and efficiencies are relevant factors. Exclusion can manifest itself in several ways in the market, including vertical integration, tying and refusal to deal. The potential harm in the market (and in a sense the goal and effect of anticompetitive exclusion) is the same: (a) a complete inability of competitors to access an essential neighboring market/ product/ service, or (b) a hindrance that places competitors at an unfairly disadvantageous position, or (c) in a more dynamic view of the market the raising of entry barriers and the jeopardizing of innovation.

The fear of potentially negative impact on the market underlies the prophylactic action of regulatory authorities, which, by virtue of ex ante regulation, attempt to prevent anticompetitive conduct from ever arising. However the potential negative effects of exclusion should not be presumed to occur without a showing that certain conditions are in place. As already mentioned economists and antitrust scholars have over the years constructed elaborate models to spell out

these conditions. Because of the multifaceted manifestations of exclusion many of these conditions pertain to specific cases of exclusionary conduct. At the same time though, there is a set of considerations that are consistently found to be relevant and important: (a) the *ability* to effectively exclude rivals; (b) the *incentives* to exclude rivals; (c) whether there are any offsetting *efficiencies* that justify the exclusionary action. These pillars form the minimum basis because they refer to factors that are both common to all exclusionary practices, and de minimis necessary to make an educated assessment. They have a long history in the scholarly debate, but they have also been adopted by antitrust authorities in the US and Europe, and also drive much of the contemporary judicial analysis.

With this tripartite framework in mind we then move on to examine exclusion's determinants in the context of the wireless telecommunications industry in particular. First, we analyze what structural prerequisites are necessary to say that a firm has the ability to perform exclusion that can be harmful to the competitive conditions in the market: a firm must have and be able to maintain a dominant position in the market; otherwise exclusion will not affect a large line of commerce. The concept of “dominant” in wireless telecommunications does not have to be the same as general antitrust law, but there must be some measure of power that a firm possesses in the market, otherwise its actions—exclusionary or not—are not in the position to affect the structure of the market. Therefore, if entry can occur easily or if competitors can respond to the exclusionary practices, the consequences will be limited. Further, the competitive advantage must persist, because if it is transitory, the effects of exclusion will again be limited. Finally, if users can find alternative ways to access similar products, services or applications, thereby bypassing the exclusionary bottleneck, then, again, the effect of exclusion is mitigated.

In all those factors, technology has a big role to play. In technology-intensive industries such as wireless telecommunications the technological proximity between neighboring states of production along the value chain makes expansion of activity upwards or downwards easier. The accumulation of similar technical expertise, and the relatively large role knowledge, skills and expertise play in technology-intensive industries, mean that neighboring actors can exert greater competitive pressure to each other. This can be either a result of a business opportunity, or even a technical necessity, namely that the successful operation of a product/service requires the firm to expand to other levels as well. The consequence of the higher level of malleability between the layers of the production chain is that it creates more competitive sources. Further, because functionality in the mobile communications value chain can move along the value chain easily, competitive threats can arise from any to any level. It is not uncommon to see functionality moving from the local device level further into the network, and with the transition to new generation IP-based mobile networks new sources of application and service provision are added, contributing further to entry opportunities and competitive pressures.

Moreover, even when entry does not occur, existing players in the value chain can have a dissuasive effect against anticompetitive exclusion. Because the production and delivery of wireless telecommunications services/products requires the cumulative contributions of successive players along the value chain, and because the functions of layers are shaped in relation to the rest of the layers, the interactions among players can place limits to the business decisions of other actors. In fact, not only do vertical interdependencies place limits, but value can flow from one layer to another and along with that the ability to effectively perform business strategies, including exclusion.

The other end of the value chain, the end users side (by users we mean consumers but also application/service developers because most parts of the telecommunications value chain are two sided markets), is also relevant in our exploration of when exclusion can potentially have anticompetitive effects on the market. If users are able to bypass the exclusionary practices employed by firms, the effective scope of exclusion is automatically limited. One way this can happen in mobile networks is the ability and growing trend of consumers and developers to multihome. This means that they simultaneously subscribe to multiple networks and systems, so that if one of them implements exclusionary or discriminatory practices, they can bypass the limitation by switching to the other. Additionally, as actors across systems become more interconnected with each other, the ability of each individual actor to affect how traffic flows decreases, because the availability of alternative paths through which data can be detoured undermines, much like multihoming, the power and effectiveness of bottlenecks and exclusionary behavior.

Assuming that at some point in a market's lifetime an actor attains enough market power (as determined by demand and supply conditions discussed previously), another question arises: is the competitive advantage on which exclusion is based sustainable? If it is not, then regulators may want to be conservative with their regulatory efforts, given that regulation tends to be hard to reverse and comes with a cost. The mobile industry is a good candidate to apply this argument for two reasons: first it is characterized by strong network effects, which tend to help firms build a competitive advantage quickly, but the same goes for their competitors. As this process repeats itself, players in network industries enjoy fast growth, but also rapid displacement upon emergence of a competing wave of network effects. Second, research shows that acute

technological dynamism renders competitive advantages less resilient. Therefore, one should remain wary toward the observation of significant market power or even “abusive” (read:exclusionary) practices based thereupon, because it may well mean either that this is the natural modus operandi of the industry or that the firm under scrutiny is simply trying to compete in the cutthroat environment of technology-intensive industries.

Moving past the ability to exclude, before regulators can establish the need to make prescriptive rules, they also need to have certain indications that market players are also likely to resort to exclusionary practices. This relates to their incentives to exclude. It is easy to see why a firm would want to exclude, but there is also a less obvious opposite incentive towards cooperation. The idea is that technological progress allows and causes greater specialization in the industry, which results in the emergence of specialized clusters of resources and knowledge along the value chain. As scale and scope grows, the production stages of the industry's value chain begin to become separable and to have the potential to form distinct markets to which formerly internalized activities are now outsourced. Initially, when the industry is dominated by self-sufficient vertical systems of production, external disintegrated competitors in some stages of production may be seen as a threat and therefore be excluded from the system. But as production stages become more clearly defined in the industry, and specialized clusters become increasingly efficient and multiply, the incentives to exclude are replaced by incentives to cooperate with them. As the decoupling between production stages increases, the necessary components of a system are to be found in different parts of the value chain, but because they still need to work together as parts of a system of production, interdependencies arise, and their resolution lies in the cooperation between the various actors and components.

Moreover, even assuming that firms may have both the ability and the incentive to exclude, and hence the market is set up in a way that would make exclusionary practices possible, likely and profitable, it doesn't ipso facto follow that exclusion is welfare-reducing. If the resulting efficiencies can offset the lost welfare from the reduction of competition in the market, they should not only be acceptable, but also desirable. It is true that efficiencies are elusive, but they have also been shown to account for much of the technological progress that is so highly valued.

We distinguish between two types of efficiencies that are grounded in the technical nature and peculiarities of the mobile telecommunications networks. First, technical efficiencies that emerge by treating wireless telecommunications systems as a whole and as the minimum unit of analysis (as opposed to looking at it at the component level). Because of the technical interdependencies and complexities, a systemic approach is oftentimes necessary to see how certain performance or productive gains can be attained, especially those that relate to the global optimum of the entire system, as opposed to the local optimal of individual subparts. The systemic approach encompasses the ability to block out undesired elements and interactions from the system, with the aim to protect its integrity, especially while the interactions among its parts have not yet stabilized.

Second, we suggest that the ability to depart from uniform treatment of partners (i.e. exclude or discriminate against some while accepting others) is a necessary precondition for the formation of efficient interactions among industry players, when the interactions under consideration are still fluid. While the first type of efficiency identified here is internal as it refers to the optimal operation of a given system, the second type is industry-wide as it affects how industry players interact with each other.

The framework and its parameters as analyzed point to two implications: (a) they factor in the particular technological conditions of the wireless telecommunications industry to expose more accurately the circumstances under which exclusion can be harmful to the market. This informs regulators about the necessity of rules, and in fact points to the general direction that technological competition, incentives and efficiencies make anti-competitive exclusion—the kind that calls for regulation—less likely; (b) if a rule is deemed necessary, it should at least be one that is in the position to take into account the particular circumstances of the case under scrutiny based on the parameters deemed important in this thesis, and that is because not all cases of exclusion fulfill the structural prerequisites for harmful effect as identified here.

These implications we turn to apply in the last part. In particular, we use the Open Internet proceeding from 2010 to its proposed update in 2014 to discuss how the Commission should have approached the regulation of exclusionary practices in the wireless market. The proposed set of rules rests on three pillars: (a) along the lines of the 2010 Order it reserves special treatment for wireless operators as opposed to fixed operators; (b) it allows differentiated treatment of traffic under a newly introduced "commercially reasonable" standard; (c) similar to the 2010 Order it limits the applicable rules to the the relationship between broadband providers and end users within the providers' network.

On those topics the analysis of the rules through the lens of this thesis would suggest that: (a) wireless operators do not deserve different treatment than fixed operators on the grounds of an abstract observation of differences with fixed operators or of "operational constraints," but rather a full and separate analysis of the parameters of vertical exclusion in mobile networks as summarized above is necessary to determine the necessity for anti-exclusion rules, (b) contrary

to the Commission's recommendation, the commercially reasonable standard should not result in a presumption that a broadband provider conduct that forecloses rivals is commercially unreasonable because there it doesn't follow from the analysis of this thesis that exclusion is in doubt anti-competitive, (c) artificially limiting the rules to the last mile leaves out bottlenecks that can have a functionally equivalent effect to the exclusionary practices in the last mile. The analysis undertaken in this thesis, applies to every part of the value chain.

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2 . The Regulation of Exclusion: The Need for an Antitrust-based Framework

Exclusion is a broad term that is used to describe a variety of business practices. In the context of telecommunications, exclusion is encountered in the form of blocking or discrimination, and can occur across the spectrum including services, applications, content, but also equipment and physical resources.[76] As we mentioned in Chapter 1, much of telecommunications regulation has been devoted to placing limits to exclusionary practices, which in broad (but not inaccurate) terms resulted in no-blocking, and no unreasonable discrimination rules that applied uniformly to every situation. At the same time such practices have also been the subject matter of antitrust laws, which however took a more flexible approach by taking into account the specifics of each case, rather than uniformly allowing or prohibiting a practice. Naturally, tension ensued, with a growing number of voices calling for more flexible telecommunications regulation.[77]

This chapter has a dual goal: first, it aims to define exclusion and explain why it can have a potentially anticompetitive effect, which is what regulators and lawmakers fear. Second, because the theoretical possibility of anticompetitive effect is not in and by itself sufficient to justify regulation, a related inquiry is necessary into the identification of the structural preconditions of exclusionary practices that have the potential to distort the competitive conditions in the market. In that direction we show how lessons from antitrust and industrial organization can endow the wireless telecommunications regulatory framework with the flexibility it needs to both allow

76 *See, e.g.*, Gerald D. Faulhaber, *Bottlenecks and Bandwagons: Access Policy in the New Telecommunications*, *in* HANDBOOK OF TELECOMMUNICATIONS ECONOMICS VOL II 488 (Sumit K. Majumdar et al. eds., 2005).

market experimentation and prevent anticompetitive practices.

The combination of this chapter, along with the conclusions of Chapter 1 pave the way for the main analysis to follow in the remainder of this thesis. To understand how the technology-intensive nature of wireless telecommunications affects exclusion in the market, one has to first know what parameters of exclusion to study, and then proceed to map the technological considerations onto them.

2.1 EXCLUSION: DEFINITION AND POTENTIAL THREATS

One of the main reasons why exclusion is prominently featured in policy debates is the versatility though which it can manifest itself in the industry and the fact that some of these manifestations can be harmful to the operation of the market. It is this generalized fear of potential threats from multiple sources and with potentially negative effects that has animated the no-blocking and no-discrimination policy.

According to an authoritative definition exclusion refers to "a dominant firm's denial of proper access to an essential good it produces, with the intent of extending monopoly power from that segment of the market (the bottleneck segment) to an adjacent segment (the potentially competitive segment)."[78] The definition is general and precise at the same time, in that it is framed in broad enough terms to cover the multifarious manifestations of exclusionary practices in the market, but at the same time hints to the conditions that need to be in place for exclusion to

77 *See infra* 2.2.1.

78 Patrick Rey & Jean Tirole, *A Primer on Foreclosure*, *in* HANDBOOK OF INDUSTRIAL ORGANIZATION VOL III 2145, 2145 (Mark Armstrong & Robert H. Porter eds., 2007).

actually be harmful (we turn to this right below in 2.2).

This definition also narrows down the scope of exclusionary practices to the ones that are most relevant to the organization of the wireless telecommunications industry, namely those that have a vertical component in them (vertical exclusion).[79] As per the definition above vertical exclusion aims at extending power from one segment of the value chain to another, and this affects how upstream and downstream markets relate to each other to deliver the final product or service to consumers. By picking some inputs or distribution channels while excluding others, firms can decide which products and services are produced and be made available in the market. It therefore interferes with the enabling platform nature of telecommunications and may prevent the kind of cumulative innovation that regulators seek to protect as explained supra in Chapter 1.[80]

The manifestations of exclusionary practices can be diverse.[81] What they all have in common is that they make it harder or impossible for a competitor to gain access to necessary inputs or distribution channels along the value chain. Exclusion does not have to be complete, namely to result in full refusal of access to an upstream or downstream input; it can also consist in manipulating the conditions of access to an input to make access less profitable or otherwise

79 See Thomas P. Lyon, *Preventing Exclusion at the Bottleneck: Structural and Behavioral Approaches*, *in* EXPANDING COMPETITION IN REGULATED INDUSTRIES 55, 55 (Michael A. Crew ed., 2000) ("The challenge for policy is how best to govern the vertical relationship between the competitive "upstream" markets ... and the monopolistic "downstream" distribution networks that deliver these products. Of particular concern is that vertically integrated firms may have incentives to leverage their market power at the distribution "bottleneck" into market power in the content market. For example, the divestiture of the Bell Operating Companies from AT&T was done in significant part because of AT&T's long history of anticompetitive actions designed to suppress competition in the telecommunications industry, despite the attempts of regulators to prevent such abuses.").

80 *See* 1.1.2.

81 *See* Thomas G. Krattenmaker & Steven C. Salop, *Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power over Price*, 96 YALE LAW JOURNAL 209, 215-219 (1986), who treat "disparate doctrines" such as tie-ins, exclusive dealings, long-term contracts, refusal to deal as a single phenomenon, namely vertical exclusion.

less advantageous for one actor relatively to another (presumably an affiliate of the excluding firm).[82] Sometimes this is referred to as discrimination.

In the telecommunications market exclusion is commonly implemented through the following forms:[83]

Vertical integration: a firm can integrate into two or more production stages. If one of the production stages controlled by the integrated firm is a bottleneck, the firm can harm its competitors in other production stages by blocking access to the bottleneck market.[84] To a very large extent, the chronicle of the liberalization of the telecommunications market is dominated by examples of such type of foreclosure. In 1913 the Justice Department filed an antitrust suit against AT&T asking it to open up its long-distance network to local exchange providers for fear that without access to long-distance service these providers stood no change to compete against local AT&T service.[85] In 1968 a private complaint forced AT&T to open its network to "foreign attachments" thereby paving the way to the emergence of the equipment industry.[86] AT&T's breakup in 1984 was also animated by the concern that local exchange providers would not be able to compete against AT&T's local service if AT&T's integrated long distance network continued to be a near-monopoly.[87] In all these cases access to a segment of the network was deemed both essential for the survival of competitors, and blocked by the integrated actor.

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82 Rey & Tirole, *supra* note 78, at 2149-2150.

83 For an overview *see* Rey & Tirole, *supra* note 78, at 2148-2150; JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 193 (4th reprint 1990).

84 DENNIS W. CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 388-390 (1990).

85 *See* United States v. AT&T (1914) (Consent Decree).

86 *See* Carter v. AT&T, 13 F.C.C. 2d 420 (1968). *See also* Hush-A-Phone v. United States, 238 F.2d 266 (1956); United States v. Western Elec. Co., 1956 Trade Cas. (CCH) 68246 (1956).

87 United States v. AT&T, 552 F.Supp. 131 (1982).

Tying: Short of integration, a firm can tie the bottleneck product to the competitive product with the intent to strengthen the competitive product's position in the market to the detriment of other products in that market. If the tying is not exclusive, its effect is that it may make competition for rivals harder, but if it is exclusive then rivals are de facto foreclosed as they lose access to the essential bottleneck market.[88] For instance, Microsoft tied Internet Explorer to its Windows operating system making it harder for alternative Internet browsers to compete, eventually forcing some of them (most notably Netscape) to extinction.[89] More recently, Google has employed the same strategy with Android and a series of Google services and products, such as Google Search and Gmail. Competing application providers complained that the tying puts them in disadvantageous position often leaving them unable to compete.[90]

Refusal to deal (or dealing on discriminatory terms): A firm controlling a bottleneck part of the value chain can refuse to deal with firms upstream or downstream, with the intent to promote a competing affiliate. Refusal to deal can be performed by refusing to transact with an actor or by employing technological means to block the interoperation of components, for example by making them incompatible.[91] For example, Skype and Google Voice were initially blocked on iPhone. The two firms alleged that AT&T saw them as potential competition to its own native voice service, and collaborated with Apple (whose AT&T was the exclusive partner carrier) to

88 Carlton & Perloff, *supra* note 84, at 371.

89 *See* Michael D. Whinston, *Exclusivity and Tying in U.S. v. Microsoft: What We Know, and Don't Know*, 15 JOURNAL OF ECONOMIC PERSPECTIVES 63 (2001); Nicholas Economides, *The Incentive for Non-price Discrimination by an Input Monopolist*, 16 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 271, 272-273 (1998).

90 *See, e.g.*, the complex and still ongoing case opened before the European Commission in 2011 alleging vertical exclusion through tying by Google against a number of competitors, most notably Microsoft. Bill Rigby & Foo Yun Chee, *Microsoft Files EU Competition Compaint vs Google*, REUTERS, March 31, 2011; Stephanie Bodoni, Microsoft, *Nokia Complain to EU Over Google Mobile Dominance*, BLOOMBERG, April 9, 2013.

91 Economides, *supra* note 89, at 272; Janusz A. Ordever & Robert D. Willig, *An Economic Definition of Predation: Pricing and Product Innovation*, 90 YALE LAW JOURNAL 8 (1981).

block them.

Regardless of the way an actor chooses to foreclose competitors, exclusion can result in either a complete inability of competitors to access an essential neighboring market/ product/ service, or a hindrance that places competitors at an unfairly disadvantageous position. Under these circumstances, the excluding firm can expand its power to other segments of the market, while its competitors may be forced to exit the market, or be squeezed to only a segment of the market, or to turn to an inferior or more costly alternative.[92]

To illustrate, consider the following examples: a situation where the downstream market consists of five firms, with firm A_1 having 50% of the market and the other four firms combined the remaining 50%. The upstream market consists also of five firms, but A_1 decides to block one of them, firm B_1. Now B_1 is in a disadvantageous position because it lost a major distribution channel to consumers.[93] This situation was prominently discussed in the merger between Time Warner and Turner Broadcasting.[94] Time Warner controlled more than 40% of the programming market, whereas Turner and its affiliates controlled about 30% share in cable distribution, which would rise to about 45% after the merger. The fear was that after the merger the Time Warner conglomerate might refuse to carry programming by alternative producers thereby barring them from a large share of the market.

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92 PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THEIR APPLICATION, at ¶756b7 (2006); W. KIP VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 248-253 (2005). EU Guidelines on the Assessment of Non-horizontal Mergers Under the Council Regulation on the Control of Concentrations Between Undertakings, 2008/C 265/07, at ¶ 29-30.

93 LAWRENCE A. SULLIVAN & WARREN S. GRIMES, THE LAW OF ANTITRUST: AN INTEGRATED HANDBOOK 638 (2000). Carlton & Perloff, *supra* note 84, at 371.

94 Time Warner, Inc. et al., Proposed Consent Agreement with Analysis to Aid Public Comment, 61 FEDERAL REGISTER 50301 (1996) (where "Time Warner, Turner, TCI and its subsidiary Liberty Media Corp. have agreed to make a number of structural changes and to abide by certain restrictions designed to break down the entry barriers created by the proposed transaction.").

Moreover, if the new scale of operations allowed by the residual demand is insufficient to support B_1, B_1 may be forced to exit the market.[95] This happened to Netscape Internet browser. The Windows operating system was the bottleneck product and Internet Explorer was the competitive product, which attempted to take on the popular Netscape Navigator. Microsoft, through tying, exclusive dealing contracts and other tactics, managed to squeeze Netscape Navigator out of the Internet browsers market by, essentially, thrusting Internet Explorer on consumers.

Consider also a related hypothetical, whereby B_1 provides a technologically advanced input that both A_1 and its competitor, A_2, use. A_1 decides to integrate (or a tactic of equivalent effect) with B_1 and to block access of A_2 to B_1. Instead, A_2 can only use the technologically inferior or more costly B_2 input. With this policy A_1 manages to raise A_2's costs of production and make it less competitive. A similar effect would arise if A1, instead of blocking B_1, sells it to A_2 at a higher price (price squeeze through price discrimination).[96] Again, A_2 incurs higher cost of production compared to A_1.

In a more dynamic view of the market, exclusionary conduct can also prevent entry. If potential entrants fear that they may be prevented from using the bottleneck product or use it under discriminatory terms, they may find it difficult to compete and therefore opt not to enter.[97] The motivation for the exclusionary actor is to protect itself from competition both in the (potentially) competitive market and in the bottleneck market.

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95 Economides, *supra* note 89, passim.

96 Tirole, *supra* note 83, at 194.

97 Sullivan & Grimes, *supra* note 93, at 642; Dennis Carlton & Michael Waldman, *The Strategic Use of Tying to Create and Preserve Market Power in Evolving Industries*, 33 RAND JOURNAL OF ECONOMICS 194, 194 (2002).

In the competitive market, because, without access to the bottleneck product, potential entrants may be discouraged.[98] A possible solution to this problem would be to enter both the upstream and downstream levels of the value chain so that a new entrant can exercise full control over its production and distribution lines. But this solution can come with a considerable extra cost, both in terms of the required time for a potential entrant to prepare, and in terms of capital expenditures.[99]

In the bottleneck market, because preventing entry in one level of the value chain (the competitive segment) may hinder entrants from gaining the necessary foothold to subsequently expand in the bottleneck market as well. This is more relevant in situations where the bottleneck market requires significant investments and potential entrants would rather take a gradual approach. A good example here is the *"ladder of investment"* theory on which much of the European telecommunications infrastructure liberalization was based.[100] The ladder of investment theory expressed the idea that, because the telecommunications market is capital-intensive, entrants will only be able to expand gradually to the various layers of telecommunications services. However, this wouldn't be possible if they couldn't initially gain access to the existing infrastructure of the incumbents. For this reason, the European

98 *See* JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 185 (with internal references) (4th reprint 1990). Patrick Rey & Thibaud Verge, 378

99 Areeda & Hovenkamp, *supra* note 92, at ¶756c3. *See also* Jonathan B. Baker, *Recent Developments in Economics that Challenge the Chicago School Views*, 58 ANTITRUST LAW JOURNAL 645, 651 et seq. (1989). *Cf.* RICHARD POSNER, ANTITRUST LAW 202 (2nd ed. 2009) ("the possibility that tying might discourage entry into the monopolized market for the tying product cannot be excluded altogether."). For a judicial application *see* Town of Concord Massachusetts v. Boston Edison Company, 915 F.2d 17, at 23 ("Insofar as it is more difficult for a firm to enter an industry at two levels than at one, the monopolist, by expanding its monopoly power, has made entry by new firms more difficult.").

100 Martin Cave, *Encouraging Infrastructure Competition via the Ladder of Investmen*t, 30 TELECOMMUNICATIONS POLICY 223 (2006); WIK-Consult, Study on the Implementation of the existing Broadband Guidelines (Final Report to the European Commission, COMP/2011/006), at 163-165.

Commission mandated that incumbents offer open access to their networks (under certain conditions that were aimed to strike a fair balance between incumbents' and entrants' interests).

The exposition of the potentially negative effects of exclusionary practices described above is not meant to imply that exclusion is commonly, or much less so always pernicious for the industry. Far from it, a serious proposition that regulation to prevent or curb exclusionary practices is necessary requires proof of more than potential harm; rather, a set of other considerations must be weighted before one is ready to allow or condemn exclusionary practices. Regulators need to base their actions on an educated analysis of the harm that anticipated and possible exclusionary practices may bring upon the market. In the following pages we expose the relevant considerations on how to do that.

2.2 Necessary Structural Preconditions to Justify Regulatory Action Against Exclusion

We consider here the conditions that need to be present to make exclusion anticompetitive. We base our analysis on lessons extracted from antitrust, and its economics counterpart, industrial organization, because these are also concerned with how to properly structure a well-functioning market, and their insight can and has been used in the telecommunications market as well.

2.2.1 The Role of Antitrust in Providing Guidance on the Treatment of Exclusion

Before even going into any details, one could reasonably ask why is antitrust brought into

the picture here? What is it that antitrust has to offer to an analysis of the role of technology in exclusion in the wireless industry, that telecommunications regulation alone can't? We believe the answer lies in that both antitrust and telecommunications regulation seek to ensure a fair competitive marketplace, but antitrust does so in a more flexible way that is better suited to consider a richer set of parameters for the restraint under scrutiny, including the the various technology-related parameters that we will identify as having an influence on exclusion.[101]

Antitrust is no stranger to the issues telecommunications regulation attempts to tackle. The numerous examples of antitrust cases in the sector show that antitrust can and has addressed these concerns.[102] But telecommunications regulation and antitrust have traditionally taken different approaches in their analysis and treatment of exclusionary practices. Whereas telecommunications regulation has relied on broad prohibitions that don't require a showing of particular harm,[103] antitrust law has come up with sophisticated tests to separate harmful from innocuous (or at least tolerable) exclusion.[104] In the telephone network era the somewhat broad-sweeping mandates made more sense because of the monopolistic conditions in the market and the general economist zeitgeist which was inimical to exclusion, but these conditions do not apply today and rigid regulations akin to common carriers may not necessarily serve the

101 *See, e.g.,* National Association of Professional Engineers v. United States, 435 U.S. 679, 691 (1978) ("The true test of legality is whether the restraint imposed is such as merely regulates and perhaps thereby promotes competition or whether it is such as may suppress or even destroy competition."). Not to mention that after the 2014 Verizon case, an antitrust-inspired framework might be the Commission's only viable choice forward. *See, e.g*., James B. Speta, *Unintentional Antitrust: The FCC's Only (and Better) Way Forward with Net Neutrality after the Mess of Verizon v. FCC*, 66 FEDERAL COMMUNICATIONS LAW JOURNAL 491, *passim* (2014).

102 *See, e.g*, United States v. AT&T Co., 552 F. Supp. 131, 135-36 (1982); Verizon Communications, Inc. v. Law Offices of Curtis V. Trinko, 540 U.S. 398 (2004).

103 Verizon, 740 F.3d 623, at 633 ("[the] order imposes and anti-discrimination requirement").

104 *See infra* 2.2.2.

industry's dynamism any more.[105]

In this context, support is growing for regulation that incorporates the flexibility of antitrust analysis on the one hand, but does not necessarily completely surrender to antitrust law.[106] The Commission seems increasingly receptive to this idea, although far from fully on board. Initially, in the 2010 Open Internet Order it noted that it:

> "reject[s] the argument that only 'anticompetitive' discrimination yielding 'substantial consumer harm' should be prohibited by our rules. We are persuaded those proposed limiting terms are unduly narrow and could allow discriminatory conduct that is contrary to the public interest. The broad purposes of this rule … cannot be achieved by preventing only those practices that are demonstrably anticompetitive or harmful to consumers."[107]

However, later, in the 2014 proceeding to update the rules, although the Commission stated that "[it] understand[s] this competition inquiry to extend beyond an application of antitrust principles to include, for example, the predicted impact of practices on future competition,"[108] the

105 *See* Philip J. Weiser, *Towards a Next Generation Regulatory Strategy*, 35 LOYOLA UNIVERSITY CHICAGO LAW JOURNAL 41, 60-63 (2003).

106 This Goldilocks-like task was best captured by the D.C. Circuit's decision in the Verizon case, where the court found that the Commission had significant authority to regulate broadband networks, but not enough to impose common carrier rules. *See supra* note 103 ("Even though the Commission has general authority in this area, it may not impose requirements that contravene express statutory mandates. Given that the Commission has chosen to classify broadband providers in a manner that exempts them from treatment as common carriers, the Communications Act expressly prohibits the Commission from nonetheless regulating them as such.").

107 In the Matter of Preserving the Open Internet, Broadband Industry Practices, GN Docket No. 09-191, ¶ 78 (2010) (Report and Order).

108 *Supra* note In the Matter of Protecting and Promoting the Open Internet, GN Docket No. 14-28, ¶ 124 (2014) (Notice of Proposed Rulemaking).

anti-discrimination rules it proposed based on the "commercially reasonable" standard greatly approximated the antitrust model.[109] Further, as Weiser notes "[the Commission] is beginning to realize that its traditional reliance on proactive command and control regulation should give way as it regulates fast-moving markets that are not price-regulated or, at present anyway, dominated by an entrenched monopoly."[110]

This transition is a step in the direction of the kind of antitrust-inspired regulation that we have in mind here: one that lies between the one extreme of rigid regulation that accepts or rejects business practices on an a priori general assessment, and the other extreme of completely abandoning regulation in favor of antitrust adjudication that provides ex post remedies.[111] Such regulatory measures would be structured based on flexible rules that allow exclusion under the condition that it does not negatively affect the institutional structure of competition in the market. The construction of the rule would incorporate competition law reasoning so that it can "make 'predictive judgments' concerning practices that might result in foreclosure,"[112] and when applied in specific cases give tailored results "developed by after-the-fact judgments."[113] In the words of former FCC Chairman Reed Hundt the Commission should "decide on a case- by-case

109 *See infra* Chapter 6.

110 Weiser, *supra* note 105, at 43.

111 *See, e.g.*, PETER W. HUBER, LAW AND DISORDER IN CYBERSPACE: ABOLISH THE FCC AND LET COMMON LAW RULE THE TELECOSM (1997); Reed E. Hundt & Gregory L. Rosston, *Articulating a Modern Approach to FCC Competition Policy*, 66 FEDERAL COMMUNICATIONS LAW JOURNAL 71, 80 (2014) ("The logical conclusion of a successful and permanent implementation of the modern approach would be that the FCC, like the state in Marxist theory, could wither away because competition would provide assurances that the benefits of communications technology would be bestowed upon the masses. Indeed, in aviation and trucking, Congress decided that neither the Civil Aeronautics Board ("CAB") nor the Interstate Commerce Commission ("ICC") needed to continue to exist, because transportation had become sufficiently varied and competitive to serve public interest purposes without interventions by these agencies. So it is possible that the modern era could lead to the laissez-faire era.").

112 Speta, *supra* note 101, at 504.

113 Weiser, *supra* note 105, at 75.

basis whether to be proactive in implementing rules to force markets open to more competition," and this decision should rest on considerations such as the possibility of "adjacent market entry, divided technical leadership, or groundbreaking technological solutions ."[114]

The challenge, then, for regulators is to correctly identify and also use those relevant considerations that determine the effect of exclusionary practices.[115] Industrial organization has helped specify the economic conditions in that direction. This thesis helps adapt them to the environment of wireless telecommunications, which we find is strongly influenced by the prominent role of technology. We believe this is the right path for regulation to take if it is to see exclusion in its right proportions in the wireless telecommunications market in particular.

2.2.2 Setting Exclusion on the Right Base: Ability, Incentives, Efficiencies

Like most business practices exclusion is neither uniformly good or bad for the industry.[116] A long line of scholarship developed over the past half century has documented the ambiguous effect (and relevant conditions) of exclusion, with an overall tendency—both theoretical and empirical—to approve rather than condemn exclusionary practices.[117] Identifying those conditions hasn't been an easy task, but today there exists a large corpus of antitrust literature that analyzes and interprets exclusionary conduct, which has been endorsed by academics,

114 *See* Hundt & Rosston, supra note 111, at 87.

115 Speta, *supra* note 101, at 494 "[t]he more that the 'unreasonableness' of any discrimination is based on notions of competitive markets, the more such a rule resembles antitrust as a conceptual matter.").

116 Tirole, as early as 1988, stated that "few topics in industrial organization are as controversial as market foreclosure." Tirole, *supra* note 83, at 193.

117 James C. Cooper et al., *Vertical Antitrust Policy as a Problem of Inference*, 23 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 639 (2005).

courts, and regulatory authorities.

To a large extent, we owe the systematization of the relevant factors in analyzing exclusionary conduct to the intellectual bras-de-fer between the Harvard school and the Chicago school of industrial organization and antitrust. In the early days of modern industrial economics, under the influence of the Harvard school, exclusion, much like any restrictive business practice in the market used to be treated with hostility. This was partly attributable to the general economic zeitgeist of the first three quarters of the previous century, which was itself inimical to any market arrangement that could facilitate exclusion.[118] The prevailing economic thinking in industrial economics at the time (the Harvard School) stood—among others—for the proposition that power in one market could be leveraged to dominate upstream or downstream markets too, and so any vertical arrangement (e.g. integration, tying etc) was suspected as an attempt to expand power by disadvantaging (:excluding) competitors.[119]

This line of thought was criticized as lacking a coherent and structured methodology with pre-stated assumptions.[120] Richard Posner described the industrial organization thinking of the 1950s and 1960s as "untheoretical, descriptive, 'institutional,' and even metaphorical."[121] The growing critique against the theories of the Harvard school was best expressed by and associated

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118 For a short narrative of the "inhospitality tradition" as Donald Turner put it, *see* Frank H. Easterbrook, *The Limits of Antitrust*, 63 TEXAS LAW REVIEW 1, 4-14 (1984). *See also* ARTHUR BURNS, THE DECLINE OF COMPETITION: A STUDY OF THE EVOLUTION OF AMERICAN INDUSTRY (1936).

119 *See, e.g.*, JOE S. BAIN, BARRIERS TO NEW COMPETITION 144 et seq. (1956); CARL CAYSEN & DONALD F. TURNER, ANTITRUST POLICY: AN ECONOMIC AND LEGAL ANALYSIS 120 et seq. (1959).

120 Note, however, that the as the adherents of the Harvard School have refined and evolved their theories, a great deal of their insight into industrial organization has become very pertinent to modern economic thinking and practice. *See* Einer Elhauge, *Harvard, Not Chicago: Which Antitrust School Drives Recent U.S. Supreme Court Decisions?*, 3 COMPETITION POLICY INTERNATIONAL 58 (2007).

121 Richard A. Posner, *The Chicago School of Antitrust Analysis*, 127 UNIVERSITY OF PENNSYLVANIA LAW REVIEW 925, 928 (1979). He goes on to note that "casual observation of business behavior, colorful characterizations … eclectic forays into sociology and psychology, descriptive statistics, and verification by plausibility took the place of the careful definitions and parsimonious logical structure of economic theory." *Id*. at 929.

with scholars at the University of Chicago, who collectively gave rise to a new wave of economic thought—the Chicago School. The Chicago School, began deconstructing the somewhat unfounded fears against arrangements that facilitated exclusion by systematically and using concrete models with certain preconditions that had to be met before one could credibly say that exclusion was likely and potentially harmful.[122] The two main contributions of the Chicago School industrial economics were the codification of the conditions under which anticompetitive effects could arise, and the methodical documentation of a series of efficiencies that seemingly anticompetitive behavior could yield. Quite in contrast with the Harvard School, the rigor of the Chicago School earned it the characterization as "the most coherent and elegant ideology that antitrust has ever experienced"[123] and managed to shift judicial policy from a generally negative treatment of vertical restraints (and exclusion)—the *per se* illegal characterization—to a much more reasonable one—the *rule of reason* analysis.[124] The watershed moment was the landmark *Sylvania* case, where the Court noted that "[vertical restrictions], in varying forms, are widely used in our free market economy. … [T]here is substantial scholarly and judicial authority supporting the economic utility. There is relatively little authority to the contrary."[125]

Chicago law and economics were not impervious to criticism either. But this time the criticism was not directed at the conditions and factors deemed important by the Chicago School

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122 Herbert Hovenkamp, P*ost-Chicago Antitrust: A Review and Critique*, 2001 COLUMBIA BUSINESS REVIEW 257, 258 (2001).

123 *Id*.

124 Contrast United States v. Arnold, Schwinn & Co., 388 U.S. 365 (1967); Continental T.V., Inc. v. GTE Sylvania, Inc., 433 U.S. 36 (1977).

125 Sylvania, *supra* note 124, at 57-58.

or the lack of structure, but rather at the fact that it showed excessive confidence in the efficient operation of markets.[126] The Chicago School was seen as "oversold" in that it failed to account for market realities, such as lack of perfect information and switching costs, and in that it overstated efficiencies.[127] That said, the teachings of the Chicago school were not rejected, but rather expanded on. In the years following the Chicago School apex, post-Chicago scholars sought to point out weaknesses and enhance the models of the Chicago school, not overturn it.[128]

If one of the effects of the perennial battle for intellectual supremacy in industrial organization and antitrust analysis was to to make it more complex (something that earned it the sneering nickname "Swiss Cheese"[129]), the other one was to crystallize some basic principles that at a minimum should be met for business practices to be considered harmful.[130] The long series of developments described herein helped regulatory authorities, courts and scholars identify three main pillars on which the analysis of exclusionary conduct should rest:[131] (a) the *ability* to effectively exclude rivals; (b) the *incentives* to exclude rivals; (c) whether there are any offsetting

126 *See* Sullivan & Grimes, *supra* note 93, 632-633. *See also* Nelson, *Comments on a Paper by Posner*, 127 UNIVERSITY OF PENNSYLVANIA LAW REVIEW 949 (1979); F. M. Scherer, *The Posnerian Harvest: Separating Wheat from Chaff* (Reviewing Antitrust Law: An Economic Perspective by Richard Posner), 86 YALE LAW JOURNAL 974 (1977).

127 Hovenkamp, *supra* note 122, at 267 ("The Chicago School contribution to antitrust did two things. First, it gave us much that was useful. Second, it was oversold.").

128 *See generally* Herbert Hovenkamp, *Antitrust Policy After Chicago*, 84 MICHIGAN LAW REVIEW 213 (1985).

129 PETER KRASS, CARNEGIE 258 (2003). *See also* Chris Sagers, Proliferating Rules of Per Se Legality in Antitrust: The Great Swiss Cheese and the Myth of Theoretical Unification, Cleveland-Marshall Legal Studies Paper No. 09-177, *available at* http://ssrn.com/abstract=1468001.

130 Today, despite some persisting differences, the two schools of thought are closer than in the past. *See* Areeda & Herbert Hovenkamp, Antitrust Law: An Analysis of Antitrust Principles and Their Application ¶ 927 (2nd ed. 2000) ("the Harvard School has moved rightward, closer to the Chicago position, while at least some Chicago School members have moderated their position to the left."). In the California Dental Association case the Court distanced itself from a rigid standard (either a Chicago or a Harvard one), while adopting a "sliding scale" of different levels of scrutiny on a per case basis. See California Dental Association v. Federal Trade Commission 526 U.S. 756, 780 (1999).

131 Sullivan & Grimes, *supra* note 93, at 415-418, 667-670.

efficiencies that justify the exclusionary action.

Although the concepts will be analyzed in detail in the following chapters, we should pause and define them briefly here. The ability to exclude refers to an actor's ability to foreclose a substantial line of commerce (in given product and geographical markets), in other words ability is the showing of potential anticompetitive harm in the industry.[132] Blanket regulatory prohibitions to prevent minor exclusionary practices would not be compatible with the tradition of industrial organization and antitrust.[133] An antitrust-like approach is more about protecting the *institutional process of competition*, and less about protecting each individual competitor no matter how small or insignificant, with the risk of protecting the tree rather than the forest.[134] One of the main parameters tied to ability is market share. In the Harvard School tradition the source of all evil in industrial organization was market concentration (i.e. large market shares), which granted firms the power to dictate the terms of the game.[135] Market concentration continues to

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132 *See, e.g.*, United States v. Brown University, 5 F.3d 658, 668 (1993) ("The rule of reason requires the fact-finder to weigh all of the circumstances of a case in deciding whether a restrictive practice should be prohibited as imposing an unreasonable restraint on competition. The plaintiff bears an initial burden under the rule of reason of showing that the alleged combination or agreement produced adverse, anti-competitive effects within the relevant product and geographic markets.").

133 *See among others*, Alberta Gas Chemicals, Ltd. v. E. I. Du Pont de Nemours & Co.,826 F.2d 1235, 1244-1246 (1987) (reviewing market shares of previous cases to prove that a substantial line of commerce must be affected by the alleged foreclosure); United States Steel Corp. v. Federal Trade Commission., 426 F.2d 592; PHILIP AREEDA & DONALD TURNER, ANTITRUST LAW, at ¶ 335.2f (1986 Supp.) ("the foreclosure argument has grave weaknesses; only where foreclosures reach monopolistic proportions—or threaten to do so—does a vertical merger become troublesome"); William H. Page, *Antitrust Damages and Economic Efficiency: An Approach to Antitrust Injury*, 47 UNIVERSITY OF CHICAGO LAW REVIEW 467, 495 (1980).

134 In the European Union where exclusionary practices in telecommunications at the European level are dealt with as part of the general article 102 of the Treaty on the Functioning of the European Union, the Commission has explicitly stated that that "what really matters is protecting an effective competitive process and not simply protecting competitors" and that "the aim of the Commission 's activity in relation to exclusionary conduct is to ensure that dominant undertakings do not impair effective competition by foreclosing their competitors in an anti-competitive way, thus having an adverse impact on consumer welfare." Communication from the Commission – Guidance on the Commission 's Enforcement Priorities in Applying Art. 82 of the EC Treaty to Abusive Exclusionary Conduct by Dominant Undertakings, ¶ 6, 19 (2009/C 45/02).

135 F. M. SCHERER & DAVID ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE (3rd ed. 1990).

play an important role today, as market structure and performance are interwoven, and large market shares (:high concentration) are an *indication* of poor market performance.[136]

However, market share alone only captures a narrow tranche of the conditions in the market because it doesn't account for the responses of (potential) competitors or consumers.[137] The ability requirement was therefore gradually enriched with additional factors. The most important one is entry barriers, which determines how easily new firms can enter the market. When entry barriers are low, entry is expected to erode large market shares, and consequently no market power can persist long enough to harm the process of competition in the market.[138] Furthermore, the effectiveness of business practices, including exclusion, is delimited by how consumers will react to them, and in particular by the possibility that they will turn to a competing product in response to exclusionary practices.[139] For example, if firm A_1 discriminates against input B, then consumers may decide to turn to firm A_2 to gain unobstructed access to input B, if A_2 provides access to B. Further analyses linked ability to additional factors that take into account strategic interactions between the firm that attempts exclusion and its rivals and customers, which still,

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136 Herbert Hovenkamp, *The Rationalization of Antitrust* (Reviewing Richard Posner's Antitrust Law (2nd ed. 2001), 116 HARVARD LAW REVIEW 917, 920 (2003); Carlton & Perloff, *supra* note 84, at 247.

137 R. J. Reynolds Tobacco Co. v. Philip Morris,199 F. Supp. 2D 362, 383 ("[a] mere showing of substantial or even dominant market share alone cannot establish market power sufficient to carry out [an anticompetitive pricing] scheme. The plaintiff must show that new rivals are barred from entering the market and show that existing competitors lack the capacity to expand their output to challenge the [defendant's] high price. ").

138 *See, e.g.*, Anti-Monopoly, Inc. v. Hasbro, Inc., 958 F. Supp. 895, 904 (1997) ("Unrebutted evidence that actual competitors have entered the market is a strong indicator that [the defendant] lacks market power."); Tampa Electric Co. v. Nashville Coal Co., 365 U.S. 320 (1961); Jefferson Parish Hospital District No. 2 et al. v. Edwin G. Hyde Citations 466 U.S. 2 (1984). Among the cases that most notoriously disregarded the market power factor is Brown Show Co., Inc. v. United States, 370 U.S. 294 (1962). *See also* EU Guidance on the Commission's Enforcement Priorities in Applying Art. 82, at ¶ 30, where the European Commission stresses that "where there is no residual competition and no foreseeable threat of entry, the protection of rivalry and the competitive process outweighs possible efficiency gains."

139 Carlton & Perloff, *supra* note 84, at 612. *See also* KATERINA MANIADAKI, EU COMPETITION LAW, REGULATION AND THE INTERNET: THE CASE OF NET NEUTRALITY 168-181 (2014).

however, required some measure of market power.[140] These factors, taken together, suggest that the ability to exclude is not simply a matter of size. Not only isn't market share the only parameter that endows firms with the ability to exclude, but the response of other market players, including rivals and consumers, is also decisive in placing limits to exclusionary power.

Moreover, the ability to exclude does not in and of itself suffice to raise concerns of anticompetitive harm. The possible *incentives* to exclude should also be taken into account. Regulatory authorities have shown willingness to do so, especially when scrutinizing vertical mergers that are deemed likely to result in vertical exclusion.[141] Assessing incentives means that it should not be taken for granted that ability to exclude equals implementation. If the underlying market power is the result of innovation, efficiency or meeting consumer demand, it doesn't automatically follow that it will be used to exclude rivals with the purpose of extending or maintaining power. Further, it is not always in firms' best interest to block out other players in the market, because cooperation among firms can produce important benefits for the involved parties.

Lastly, the motivation behind exclusion is also important, which brings us to the issue of efficiencies. If a seemingly anticompetitive act can be explained on grounds other than the desire

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140 Michael Riordan & Steven A. Salop, *Evaluating Vertical Mergers: A Post-Chicago Approach*, 63 ANTITRUST LAW JOURNAL 513, 518 (1995). *See also* Maniadaki, *supra* note 139 at 182-183.

141 *See, e.g.*, FCC, In re Applications of Ameritech Corp. and SBC Communications Inc. for Consent to Transfer Control of Corporations Holding Commission Licenses, Memorandum Opinion and Order, CC Docket No 98-141 (October 6, 1999) (where the Commission highlighted the need to "analyze the incentive and ability to discriminate ... with respect to competitors providing advanced services, interexchange services, and local exchange services in the SBC and Ameritech regions."); Richard G. Parker, Senior Deputy Director, Bureau of Competition, Federal Trade Commission, Address Before the International Bar Association (Sept. 28, 1999) (where Parker commenting on the cancelled vertical merger between Barnes&Noble and Ingram explained the emphasis the FTC placed on the incentives to raise rivals' cost: "As I already suggested, the question we ask is whether the newly vertically-integrated company will have an incentive (and, of course, the ability) to raise the costs of its rivals.").

to harm rivals, then the presumption of exclusionary incentives must be tested. As early as 1899 Justice Taft distinguished between naked and ancillary restraints of commerce, the difference being that ancillary restraints were not grounded on anti-competitve incentives, but rather sought to promote legitimate objectives, and should therefore not automatically be condemned.[142] After all, it has traditionally been recognized that even monopoly power does not itself violate antitrust laws.[143] Industrial economics and antitrust are all about protecting the competitive process, through which innovation and progress emerge. Under that light, even prima facie anticompetitive acts can be excused if they are tied to offsetting *efficiencies*, which enhance performance, lower costs, or induce technological change.[144] The efficiencies defense is now universally accepted, even though in practice they have proven somewhat elusive.[145]

These three pillars form the minimum basis because they refer to factors that are both common to all exclusionary practices, and de minimis necessary to make an educated assessment. This means that these factors may not always be *sufficient*, but they are in any case *necessary* as the least common denominator that needs to be considered before regulators can credibly say that exclusionary practices pose enough of a concern to warrant regulatory action. Other factors can also be important, but tend to pertain to specific types of exclusionary conduct.

142 *See* United States v. Addyston Pipe & Steel Co., 85 F. 271 175 U.S. 211 (1899).

143 *See e.g.*, Standard Oil Co. v. United States, 221 U.S. 1, 62, 75-77 (1911). More recently in Verizon Communications, Inc., v. Law Offices of Curtis V. Trinko, LLP, 540 U.S. 398, 407 (2004) the Court noted that the pursuit of "monopoly prices ... is an important element of the free-market system. ... It is what attracts 'business acumen' in the first place ... ."

144 *See* In re IBM Peripheral EDP Devices Antitrust Litigation, 481 F. Supp. 965, 1005 (N.D. Cal. 1979) (holding that IBM did not violate section 2 by tying its computer central processing unit to its peripheral devices, because the combination resulted in an improved design), affid sub nom. Transamerica Computer Co. v. International Business Machines Corp., 698 F.2d 1377 (1983). *See also* Guidance on the Commission's Enforcement Priorities in Applying Art. 82, supra note 138, ¶ 46 et seq.

145 U.S. Department of Justice & Federal Trade Commission, Horizontal Merger Guidelines, at ¶ 10 (where it is acknowledged that "efficiencies are difficult to verify and quantify" and that "efficiency claims will not be considered if the are vague, speculative or otherwise cannot be verified by reasonable means.").

For example, to prove anticompetitive tying one would have to provide, among others, evidence that the tied product is one that consumers would not purchase, were it not for the tying.[146] This condition is not relevant in other forms of exclusion. To the contrary, to properly assess either a specific case of tying or the need to promulgate ex ante industry-specific rules on tying, the ability to execute a tying strategy with possible anticompetitive effects, the incentive to do so, and whether the strategy is justified by efficiencies would still be relevant.

The ability-incentives-efficiencies framework may have its roots in an academic debate as traced above, but its relevancy remains unabated in the context of regulatory activity. As Geradin and Sidak have put it "there are interactions between antitrust and sector-specific regulations and these have to be taken into account when addressing the issue of remedies."[147] The European Commission's Non-Horizontal Merger Guidelines have succinctly summarized the triptych vis-a-vis exclusionary practices thusly:

> "In assessing the likelihood of an anticompetitive input foreclosure scenario, the [European] Commission examines, first, whether the merged entity would have, post-merger, the *ability* to substantially foreclose access to inputs, second, whether it would have the *incentive* to do so, and third, whether a foreclosure strategy would have a significant detrimental effect on competition downstream

146 Jefferson Parish Hospital District No. 2 v. Hyde, 466 U.S. 2 (1984).

147 Damien Geradin & J. Gregory Sidak, *European and American Approaches to Antitrust Remedies and the Institutional Design of Regulation in Telecommunications*, *in* HANDBOOK OF TELECOMMUNICATIONS ECONOMICS: VOLUME II 517, 519 (Sumit K. Majumdar et al., eds 2003). They conclude that that the prophylactic approach of regulatory authorities considers "the probability of anticompetitive behavior in the absence of the prior restraint … the magnitude of the harm from such behavior … the the likelihood and magnitude of offsetting efficiency justifications … and the danger of false positives." *Id*.

[author's note: this is where the Commission examines efficiencies].” (internal references omitted).[148]

Similarly, the US Department of Justice Horizontal Merger Guidelines also reference ability and incentives as factors to look at in assessing the likelihood that a merger will have a negative impact on the market, while they devote a separate section to efficiencies.[149] The Commission has also used this framework when, for example, it explicitly structured the 2010 Open Internet Order around documenting in separate sections both the ability and the incentives of operators to exclude and discriminate against rivals, and it used efficiency justifications in carving out the limitations its rules.[150] The Commission has also analyzed ability, incentives and efficiencies in merger reviews.[151]

The triptych distilled by industrial organization and antitrust has also been highlighted by scholars, notably by Yoo who analyzes network neutrality under the lens of vertical exclusion tools.[152] He notes that vertical exclusion requires market power both in the primary and the secondary market (:ability), that “even when the market is structured in a way that allows firms to exercise leverage over vertically related markets, those firms generally lack the incentive to do so,” and that “vertical integration and vertical restraints can be the source of substantial

148 EU Guidelines on the Assessment of Non-horizontal Mergers, *supra* note 92, at ¶ 32

149 Horizontal Merger Guidelines, *supra* note 145 *passim* (2010);

150 2010 Open Internet Order, *supra* note 107, at ¶ 20-35, 80-93.

151 *See*, *e.g.*, BC Communications Inc./Ameritech, Memorandum Opinion and Order, FCC 99-279, 14 FCC Rcd. 14712, 14742 (“the proposed merger also would increase the incentives and ability of the larger merged entity to discriminate against rivals in retail markets where the new SBC will be the dominant incumbent LEC.”).

152 *See* Christopher S. Yoo, *What Can Antitrust Contribute to the Network Neutrality Debate*, 1 International Journal of Communication 493, 504-409 (2007).

efficiencies."[153] Similarly Weiser advocates for a model of regulation that balances the ability to foreclose, with the redeeming effect of the restraint (:efficiencies), and calls for the taking into account of the internalizing complementary efficiencies theory (ICE), which reflects "an often underappreciated principle, [that] even a platform monopolist has a powerful incentive to attract compatible applications to its platform."[154]

What this thesis will now attempt to do is explore the ways by which the central role of technology in the wireless telecommunications industry informs the meaning and applicability of the triptych as identified in this chapter. We will show that the high technology infrastructure of wireless industry negatively affects the ability to perform exclusion that is likely to have anticompetitive effects; positively affects co-opetitive incentives, and results in systemic efficiencies that maybe have remained under-appreciated.

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153 *Id*. *See also* Easterbrook, *supra* note, 118 at 19 et seq.

154 Weiser, *supra* note 105, at 71, 75 et seq.

3 . Technological Competition and the Ability to Exclude

As evidenced by the consensus reached in industrial economics and antitrust over the past few decades, exclusionary practices are not always harmful to the degree that would justify either an ex ante (regulatory) or an ex post (adjudicatory) response. To be sure, exclusion is always harmful to the firm that is being excluded. This cannot, however, the basis for regulation.

To the extent that one accepts that the purpose of regulation is not to protect every individual player in the market, but rather fair competitive conditions as an institutional process, exclusionary practices need to go beyond the occasional nuisance of a competitor in order to justify a the enactment of rules that will apply across the market.[155] For this reason, regulatory response in the market is warranted in so far as the probability and magnitude of exclusionary practices threaten the general wellbeing of the market and not just that of individualized players.

Therefore, while theoretically any firm in the market can choose to exclude or discriminate against inputs or distribution channels, some measure of power capable of having a dent in the market would be required to say that exclusion disrupts the normal operation of the industry.[156] For cases of more limited scale the expectation is that, because the competitive process remains intact, existing firms or potential entrants stand ready to offer what the excluding actor has denied the market, and sooner or later the pressure from the general competitive conditions will

155 LAWRENCE A. SULLIVAN & WARREN S. GRIMES, THE LAW OF ANTITRUST: AN INTEGRATED HANDBOOK 21 (2000); Frank H. Easterbrook, *The Limits of Antitrust*, 63 TEXAS LAW REVIEW 1, 20 (1984).

156 *See* DANIEL SPULBER & CHRISTOPHER S. YOO, NETWORKS IN TELECOMMUNICATIONS: ECONOMICS AND LAW 144 (2009); EU Guidelines on the Assessment of Non-horizontal Mergers Under the Council Regulation on the Control of Concentrations Between Undertakings, 2008/C 265/07, at ¶ 22.

discipline the pathogenic actor.[157] It would indeed be disproportionate and overzealous to impose general rules across the industry as a means to combat either isolated cases or a multitude of cases which however affect a negligible part of the market.

To the contrary, when a harmful practice is expected to have a sizable impact on the industry, either because a single powerful actor is engaging in it, or because multiple actors collectively (but independently—we are not raising a cartel issue here) are engaging in it, then regulatory measures might be necessary to prevent them. This doesn't mean that blanket obligations or prohibitions are necessarily the right path, unless, as explained in Chapter 2, the probability and magnitude of exclusionary practices is such that they by and large inflict harm on the market, and so in depth analysis would be a waste of resources. Rather, a good rule will be in the position to assess the specific conditions under which the exclusionary practice under scrutiny arises. This way, not only aren't unnecessary rules enacted, but when they do, they do not apply where it is not necessary.

In both cases, ability becomes a relevant and important factor because it determines the scale or magnitude of the effect that exclusion will have on the industry, which in turn weighs in in the justifiability of regulatory action. The question that comes next from here is how should one construe this kind of ability; what are the indicia someone would have to look for to make a determination that the wireless telecommunications market is structured in a way amenable to the build-up of market power that could support harmful exclusion, or that a particular case of exclusion has the potential to negatively affect the industry.

The inquiry, as industrial organization and antitrust theory and practice have systematized,

157 Easterbrook, *supra* note 155.

goes beyond the simplistic market share factor, to include additionally both demand and the supply side considerations, as well as the dynamic element of industry evolution. These parameters, while comprehensive, have remained largely industry-agnostic, meaning that at an abstract and theoretical level they apply equally to any industry. But to make them more relevant to the wireless industry one needs to account for the technological aspects of it, because this component is prevalent in the wireless industry. The purpose of this chapter is to show how the technological realities of the wireless industry co-determine the ability of industry players to amass market power and then use it to effectively exclude or discriminate against inputs or distribution channels along the value chain.

The analysis shows that—overall—technology has a facilitating effect on entry and vertical competitive pressures, as well as on the ability of end users and service, content and application providers to bypass bottlenecks and connect to each other. At the same time theoretical and empirical evidence on the technological dynamism of the industry point to frequent shifts in power balance making strict regulatory oversight potentially anachronistic. This means both that the adoption of anti-exclusion rules has to meet a higher standard, and that particular cases of exclusion may not be as pernicious as a mainstream analysis may suggest.

We discuss here ability only as the first parameter of the overall assessment of exclusion in the wireless telecommunications industry, the other two being the incentives to exclude and the relationship between exclusionary practices and efficiencies. Ability is probably the most important factor, because without it, not only is there no actual manifestation of harmful effect on the market, but there is also no threat thereof. To the contrary, if the industry structure is such that would allow exclusionary practices capable of disrupting the normal competitive process,

the incentives to engage in it could arise any time, and therefore there is at least an abstract possibility looming over the industry, which could make market players and regulators more eager to act. Still, incentives and efficiencies remain essential parts of the discussion and will be analyzed below in Chapters 4 and 5 respectively.

3.1 STRUCTURAL PREREQUISITES FOR ANTICOMPETITIVE EXCLUSION

The ability to engage in anticompetitive exclusion—the kind that warrants regulatory action—comprises a set of factors that collectively determine whether actors have the necessary power in that direction. These factors (demand and supply side considerations, and durability of power) are sourced from industrial economics and antitrust, because these fields study the structure of the industry and the impact of business practices on other players in the industry. We then enrich them with technological arguments which we believe better capture the realities of the wireless telecommunications market.

The starting point to determine ability is market power. Although market power is usually defined as the ability of an actor to raise prices by a substantial degree and in a non-transitory manner,[158] market power can also manifest itself in non-price ways; strategic behavior, such as exclusion, also presupposes and is the result of market power.[159]

Market power itself is not frowned upon,[160] and so the practices it enables must it associated

158 Richard G. Price, *Market Power and Monopoly Power in Antitrust Analysis*, 75 CORNELL LAW REVIEW 190, 192-195 (1989).

159 HERBERT HOVENKAMP, FEDERAL ANTITRUST POLICY: THE LAW OF COMPETITION AND ITS PRACTICE 88 (4th ed 2011); Sullivan & Grimes, *supra* note 155, at 29-30.

160 *See* Standard Oil Co. of N.J. v. United States, 221 U.S. 1, 62 (1911); United States v. Grinnell Corp., 384 U.S. 563, 570-571 (1966).

with anti-competitive harm. In the case of a price increase, the harm is that consumers have to pay more for the same product or service. In the case of exclusion, the potential harm can either be the raising of competitors' costs,[161] or the inability of competitors or complements to reach necessary inputs or distribution channels, which in turn impairs the dynamic element of competition and suppresses sources of competition and innovation.[162]

The market power requirement and its relation to exclusion were summarized well in the classic Lorain Journal case.[163] The *Journal*, a newspaper published in Lorain, Ohio, where it enjoyed a 99% market share, refused to accept any local advertisements coming from agents who also advertised in WEOL, a local radio station, which was perceived by the Journal to compete in the news dissemination market. The Court analyzed the market conditions and concluded that the Journal's prominent position in the market made it "an indispensable medium of advertising."[164] Therefore, the Journal's decision to block advertisers who cooperated with WEOL had a detrimental effect both to them and to the prospects of competition in the Lorain market, because other entrants (such as WEOL) were denied access to advertising revenues. Had the Journal not enjoyed such a dominant position, it wouldn't have been able to extort advertisers; they would simply turn to the Journal's competitors.

In the Lorain case the ability to exclude was attributed to the newspaper's near-monopoly market share. The Journal had a 99% penetration rate and the fact that it sustained such high market share from 1933 until 1948 convinced the Court that it lacked serious competition which

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161 *See, e.g.*, Thomas G. Krattenmaker & Steven C. Salop, *Anti-competitive Exclusion: Raising Rivals' Costs to Achieve Power over Price*, 96 YALE LAW JOURNAL 209, 234-238 (1986).

162 KIP W. VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 93-96 (4th ed. 2005).

163 Lorain Journal Co. v. United States, 342 U.S. 143 (1951).

164 *Id*. at 152.

made exclusion effective and persistent. But market share, albeit a helpful first indicator, is no longer relied on exclusively to determine the competitive advantage of a firm in the market. Other indexes come into play in establishing that an actor has accumulated the kind of feared influence over the market that would allow him to block out potential rivals.[165]

Today standard market analysis will insist on certain structural characteristics before it can conclude that the market's structure is such that firms can amass enough power to harm through exclusion the competitive process in the market. In particular firms must possess *substantial* and *non-transitory* power in a *given market*, which they would then leverage to exclude complements or rivals.[166] The "substantial" element tells us the degree of power, which is determined by proxies such as market share, the degree of the ability to raise price or to (afford to) exclude.[167] The measurement itself (whether it reaches up to the *substantial* level) is an empirical question and is outside the scope of the analysis here. The "non-transitory" element dictates that the identified market power must be durable, whereas the "given market" element means that power is assessed within certain market boundaries. Market boundaries are delineated by demand and supply substitution (elasticities of demand and supply).

These factors, while they may seem sufficiently separate, are intertwined. The degree of market power ("substantial") cannot be measured unless the market has been defined ("given market"), which in turn presupposes knowing the demand and supply substitution conditions. To conclude, to say that an actor's *ability* to exclude can inflict competitive harm one must prove (a)

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165 *See generally* the seminal article by William Landes & Richard Posner, *Market Power in Antitrust Cases*, 94 HARVARD LAW REVIEW 937 (1981).

166 Sullivan & Grimes, *supra* note 155, at 23-24. Hovenkamp, *supra* note 159, at 88-89. *Cf.* U.S. Department of Justice & Federal Trade Commission, Horizontal Merger Guidelines, at ¶ 4.1.2 (2010).

167 *See* Sullivan & Grimes, *supra* note 155, at 59-70 (where the authors discuss the different proxies and parameters that are taken into account when measuring market power).

that supply side substitution is low, (b) that demand side substitution is difficult, and (c) that these conditions can hold for an appreciable duration of time.

3.1.1 Supply Side Considerations

Supply side substitution (also known as supply elasticity) is the measure that determines the *response of competitors* to a certain action.[168] It can mean that an action attracts new entry by competitors, or that it causes countermeasures by existing competitors.[169] So, supply side substitution can be measured either as a parameter of market definition (i.e. anticipated responses by competitors) or as a parameter of entry barriers (i.e. potential entry).

Assume a downstream firm that excludes an upstream input with the goal to deny it of a distribution channel making it more costly for it to reach consumers. This strategy cannot be successful if the downstream firm's rivals are ready to offer a distribution channel to the input or if the input provider expands into the downstream market itself.[170] Consider also the opposite situation where a downstream firm excludes its competitors from accessing a cost-saving input with the goal to make them less competitive by raising their costs ("cost" here is used generically to denote any competitive advantage).[171] For this strategy to work one must assume that the input

168 Hovenkamp, *supra* note 159, at 118-119, 123.

169 *Cf.* Merger Guidelines, *supra* note 166, at ¶ 5.1, 5.2 and 9 (where it is proposed that the response by competitors should be assessed inter alia based on timeliness, likelihood and sufficiency).

170 Krattenmaker & Salop, *supra* note 161, at 254.

171 This in turn presupposes that the input supplier has an interest in partnering only with the exclusionary downstream firm, and for this to be profitable for the input supplier that downstream firm must possess a rather large market share. *See* Malcolm B. Coate & Andrew N. Kleit, *Exclusion, Collusion, and Confusion: The Limits of Raising Rivals' Costs*, Federal Trade Commission Working Paper No. 179, at 8-14 (1990). *See also* Thomas G. Krattenmaker & Steven C. Salop, *Analyzing Anticompetitive Exclusion*, 56 ANTITRUST LAW JOURNAL 71-89 (1987). This problem disappears if the upstream and downstream firms integrate.

market it protected by entry barriers so that no other cost-saving input available to competitors can join.[172] In effect, if whenever an actor attempted to dominate the market or exercise his power, new actors entered the market or existing actors reacted with a competitive strategy, the effectiveness of anti-competitive strategies would be limited, even to the point that anticipation of countermeasures would eclipse the incentive behind them.[173]

Supply side substitution was not always a relevant consideration in analyzing market structure. One of the first cases to explicitly take it into account was Telex Corp. v. IBM Corp., where the issue was whether IBM monopolized the market for "plug-compatible" peripherals.[174] To assess this the court had to define the market, and, by extension, IBM's competitors. The district court defined the relevant market as *IBM plug-compatible* peripherals under the rationale that non-compatible peripherals could not be used by users of IBM machines.[175] The circuit court reversed the decision opining that producers of non-compatible peripherals could switch to producing compatible peripherals, and that they could use cheap adaptors to make non-compatible peripherals compatible.[176] In effect the circuit court expanded the competitors list to include not only direct and existing competitors, but also potential competitors that could switch from neighboring markets. Under this analysis, the effect of IBM's exclusionary strategy was limited also by firms that initially were not direct competitors (due to incompatibility) but could become such in response to IBM's actions.

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172 Coate & Kleit *supra* note 171, at 7.

173 "Ease of Entry" is now considered a standard defense in mergers. *See* Sullivan & Grimes, *supra* note 155, at 603-608.

174 Telex Corporation v. International Business Machines Corporation, 510 F.2d 894 (1975). *See* similarly in Europe Europemballage Corporation and Continental Can Inc. v. Commission, ECR 215 (1973).

175 Telex Corporation v. International Business Machines Corporation, 367 F. Supp. 258, 276 et seq. (1973).

176 Telex Corporation, *supra* note 174, at 919.

By factoring in all the potential competitive sources one is in a better position to assess the true power of an actor. The question is who counts as a potential competitor that can counterbalance exclusionary practices.[177] A credible intention to compete as well as the technical expertise to do so are essential. We examine below the issue of how the technology-intensive nature of mobile telecommunications helps with the emergence of more sources of competitive pressure that can serve as a backstop to the intention or effect of exclusion.

3.1.2 Demand Side Considerations

Demand side substitution refers to the degree of substitutability of a product or service in consumers' eyes.[178] In economics this factor is called cross-price elasticity and it reflects the rate at which *consumers switch* to a competing product in response to a price increase.[179]

In the case of exclusion in telecommunications where many products and services act as multi-sided platforms, substitutability means the ability of end users *or* developers to turn to a product or service similar to that which is excluded. Because in telecommunications the end user experience is the combination of consecutive platforms and inputs, substitutability can be the result of either switching to a competitor of the exclusionary intermediary or to a competitor of the excluded input. For example, if Apple blocks an application on the iPhone, demand side substitutability is the extent to which end users can switch to a similar application or to a

177 *See* Hovenkamp, *supra* note 159, at 22.

178 Hovenkamp, *supra* note 159, at 101.

179 For a famous application of this factor in antitrust *see* United States v. E.I. du Pont de Nemours & Co, 51 U.S. 377 (1956).

competing mobile operating system/phone.

The fact that in network industries it is oftentimes hard or impossible to find a comparable product or service to switch to, because of the powerful network effects does not detract from the theory, but it can make it less relevant in assuaging anticompetitive concerns. In the example above if Apple blocks Skype, the fact that there are several other video-call/chat applications doesn't automatically mean that they serve the purposes of substitution, because Skype's installed base, non-interoperability with other applications, and user expectations around it make it unique even within the market of video-call/chat market.

Consequently, from the perspective of demand side, the effectiveness of exclusion is analogous to the extent of both the market power the excluding actor holds and the number and qualities of the remaining players in the market. Effective exclusion would mean either that there are no (comparable) competitors to whom end users or developers can switch, or that there are, but something prevents end users or developers from switching. The former describes a situation where there is a dominant (even monopolist) player. The latter can be attributable to various reasons including high switching costs, the technical inability to use the substitute (e.g. because of incompatibility), behavioral considerations (e.g. brand loyalty especially in the case of a primary product and a complement both of which can be supplied by the same firm), and the inability to reach competitors or substitutes because they are in different geographical markets (this is true even on telecommunications networks, where some services are available only to users from a specific country or region). Absent these factors, sufficient players remain to which users can switch, and consequently exclusion can hardly be the source of competitive harm.[180]

180 Sullivan & Grimes, *supra* note 155, at 631

3.1.3 Durability of the Competitive Advantage

The observation that the structural conditions for effective exclusion are present is still not conclusive evidence that competitive harm in the market can occur. The observed conditions that give rise to market power can simply be the fortunate confluence of factors such as shocks in supply and demand, changes in consumer taste, or the introduction of a new technology in the market.[181] Such factors are ephemeral and can lead only to spikes of market power, which is naturally bound to attenuate when the factors that gave rise to it disappear.[182] On the other hand, market power can be attributable to more resilient factors, such as industry concentration (and the concomitant collusion and suppression of competition) and entry barriers, which are stronger indications that market power may persist.[183]

To be a source of concern the structural conditions underlying exclusion must be non-transitory.[184] The element of market power persistence should not be taken for granted, because the assumption in competitive markets is that the buildup of chronic market power is a disequilibrium phenomenon, and that the amassed market power is expected to dissipate thanks to the pressure coming from existing competitors or new entrants.[185] Therefore, to reach an

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181 Robert Jacobsen, *The Persistence of Abnormal Returns*, 9 STRATEGIC MANAGEMENT JOURNAL 415, 415 (1988).

182 *Cf*. Merger Guidelines, *supra* note 166, at 5.2 (where it is acknowledged that market shares can understate or overstate a firm's actual power, and that historical data must be taken into account to determine whether the observed market share is transient or persistent).

183 Jacobsen, *supra* note 181, at 417.

184 A common proxy for market power is *persistent* high profits, whereas anecdotal evidence of supra-competitive profits does not suffice. *See* Sullivan & Grimes, *supra* note 155, at 2.2.

185 *See, e.g.*, Thomas G. Krattenmaker, *Monopoly Power and Market Power in Antitrust Law*, 76 GEORGETOWN LAW JOURNAL 241, 248-250 (1987).

informed conclusion on the persistence of market power underlying potential exclusion, one must consider any conditions that might accelerate the attenuation of market power along with those factors that sustain it. We propose below that the technology-intensive nature of the wireless telecommunications market indeed brings together factors that increase the competitive forces in the industry making the maintenance of the ability to exclude more challenging.

That said, the durability argument as presented here does not suggest that complete inaction is the appropriate regulatory policy under the assumption that market imperfections will eventually self-rectify. Nor that transient market power is incapable of disadvantaging competitors or of having some degree of negative impact on the market, and in that sense be of competitive significance. But we do note that some industries evolve faster than others, and that the heightened technological dynamism of the wireless industry (as evidenced infra in 3.2.3.2) and the possibility of market power dissipating faster, should be kept in mind when assessing the risk of competitive harm.[186]

Also, the fact that the durability parameter cannot be translated into a specific time horizon does not make it irrelevant. One of the great downsides of regulation and adjudication is that both are very resource-intensive, time-consuming, and maybe most importantly irreversible.[187] As Judge Easterbrook noted in the antitrust context "judicial errors that tolerate baleful practices are self-correcting, while erroneous condemnations are not."[188] Similarly the Federal Trade Commission has noted in its 2007 Broadband Connectivity and Competition Policy Report that

186 *See, e.g.*, Douglas H. Ginsburg and Joshua D. Wright, *Dynamic Analysis and the Limits of Antitrust Institutions*, 78 ANTITRUST LAW JOURNAL 1, 22 (2012).

187 *See, e.g*, Robert W. Hahn & John A. Hird, *Costs and Benefits of Regulation: Review and Synthesis*, 8 YALE JOURNAL ON REGULATION 233 (1991).

188 Easterbrook, *supra* note 155, at 3.

> "[e]ven if regulation does not have adverse effects on consumer welfare in the short term, it may nonetheless be welfare-reducing in the long term, particularly in terms of product and service innovation. Further, such regulatory schemes inevitably will have unintended consequences, some of which may not be known until far into the future. Once a regulatory regime is in place, moreover, it may be difficult or impossible to undo its effects."[189]

The decision to regulate and "condemn" certain practices should be predicated on the conviction that they won't go away on their own within an—admittedly arbitrary—time projection, and the argument advanced here essentially cuts in the direction of supporting such a conviction. Otherwise, a premature or erroneous intervention to rectify perceived anticompetitive conduct will cause the benefits of a potentially beneficial strategy to be lost for good, whereas allowing potentially harmful conduct should pass the test of time before regulatory authorities or courts are convinced that it will not go away without intervention.

3.2 THE TECHNOLOGY COMPONENT IN THE STRUCTURAL PREREQUISITES OF ANTICOMPETITIVE EXCLUSION

The conditions presented above are not immutable from industry to industry. The special

189 FTC Staff Report, Broadband Connectivity & Competition Policy, at 11 (2007), *available at* http://www.ftc.gov/sites/default/files/documents/reports/broadband-connectivity-competition-policy/v070000report.pdf. Commissioner Ohlhausen of the Federal Trade Commission has also remarked that "[b]ecause it is so difficult to predict the future of technology, government officials, like myself, must approach new technologies and new business models with a significant dose of regulatory humility. ... And we must remain conscious of our limits ... Even worse, data-driven decisions can seem right while being wrong. Political polling expert Nate Silver notes that "[o]ne of the pervasive risks that we face in the information age ... is that even if the amount of knowledge in the world is increasing, the gap between what we know and what we think we know may be widening." Regulatory humility can help narrow that gap." Remarks of Maureen K. Ohlhausen, Commissioner, U.S. Federal Trade Commission, The Procrustean Problem with Prescriptive Regulation, Sixth Annual Telecom Policy Conference, Free State Foundation (Washington, D.C. Mar. 18, 2014), *available at* http://www.ftc.gov/system/ files/documents/public_statements/291361/140318fsf.pdf.

characteristics of a given industry may cause them to apply with lesser or greater vigor. We propose here that the technology-intensive nature of mobile telecommunications exerts significant influence on the demand and supply sides' reactions to exclusion as well as on the time horizon of exclusion. In detail we trace how technology (a) multiplies the sources of competition and facilitates competitive interactions on the demand side, (b) simplifies and nurtures the ability of consumers to reach substitutes and gain access to alternative routes to the desired products and services, (c) changes how we think of the durability of market power at the root of exclusionary practices. Because technology is such an important parameter, not taking into account technological competition would result in a distorted picture of the state of the market and potentially result in underestimation of the competitive pressures firms face in the market.

3.2.1 Supply Side Considerations

The common perception of the organization of markets is that actors who have similar functions in the value chain, i.e. they provide similar products or services, are competitors, and are placed in a horizontal relationship, whereas, actors that provide services and products that are meant to work together in the course of generating value are thought to be complements to each other, and are placed in a vertical relationship.[190] Indeed, competition law by and large studies the effect of practices of *competitors*, that is actors *within* the same market.

190 *See* Robert L. Steiner, V*ertical Competition, Horizontal Competition, and Market Power*, 53 THE ANTITRUST BULLETIN, 251, 251-253; Non-Horizontal Merger Guidelines (Originally issued as part of "U.S. Department of Justice Merger Guidelines," June 14, 1984), ¶ 4.0 (“By definition, nonhorizontal mergers involve firms that do not operate in the same market.”).

Albeit intuitive, this approach overlooks the important competitive pressures that can emerge in parts of the value chain that do not belong in the same level (and therefore are not in a horizontal relationship), as well as the dynamic interfacing of the different parts of the value chain.[191]

To be sure, horizontal competitors are still the primary source of pressure for market players. But exclusion in the wireless industry, by resulting in blocking or discrimination against inputs or distribution channels in upstream or downstream markets, implicates players in other parts of the value chain as well. In this case, the mainstream competition stemming from direct horizontal rivals is not enough to capture the full competitive pressure market actors are subject to. We find that technology has a very important role to play in this. First, the nature of technological know-how and technical requirements induces and facilitates vertical mobility, whereas new technological developments allow the relocation of functions along the value chain. This makes entry easier and more likely, and reduces market power. Second, even if entry doesn't occur, the interdependence between the various parts of the value chain stands as an obstacle in unilateral decisions to exclude. We explore there in succession below.

3.2.1.1 Multiplication of Potential Entrants and Sources of Competition

This section traces the ways by which the technical nature of mobile telecommunications facilitates entry thereby making the supply side more responsive to exclusionary practices. The

191 *See* Steiner, *id.* at 256-259; Ioannis Lianos, *The Vertical/Horizontal Dichotomy in Competition Law: Some Reflections with Regard to Dual Distribution and Private Labels*, *in* PRIVATE LABELS, BRANDS AND COMPETITION POLICY 161 (Ariel Ezrachi & Ulf Bernitz eds., 2009).

possibility of entry either weakens the effects of exclusion due to another competitor joining the market or acts in a dissuasive manner to prevent exclusion from taking place in the first place.

3.2.1.1.1 Technological Proximity and Vertical Entry

In the classic static view of a value chain the various layers that make it up are thought to have been assigned *distinct* roles, and the final product or service is the result of the cumulative contributions of all layers. This understanding implies that, although the layers are working together, they are separate and each is confined to its own respective area of activity. A software developer will contribute the applications, a hardware manufacture will contribute the device, a network provider will contribute connectivity and so on.

However, there is nothing that axiomatically locks firms in a single layer. In fact it is rather intuitive that, given the opportunity and provided that it makes business sense, a firm in one layer can enter adjacent layers. In this context, firms that used to serve as complements to other levels of the value chain can transcend their boundaries and enter a competing relationship with their once complementors.[192] Vertical mobility of this kind adds to the supply side pressure the same way direct horizontal entry would occur to fill in whatever the excluding firm deprived the market of.

Technology-driven industries are particularly prone to vertical mobility. As Bresnahan and Greenstein have persuasively argued, the technological interdependence of firms along the value chain and the ability of firms to accumulate technical knowledge around their surroundings

192 Timothy F. Bresnahan & Shane Greenstein, *Technological Competition and the Structure of the Computer Industry*, 47 THE JOURNAL OF INDUSTRIAL ECONOMICS 1, 37-38 (1999).

enables them to cross over to neighboring layers upstream or downstream:

> "Technically, there are no given and exogenous boundaries between the layers. The functions now performed by one platform component might instead be performed by another. Both software and hardware have shown this malleability. The firms supplying key components of the same platform often have broadly similar technical capabilities. Each would be capable of taking over the other's position."[193]

This process can take time. Established platforms and technologies can be hard to dislodge because they are linked to significant investments, a well-developed customer base, and often lock-in effects.[194] But prospective entrants can eventually amass the necessary knowledge and capital over time, "attain sufficient capabilities to attract a larger network of suppliers and support ... [and] grow strong enough to move into an old platform's market."[195] Cohen and Levinthal describe a similar process, which they call *absorptive capacity*.[196] The absorptive

193 Timothy Bresnahan, *New Modes of Competition*, *in* COMPETITION, INNOVATION AND THE MICROSOFT MONOPOLY: ANTITRUST IN THE DIGITAL MARKETPLACE 155 (Jeffrey Eisenach & Thomas M. Lenard eds., 1999).

194 *See* JOHN SUTTON, SUNK COSTS AND MARKET STRUCTURE 45-83 (2007) (who concludes that a platform or technology incurs significant endogenous sunk costs on the basis of irreversibility, specificity, unlimited efficacy, and (near-) unanimity about efficacy). *See also* Stanley M. Besen & Garth Saloner, *Compatibility Standards and the Market for Telecommhunications Services*, *in* CHANGING THE RULES: TECHNOLOGICAL CHANGE, INTERNATIONAL COMPETITION, AND REGULATION IN COMMUNICATIONS 177, 194-199 (Robert W. Crandall & Kenneth Flamm eds., 1989).

195 Bresnahan & Greenstein, *supra* note 192, at 20-21.

196 Wesley M. Cohen and Daniel A. Levinthal, *Absorptive Capacity: A New Perspective on Learning and Innovation*, 35 ADMINISTRATIVE SCIENCE QUARTERLY 128, 128 (1990). *See also* Joris Knoben & Leo A.G. Oerlemans, *Proximity and Inter-Organizational Collaboration: A Literature Review*, 8 INTERNATIONAL JOURNAL OF MANAGEMENT REVIEWS 71, 77-78 (2006).

capacity of firms increases with their familiarity with the new knowledge they acquire from another firm, and so the closer the firms are in terms of prior knowledge and activities proximity the easier it is for them to cooperate or compete.[197]

In effect, firms "that had previously supplied different segments, now compete for the same customers."[198] Potential entrants are no longer only firms that do business in the same market (horizontal competition), but also firms that supplied a necessary component within the same value chain, have a good understanding of the end service or product, and can therefore tweak their technology to move upstream or downstream and expand to another level too. If a firm, then, decides to exclude inputs or foreclose distribution channels, thereby creating unmet demand in the market, these "technologically adept" firms are waiting in the wings to fill in.

The greater the technological proximity between two layers, the easier it is for firms in separate layers to "invade" each others' turf and directly introduce competing products and services. Neighboring layers are particularly good candidates for that.

Consider, for example, the gradual expansion of Google into the mobile industry value chain. Google was initially solely an applications and services provider. The company soon realized that if it wanted to go beyond the limited distribution that it could achieve through such partnerships, it would have to bypass the mobile operating system bottleneck entirely.[199] Capitalizing on its experience with mobile services and applications Google forayed into the adjoining mobile operating system market by assuming stewardship of the Android project (a

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197 Cohen & Levinthal, *supra* note 196, at 135-136.

198 *Id*. at 2.

199 FRED VOGELSTEIN, DOGFIGHT: HOW APPLE AND GOOGLE WENT TO WAR AND STARTED A REVOLUTION 51 (2013) (explaining how Google feared that if Microsoft—their number one rival at the time—managed to dominate the mobile market, it would interfere with users' access to Google services).

similar expansion was attempted by Mozilla, which is known for its browser but now also produces a mobile operating system, adding to the competition).[200]

Soon after, and with a solid position in the mobile operating systems market,[201] Google crossed another layer and entered the devices market as well.[202] The operating system (a layer which Google had already dominated) is one of the most critical components of a mobile device, and Google's expertise in the operating system layer could be leveraged to successfully enter the adjacent devices market too. Considering Google's path, it should come as no surprise that the company has recently announced that it will crack into the last mile market too.[203] This is an interesting development because it shows both that firms move around in technologically similar markets, and the difficulties they can encounter in the process. Google first announced its interest to expand to the wireless carrier market in 2011,[204] and yet it took four years to actually materialize the plan even on a small scale.

The effect of Google's vertical expansion in the market is quite noticeable. At the time of Android's introduction all major mobile operating systems were tied to devices manufactured by the developers of the installed operating system (iPhone to iOS, Nokia phones to Symbian, Blackberry phones to Blackberry OS). With the mobile market split in three large market shares vertical exclusion was a concern. Google's Android would be the first major operating system to

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200 *Google Buys Android for Its Mobile Arsenal*, BLOOMBERG, August 16, 2005; Brendan Greeley, *Is the Firefox Mobile Operating System a Droid Killer*, BLOOMBERG, June 19, 2014.

201 When Google launched Nexus the Android market share had already surpassed iOS with a spectacular 615% growth from 2009 to 2010. See Jacqui Cheng, *Android Tops Everyone in 2010 Market Share; 2011 May Be Different*, ARS TECHNICA, January 31, 2011.

202 Amol Sharma, *Google Pushes Tailored Phones to Win Lucrative Ad Market*, WALL STREET JOURNAL, August 2, 2007.

203 David Goldman, *Google Is Becoming a Wireless Carrier*, CNN, January 23, 2015.

204 David Goldman, Google: Your New Phone Carrier?, CNN, January 1, 2011; Michael Santo, G*oogle and Dish Network Teaming on New Data-only Wireless Carrier Service*, Examiner, November 17, 2012.

come with the promise of openness and customizability, a model that departed from that of the existing major operating systems. The competitive pressure created by Android was so great that two of the three main competitors—Blackberry and Nokia—were eclipsed from the mobile market in a matter of five years post Google entry, and Apple was forced to become more open.[205] In a speech that went viral in mid 2013 Tim Cook, Apple's CEO, famously stated "I think you will see us open up more in the future,"[206] and some commentators have even suggested that Apple is more open than Google.[207]

To be sure, the ability of firms to move upstream or downstream as they develop comparable technical expertise can harm competition for the same reasons it can enhance it. The vertical expansion of a dominant firm in one layer to adjacent levels of production is at the core of the fears surrounding exclusion. This, for example, was a common concern in the early life of Java. Java was originally developed as a middle layer between the operating system and the software that ran on top of it. It was seen as a platform layer distinct from that of the applications that were designed for Java and from the underlying operating system. In this configuration Sun -the company behind Java- was not in a competing relationship with developers of Java applications. However, the growing popularity of Java raised fears that Sun would enter the applications layer too. As Garud et al. explain:

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205 VisionMobile, A Clash of Ecosystems, November 2011, *available at* http://www.visionmobile.com/product/clash-of-ecosystems/; Justin Fox, *Why Apple Has to Become More Open*, HARVARD BUSINESS REVIEW, March 11, 2013.

206 Ina Fried, *Could Apple Be Getting Just a Bit More Open?*, ALLTHINGSD, May 28, 2013.

207 Christopher Mims, *It's Official: Apple Is Now More Open than Google*, MIT TECHNOLOGY REVIEW, August 4, 2011; VisionMobile, Open Governance Index, July 2011, *available at* http://www.visionmobile.com/product/open-governance-index/.

> "Such concerns were heightened by Sun's introduction of Java products that competed with those offered by other members of the Java collective. Even ardent supporters were afraid that Sun's control would give it undue advantage when competition intensified in the Java product-market. Pat Sueltz, then general manager of Java software at IBM, suggested: 'Sun ... should establish the standard and compete above it. To the extent that Sun has any advantage, it limits the creativity of their partners.'"[208]

But the fact that vertical mobility can cut both ways does not detract from the theory. As a matter of principle any factor that facilitates entry in the market should be welcome. The fact that technological proximity makes entry easier and can form a stepping stone for abuse of market power is no reason for concern unless the rest of the conditions that antitrust proscribes are met.

3.2.1.1.2 Expansion of Natural Technical Boundaries

Entry as the result of technological proximity is a *strategic* choice by a firm to expand into a market after having familiarized itself with the technical know-how of the new market. In a sense, vertical entry of this kind presents itself as an opportunity rather than a pressing need. Slightly different is the situation where technical considerations do not simply suggest expansion into a new layer, but almost mandate it for the efficient operation of the product or service. In this case too, the technological imperatives facilitate vertical mobility which in turn increase

208 Raghu Garud et al., *Institutional Enterpreneurship in the Sponsorship of Common Technological Standards: The Case of Sun Microsystems and Java*, 45 ACADEMY OF MANAGEMENT JOURNAL 196, 204 (2002).

supply side pressure.

The boundaries of the firm can change to incorporate or lose functions for a variety of reasons. Initially, scholarship focused on economics and management/organization. A long line of relevant literature has suggested that firms' boundaries expand or contract on the basis of transaction costs or managerial control. The transaction costs theory places the natural boundaries of the firm around those activities that are cheaper to produce or perform internally than procure from the open market.[209] Managerial/organizational control theories revolve around the idea that the insular nature of the firm enhances internal cohesion, coordination and control, and so activities that are closely linked together should be brought under the same roof.[210]

The economics and management literature examined the economic and organizational aspects of the firm. Recent technology studies have attempted to explain how technology becomes a relevant parameter of boundary delineation in technology-intensive industries. The proposition is that every system can be broken down into smaller modules, and that the technical

209 Ronald Coase, *The Nature of the Firm*, 4 ECONOMICA 386, 397 (1937); Steven N.S. Cheung, *The Contractual Nature of the Firm*, 26 JOURNAL OF LAW AND ECONOMICS, 1 (1983); Oliver E. Williamson, *The Vertical Integration of Production: Market Failure Considerations*, 61 AMERICAN ECONOMIC REVIEW 112, 112-114 (1971)

210 David Teece et al., *Understanding Corporate Coherence*, 29 JOURNAL OF ECONOMIC BEHAVIOR AND ORGANIZATION 1, 18-19 (1994); Pavel Pelikan, *Can the Innovation System of Capitalism Be Outperformed*, *in* TECHNICAL CHANGE AND ECONOMIC THEORY 370 (Giovanni Dosi et al. eds., 1988); Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AMERICAN ECONOMIC REVIEW 777, 778 (1972). Alchian and Demsetz describe the essence of the firm as a contractual structure with: 1) joint input production, 2) several input owners, 3) one party who is common to all the contracts of the joint inputs, 4) who has rights to renegotiate any input's contract independently of contracts with other input owners, 5) who holds the residual claim, 6) who has the right to sell his central contractual residual status. *Id*. at 794; Benjamin Klein et al., *Vertical Integration, Appropriable Rents and the Competitive Contracting Process*, 21 JOURNAL OF LAW AND ECONOMICS 297 (1978); Bruce Kogut & Udo Zander, *Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology*, 3 ORGANIZATION SCIENCE 383 (1992). ("Firms exist because they provide a social community of voluntaristic action structured by organizing principles that are not reducible to individuals," at 384); MORRIS SILVER, ENTERPRISE AND THE SCOPE OF THE FIRM: THE ROLE OF VERTICAL INTEGRATION 17 (1984) ("[The entrepreneur's] problem is that he cannot, at reasonable cost, convey his implausible 'secret' to those with the technical capabilities needed to produce the required operations at the lowest cost"); EDITH PENROSE, THE THEORY OF THE GROWTH OF THE FIRM (4th ed. 2009).

functions and components that are closely intertwined should be grouped together and put in the same module.[211] The goal is to limit interactions and spillovers *between* modules because external-to-the-module interactions impose and overhead cost to the completion of an operation. When all functions that exhibit high interdependencies are grouped in appropriately defined modules the system performs optimally.

Importantly for our purposes here, modules do not have to remain static. As technical realities change the functions performed by modules can be rearranged, or removed completely, or new functions can be introduced in the system to accommodate new functionality that is dictated by the principles of efficiency and progress.[212] In the process, modules that were thought to fall exclusively under one level of the value chain can expand (or shrink) to include operations that belonged in another part.

These changes are accordingly reflected in firms' boundaries. Firms constantly re-evaluate their position in the mobile industry value chain and might decide to change their boundaries to engulf (or discard) some functionality and roles because this is the most efficient scope of operation on technical grounds.[213] At any given moment, technology designers seek and delineate their products' and services' "natural boundaries"[214] and enter new markets by internalizing the

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211 CARLISS Y. BALDWIN & KIM B. CLARK, DESIGN RULES: THE POWER OF MODULARITY 64, 70 (2000); Carliss Y. Baldwin & Kim B. Clark, *Modularity in the Design of Complex Engineering Systems*, *in* COMPLEX ENGINEERED SYSTEMS: SCIENCE MEETS TECHNOLOGY 175 (Dan Braha et al. eds., 2006); Herbert A. Simon, *The Architecture of Complexity*, 16 PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY 467, 474-477 (1962); Ron Sanchez & Joseph T. Mahoney, *Modularity, Flexibility, and Knowledge Management in Product and Organization Design*, 17 STRATEGIC MANAGEMENT JOURNAL 63, 65 (1996).

212 Baldwin & Clark, *supra* note 211, at 156, 180.

213 Kevin Boudreau, *The Boundaries of the Platform: Vertical Integration and Economics Incentives in Mobile Computing*, MIT Sloal Working Paper, at 2-3 (2006); Annabelle Gawer & Rebecca Henderson, *Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel*, 16 JOURNAL OF ECONOMICS AND MANAGEMENT STRATEGY 1, 3-6 (2007).

214 *See* Baldwin & Clark, *supra* note 211, at 64 (speaking of a "natural division" between parts in modular systems).

production of resources that they used to procure from complementors. This brings used-to-be complementors in a competing relationship with the newly enlarged firms. Under these circumstances, should a firm exclude a complement or distribution channel from the market, the competitive response may not only come from its direct horizontal competitors, but also from firms that will expand upstream or downstream to fill in for the excluded complement, or create an alternative distribution channel, if doing so can be technically efficient.

This type of boundary rearrangement and the ensuing competitive pressure was obvious in the early phases of the mobile devices industry. In the 90s the market for mobile computing and communication devices was still nascent and the character and identity of such devices was still very fluid. This resulted in intense experimentation with the scope of firms.

Consider Palm, the company behind the very popular Palm Pilot. Palm was born with the vision to lead the handheld computing and communications devices market. Despite that grand aspiration Palm started with only two software engineers and originally planned to write just the applications for the device; the operating system and the hardware would come from third parties.[215] Palm partnered with GEOS for the operating system and Tandy (now Radioshack) for the hardware (the device was called Zoomer), but the result was not a success. GEOS was incomplete for the required device specifications (e.g. it wasn't designed to accommodate touch pen functionality on which Palm relied heavily) and Palm's relationship with Tandy proved rocky.[216]

Palm soon realized that while the value of a handheld device to users would come from the

215 ANDREA BUTTER & DAVID POGUE, PILOTING PALM: THE INSIDE STORY OF PALM, HANDSPRING, AND THE BIRTH OF THE BILLION DOLLAR HANDHELD INDUSTRY 5-18 (2002).

216 *Id*.

applications (and so in a sense it was in the right market), the available technology at the time would never allow Palm to offer a well-rounded solution unless it expanded to and controlled the more critical components of the "Palm platform" experience, namely the operating system and the device.[217] In the years following Zoomer Palm set out to design its own device and operating system. The new product, Palm Pilot, running Palm OS, was a big success when it hit the market it 1996.

Palm's expansion into the operating system and device market was not solely initiated on economic or managerial grounds. At the time there was no mature stand-alone operating system that companies could credibly rely on to develop mobile applications, and because mobility had only recently began to be an issue, hardware manufacturers also didn't have good ready propositions. The coupling between applications and operating system was so tight that Palm had to enter the operating system market too.[218]

The same was true for other competitors. Microsoft joined the race around the same time after a few failed internal projects.[219] It left the hardware to outside manufacturers, but it, too, set as a priority to come up with an operating system (Windows CE) (as well as a set of applications) from the beginning.[220] The third major competitor, Psion took a fully integrated approach from the very beginning, including applications, operating system and hardware.[221]

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217 Ramon Casadesus-Masanell, *Palm (A): The Debate on Licensing Palm's OS*, Harvard Business School Case N9-708-514 (May 20, 2008), at 5.

218 Butter & Pogue, *supra* note 84, at 131 ("Palm had *had* to produce a new OS. No existing OS would permit the design of a fast, easy- to-use, and inexpensive handheld computer. The Palm OS was small, fast, powerful, flexible, and designed for connectivity to the PC—all the things the other OS options were not.").

219 Chris Tilley, The History of Windows CE, HPC Factor, *available at* http://www.hpcfactor.com/support/windowsce/default.asp

220 *Id*.

221 Andrew Orlowski, *Psion: The Last Computer*, THE REGISTER, June 26, 2007 (where the author describes Psion 5 as "a remarkable achievement: entirely new silicon, a new operating system, middleware stack and

However, the tying of software to hardware in Psion products was explained more by historical rather than technical reasons (Psion had been in the integrated portable devices market for more than a decade already and its handheld computer was essentially an outgrowth of that line of products).[222]

When the technical interdependencies between applications and the operating system thinned out, decoupling and different combinations became more viable options.[223] With greater standardization and better interfaces, the natural boundaries of applications, operating system and devices were more clearly delineated and separated, and firms could open up parts of their value chain to third parties. Nearing the end of the 90s Psion started licensing its OS to other device manufacturers, until it was absorbed by Nokia's Symbian, which also absorbed Palm OS, and both Symbian and Windows CE opened up to third party application developers.[224]

The preceding narrative shows that firms move in and out of markets not only because they see a business opportunity, but rather a necessity. From a competition point of view this is welcome because it creates imperative incentives for firms to cross their boundaries and enter new markets. By doing so they weaken bottlenecks and fill in for what their rivals may have deprived them market of.

During Psion's dominance from 1991 (introduction of its Series 3) to 1996, competition in

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applications [all] developed from scratch in just over two years."). See also Steve Litchfield, *The History of Psion*, PALMTOP MAGAZINE, 1998, *available at* http://stevelitchfield.com/historyofpsion.htm.

222 Litchfield, *id*.

223 *See*, *e.g*., Rahul C. Basole & Karla Jurgen, *On the Evolution of Mobile Platform Ecosystem Structure and Strategy*, 3 BUSINESS & INFORMATION SYSTEMS ENGINEERING 313, 318-319 (2011) (where the authors chronicle the expansion of the mobile ecosystem and the different combinations among the participating players).

224 *See* Benjamin Edelman et al., *Symbian, Google & Apple in the Mobile Space (A)*, HBS Case 909-055 (April 2009), at 2 (with internal links).

the applications market industry-wide was feeble, since Psion was a fully integrated firm and unless it approved an application, third party applications could not gain access to a major distribution channel. In 1996, when Palm realized that it needs to expand from the applications domain down to the operating system and device layers too in order to compete effectively, it became the first real competitor to Psion.[225] With the expansion of Palm and Microsoft, the mobile chain became less dependent on Psion and more channels were created thus limiting the bottleneck effect.

3.2.1.1.3 Flexible Locus of Functionality

Up to this point entry in the various levels of the value chain occurred through the expansion of existing players upstream or downstream. The expansion was motivated either by a strategic choice to leverage existing technical expertise to enter an adjacent market, or by the necessity to do so on the grounds of technically efficient scope. Both conditions suggest that when an actor deprives the market of an input or distribution channel at a certain level of the value chain, the surrounding actors have the ability (or even need) to enter the bottleneck market. The prospect of entry is expected to dissuade firms from resorting to exclusionary practices, or, in case exclusion occurs, actual entry can restore the market to (more) competitive levels and can mitigate the effect of exclusion.

Taking it a step further now, we posit that additional competitive pressure that is in the position to limit the ability to effectively exclude, can arise as the result of the introduction of a

225 Sunil Chhabra et al., *US Robotics: Owning the Pocket*, University of Michigan Business School Case, *available at* http://www-personal.umich.edu/~afuah/cases/case18.html.

new *locus* in the value chain, where content, services, application or functionality can be hosted. When this happens it is easier for the market to supply consumers with what they want. The technical nature of mobile telecommunications networks allows greater flexibility in the relocation or replication of functionality along the value chain thereby creating competition in new parts of the value chain and adding to the list of competitive sources that constrain firms' bottleneck behavior. To show how this can happen we attempt to identify examples of where and how these new loci arise.

To begin with, probably the most well-known illustration of this type of competitive entry is Java's business model as highlighted by its battle with Microsoft.[226] Java is technically a programming language, and its innovation lies in the “write once, run everywhere” ability, which means that once an application is developed for Java on a given platform (e.g. the Microsoft Windows operating system) it can run on any platform without the need to be recompiled (e.g. a Java-enabled mobile phone).[227] This revolutionary feature formed an operating environment that allowed Java software to run regardless of the underlying operating system, and in effect to create a *new middle layer* between the operating system and the applications that ran on top of it, which broke the link and interdependence between an operating system's APIs and the applications.

As anyone familiar with the Microsoft case knows, Microsoft vehemently fought Sun (the company behind Java) and attempted to exclude it from Microsoft Windows by introducing

226 *See* U.S. v. Microsoft, 253 F.3d 34, 74 et seq. (2001).

227 See Sun Microsystems, JavaSoft Ships Java 1.0, January 23, 1996, *available at* http://tech-insider.org/java/research/1996/0123.html (“Java's write-once-run-everywhere capability along with its easy accessibility have propelled the software and Internet communities to embrace it as the de facto standard for writing applications for complex networks.”).

incompatibilities between Microsoft's and Sun's Java Virtual Machine.[228] Microsoft was concerned that the independent evolution of Java might mean that a new platform for applications development would emerge, one that did not depend on Windows to run.[229] Although Java was not an operating system and hence did not compete in the same (horizontal) market as Windows, the fear was that it could replace Windows "as the ubiquitous platform for software development" and usurp a lot of its functionality directly competing with it as a platform for software development.[230]

In this scenario, even if Windows wanted to exclude an application, it could only do so when the application ran directly on Windows, not if it could run on Java's intermediate layer (at least not without sabotaging Java). Potential exclusionary practices on the Windows' side could therefore be curtailed not because of the emergence of a new operating system, but because part of the functionality of the operating system would have migrated elsewhere the value chain, namely the new layer introduced by Java.

While Java's intermediation function is becoming less relevant in the mobile development

228 Raghu Garud et al., *Institutional Entrepreneurship in the Sponsorship of Common Technological Standards: The Case of Sun Microsystems and Java*, 45 ACADEMY OF MANAGEMENT JOURNAL 196, 204 (2002). See also U.S. v. Microsoft, supra note 88, at 74-75 ("The District Court held that Microsoft engaged in exclusionary conduct by developing and promoting its own JVM. Sun had already developed a JVM for the Windows operating system when Microsoft began work on its version. The JVM developed by Microsoft allows Java applications to run faster on Windows than does Sun's JVM, but a Java application designed to work with Microsoft's JVM does not work with Sun's JVM and vice versa." (internal citations omitted)). The claim here is not that Microsoft violated antitrust laws on the basis of its exclusionary conduct. As the court noted "[i]n order to violate the antitrust laws, the incompatible product must have an anticompetitive effect that outweighs any procompetitive justification for the design. Microsoft's JVM ... allows Java applications to run faster on Windows ... and does not itself have any anticompetitive effect. Therefore, we reverse the District Court's imposition of liability for Microsoft's development and promotion of its JVM.").

229 In a 1995 memo addressed to Microsoft's executives Bill Gates wrote: "A new competitor 'born' on the Internet is Netscape. Their browser is dominant, with 70% usage share, allowing them to determine which network extensions will catch on. They are pursuing a multi-platform strategy where they move the key API into the client to commoditize the underlying operating system.' *See* Bill Gates, The Internet Tidal Wave, Microsoft Case Exhibit 20 (1995), *available at* http://www.justice.gov/atr/cases/exhibits/20.pdf.

230 U.S. v. Microsoft, *supra* note 88, at 74.

ecosystem, because application execution goes through the gateway of the applications store,[231] we maintain that the same principle can still apply in the new generation of wireless communications. The argument is that emerging technologies show promise for multiplication of the ways by which some services, functions and applications can be offered (much like Java was another way to build and run applications/services), which would accordingly limit the power of each, including existing ones, to affect the value chain. It is important to note here that the analysis that follows draws conclusions on emerging industry trends and not historical examples, something that necessarily involves some conjecture. Although we recognize this weakness, we still believe that the available evidence—albeit incomplete—point to a clear path worth considering when attempting to evaluate how much power players can amass vis-a-vis other (potential and existing) competitors in the market.

The core of the argument and the main thrust behind it is the transition of the wireless telecommunications infrastructure to IP-based technologies. The IP layer, by serving as the common interoperability layer between various technologies up and down the protocol stack (spanning layer) allows interconnection between different networks and platforms,[232] and the clearer separation of the IP-based protocol stack, as opposed to that of legacy (mobile) telephone systems, increases their programmability.[233] This means that service and application delivery

231 That said, Java remains very relevant as a programming language (especially given that Android's ecosystem development greatly relies on Java). *See* Andrew Binstock, *If Java is Dying, It Sure Looks Awfully Healthy*, DR.BOBB'S, October 8, 2013; Zach Walton, *Java, Objective-C Still Popular Thanks To Mobile Development*, WEBPRONEWS, January 9, 2014.

232 David D. Clark, *Interoperation, Open Interfaces and Protocol Architecture*, *in* THE UNPREDICTABLE CERTAINTY: WHITE PAPERS INFORMATION INFRASTRUCTURE THROUGH 2000 133, 133-134 (NII 2000 Steering Committee, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council, 1998).

233 RAY HORAK, TELECOMMUNICATIONS AND DATA COMMUNICATIONS HANDBOOK 182 (2007).

architectures are no longer designed with a specific use in mind, but rather to support and host a variety of services and applications. We discuss here a few examples that this transition enables.

A good start is the much hyped IP Multimedia Subsystem (IMS), which is presented—possibly with a pinch of exaggeration—as the future of service provision in mobile communications networks.[234] IMS forms part of an overhaul that mobile communications networks are undergoing, called System Architecture Evolution (SAE),[235] and is a standardized architecture developed by cellular operators for the transmission of multimedia (including voice, text messages, video) and other traffic.[236] In SAE networks service provision is based on IP (based on IMS), which means that for the first time cellular networks can natively (i.e. without the need for gateways) connect to other networks running IP, such as the Internet, Wi-Fi and WiMAX networks, and IP services and applications can be developed and deployed across networks.[237]

SAE is the first cellular mobile telecommunications structure to rely exclusively on the IP protocol for the development of services and applications and the transmission of the data they generate, and, although it hasn't been fully deployed (transition will take several years and carriers still largely rely on the legacy 2G/3G networks with incremental 4G upgrades), all

234 *See, e.g.*, AT&T, *IP Multimedia Subsystem: An Architecture for the Future*, White Paper AB-0891-02 (2008).

235 *See* Kalyani Bogineni et al., *LTE Part II: Radio Access*, 47 IEEE COMMUNICATIONS MAGAZINE 40 (2009); Kalyani Bogineni et al., *LTE Part I: Core Network*, 47 IEEE COMMUNICATIONS MAGAZINE 40 (2009).

236 Antonio Cuevas et al., *The IMS Service Platform: A Solution for Next-Generation Network Operators to Be More than Bit Pipes*, 44 IEEE COMMUNICATIONS MAGAZINE 75 (2006); Gilles Bertrand, *The IP Multimedia Subsystem in Next Generation Networks* (unpublished manuscript), *available at* http://www.rennes.enst-bretagne.fr/~gbertran/files/IMS_an_overview.pdf.

237 GONZALO CAMARILLO & MIGUEL A. GARCIA-MARTIN, THE 3G IP MULTIMEDIA SUBSYSTEM: MERGING THE INTERNET AND THE CELLULAR WORLDS 5 (2005); JYH-CHENG CHEN & TAO ZHANG, IP-BASED NEXT-GENERATION WIRELESS NETWORKS: SYSTEMS, ARCHITECTURES AND PROTOCOLS 20 (2004).

carriers will eventually transition to it.[238] SAE is the cellular mobile networks' first-time departure from a system designed and optimized for one service (voice) to a general platform that can accommodate a variety of services and applications (much like the Internet).[239] For the first time since the commercialization of the Internet an alternative general purpose platform, encompassing all players along the value chain, and potentially equivalent in reach and scope, is beginning to emerge. As Siemens' Director for Fixed-Mobile Convergence Solution put it: "IMS is designed to provide *operators* with the means to satisfy the growing demand for rich, diverse communications services ... For *vendors* and new application providers, the IMS architecture supports rapid and efficient service creation. For *users*, IMS makes it possible to access multiple services in the course of the same call or session." (emphasis added).[240]

In short, the emerging operational environment of cellular networks is one that resembles the general purpose nature of the Internet. Theoretically, then, this environment can serve as a parallel—if more limited—platform for service, application, and content creation and delivery, the first time this ever happens in the wireless world.[241] Exclusionary practices in one system could therefore be mitigated by the ability to switch to the other system, both serving the same subscribers.

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238 *See* Darren McQeen, *The Momentum Behind LTE Adoption*, 47 IEEE COMMUNICATIONS MAGAZINE 44 (2009); Alexander Harrowell, *IMS: Two Visions of the Telecoms Future*, 130 MOBILE TELECOMMUNICATIONS INTERNATIONAL 1 (2006). For the transition to full IP *see also* Voice over LTE, Ericsson White Paper 284 23-3145 Uen, December 2010, available at http://www.3g4g.co.uk/Lte/LTE_VoLTE_1012_Ericsson.pdf.

239 Antonio Cuevas et al., *supra* note 236. *Compare* Barry M. Leiner et al., *The Past and Future History of the Internet*, 40 COMMUNICATIONS OF THE ACM 102, 104 (1997) ("[t]he Internet was not designed for just one application but as a general infrastructure on which new applications could be conceived").

240 Felipe Alvarez del Pino, *IMS: Application Enabler and UMTS/HSPA Growth Catalyst*, *in* BUSINESS MODELS AND DRIVERS FOR NEXT-GENERATION IMS SERVICES 4 (International Engineering Consoritum, 2007).

241 For a similar trend in wireline networks *cf.* David Clark's discussion on alternative IP platforms David Clark, *Platform Models for Sustainable Internet Regulation*, Paper presented at the 41st TPRC (2013), available at http://ssrn.com/abstract=2242600.

One might view the proposition that exclusion—say—on the Internet is rendered less effective given the alternative of another system with suspicion, but it is not an unfounded possibility, it is just new. IMS is not the only emerging alternative architecture; other hybrid architectures have appeared taking advantage of the universal and general purpose nature of IP.[242] Over the past few years telecommunications applications and services have been deployed on such architectures as infrastructure-as-a-service (IaaS),[243] network-as-a-service (NaaS),[244] and network virtualization.[245] Bell Labs/Alcatel-Lucent has described this general trend as follows: "It is envisaged that services and applications will migrate to a cloud-computing paradigm where thin-clients on user devices access, over the network, applications hosted in data centers by application service providers."[246] These technologies provide the necessary hardware and software to develop and deploy services and applications, which are delivered to end users through last mile infrastructure operators. This model is becoming increasingly popular among

242 Aside of the ones mentioned here below, *see also* Vânia Gonçalves & Pieter Ballon, *Adding Value to the Network: Mobile Operators' Experiments with Software-as-a-Service and Platform-as-a-Service Models*, 28 TELEMATICS AND INFORMATICS 12 (2011); JOSEPH GHETIE, FIXED-MOBILE WIRELESS NETWORKS CONVERGENCE: TECHNOLOGIES, SOLUTIONS, SERVICES 343-5 (describing the overlapping functionality of Software Delivery Platforms with IMS); *see also* Kyriacos Sabatakakis, *New Service Creation in an IP Environment: The Advantages of Integrated IMS and Service Delivery Platform Capabilities*, 1(6) IEC MAGAZINE 0 (2006).

243 *See, e.g.*, TATA Communications, *Infrastructure-as-a-Service: Fulfilling the Promise of Cloud Computing*, White Paper, *available at* http://www.tatadocomo.com/business/download/WhitePaper-Infrastructure-as-a-Service.pdf; Interoute, What is IaaS, *available at* http://www.interoute.com/what-iaas.

244 *See, e.g.*, M. Hoffmann & M. Staufer, Network Virtualization for Future Mobile Networks: General Architecture and Applications, 2011 IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS WORKSHOPS 1 (2011); Ashiq Khan et al., *Network Sharing in the Next Mobile Network: TCO Reduction, Management Flexibility, and Operational Independence*; 2011 IEEECOMMUNICATIONS MAGAZINE 134 (2011); Press Release, Fujitsu Unveils 'Network as a Service Concept,' *available at* http://www.fujitsu.com/global/about/resources/news/press-releases/2007/0516-02.html.

245 *See, e.g.*, NokiaSiemens Networks, Network Virtualization Enabling Novel Business Models in a Dynamic Market, available at http://networks.nokia.com/system/files/document/nsn-noo-2012_networkvirtualization_v01.pdf.

246 Fang Hao et al., *Enhancing Dynamic Cloud-based Services Using Network Virtualization*, 2009 PROCEEDINGS OF THE 1ST ACM WORKSHOP ON VIRTUALIZED INFRASTRUCTURE SYSTEMS AND ARCHITECTURES 33, 33 (2009)

mobile virtual network operators (MVNOs), who until recently were limited to whatever network capabilities the host carrier supported, but can now have their own platform. In fact, as Wi-Fi is becoming more prevalent, reliance on traditional carriers is decreasing even further.[247]

With these various solutions available in the market it is not unreasonable to expect competition among them as to which will attract valuable service, application and content developers and users, something that remains valid even if we are talking about competition among closed systems.[248] It is true that competition might intensify if platforms become more inclusive (this depends on the assumptions one makes in the two-sided platform analysis).[249] But even if platforms are not fully open and inclusive, under a holistic view of the industry, the multiplication of loci of application and service development and delivery is by definition an improvement in the market's competitive conditions compared to a regime where there is only one option (the Internet).

As mentioned previously, the telecommunications industry is not yet at the point where different platforms and architectures of service and application deployment are fully developed and competitive. But a forward-looking analysis of the competitive conditions in the market should at least acknowledge that the industry is moving away from monolithic propositions and towards greater heterogeneity of network solutions and platforms. Under these changing circumstances, given the multiple options of service, application and content development and delivery, the ability to exclude in one platform is weakened by the possibility to turn to other

247 *See, e.g.*, Republic Wireless, https://republicwireless.com, TextNow Wireless, https://www.textnow.com/wireless.

248 Gonçalves & Ballon, *supra* note 242, at 19-20 (where the authors describe platform leadership competition among various proprietary platforms developed by mobile operators).

249 Jeffrey Church & Neil Gandal, *Platform Competition in Telecommunications, in* HANDBOOK OF TELECOMMUNICATIONS ECONOMICS VOLUME II 117, 134 (Sumit K. Majumdar et al. eds., 2005).

platforms, at least as compared to a situation that competition exists only between the traditional non-generative cellular mobile architecture and the Internet.

3.2.1.2 Competitive Pressure and Dissuasive Effects from Existing Players

The kind of competitive pressure presented so far stems from *entry* in the bottleneck market where exclusionary practices are feared. On top of the limiting effect competitive entry has on exclusionary practices, a parallel dissuasive effect can arise from the actions of *existing* players in the value chain *without entry actually occurring* in the bottleneck market. It is enough that the technological proximity and interdependency between firms in the value chain can serve as a backstop to anticompetitive behavior without firms becoming direct competitors in the same market.

3.2.1.2.1 Shifts of Power due to Technological Proximity

We saw previously how technological proximity between firms along the value chain enables them to jump from one layer to another and how this undermines the power of bottlenecks. We use the same theoretical insights here to make a slightly different argument: technological proximity facilitates the exchange of power between players in a way that can weaken bottlenecks by moving the center of value elsewhere in the value chain. A dominant actor around whom a platform or a technology revolves can lose some of his relevancy when control over the platform or technology shifts to other actors. While new entry does not actually

take place, the fact that control and value have shifted means that the once dominant player will likely not be able to enforce an exclusionary policy that harms the platform or technology.

Systems that consist of multiple components (much like the mobile telecommunications value chain) are not necessarily locked in a fixed allocation of value and importance among their parts and components.[250] While the overall value may remain the same, the internal allocation and the actors representing each part can change, and the change is motivated by the "vertical competition for control of a platform among the sellers of its various components." [251] At any given time only one or a few parts of the value chain can be those that define its general architectural shape.[252] These are the ones around which the rest of the parts will develop. As the system evolves in time it is possible that another component will take the lead as the epicenter of the system's design. The system will then coagulate around that new keystone component.

In such contexts it is often unclear which standard, platform, function or component will become the strategically most important one, around which value and market activity will coalesce, and it is also entirely possible that none is actually sufficiently defined, in which case competition between and within them for one to emerge (temporarily) victorious is inevitable.[253] As this process unfolds the various components in a system are not only constrained by their counterparts in other systems, but also within the system itself by their own complements.[254]

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250 *See, e.g.*, Hemant Kumar Sabat, *The Evolving Mobile Wireless Value Chain and Market Structure*, 26 TELECOMMUNICATIONS POLICY 505 (2002); Joe Peppard et al., *From Value Chain to Value Network: Insights for Mobile Operators*, 24 EUROPEAN MANAGEMENT JOURNAL 128 (2006).

251 *See* Bresnahan & Greenstein, *supra* note 192, at 23.

252 Carliss Y. Baldwin & Jason C. Woodard, *The Architecture of Platforms: A Unified View*, in PLATFORMS, MARKETS AND INNOVATION 19, 24-25 (Annabelle Gawer ed., 2009).

253 Pieter Ballon, *Platform Types and Gatekeeper Roles: The Case of the Mobile Communications Industry*, Paper presented at the Druid Summer Conference 2009, at 4, available at http://www2.druid.dk/conferences/viewpaper.php?id=5952&cf=32; Boudreau, supra note 213.

254 *See* Joseph Farrell et al., *The Vertical Organization Of Industry: Systems Competition versus Component*

The most representative example in the literature is how IBM lost leadership of the personal computer (PC) platform to Microsoft and Intel.[255] In the early 1980s IBM introduced its personal computer, which it decided to build on a modular architecture and rely on Microsoft's Windows for the operating system and on Intel for the processor.[256] Despite its initial success, the fact that other vendors could use Microsoft Windows and Intel to build their own "IBM-compatible" personal computers weakened IBM's position in the market.[257] IBM responded (belatedly) by introducing proprietary interfaces and its own operating system (OS/2), but control had already shifted from IBM to the "Wintel" duo. IBM was relegated to just another personal computer manufacturer. This example highlights how two firms that were not directly competing with IBM, but to the contrary were a big part of the "personal computer platform," managed to take away control from IBM and in doing so exposed IBM to much fiercer competition from other manufacturers, who absent the enabling factor of the Wintel duo might not have been able to compete effectively with IBM.

These dynamics are also noticeable in the wireless communications value chain. The increasing influence of the operating system as a component is a good example. It used to be the case that the operating system of a mobile device was not the most pronounced element in the users' experience; with the emergence of smart touch phones and the application distribution platforms model, the operating system became a defining part of how users interface with their

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Competition, 7 JOURNAL OF ECONOMICS AND MANAGEMENT STRATEGY 143 (1998) (where the authors compare competition between systems as a whole and between components of systems).

255 For a relevant account *see* Bresnahan & Greenstein, *supra* note 192, *passim*.

256 CHARLES H. FERGUSON & CHARLES R. MORRIS, COMPUTER WARS: THE POST-IBM WORLD 7-10 (1993).

257 Burton Grad, *A Personal Recollection: IBM's Unbundling of Software and Services*, 24 IEEE Annals of the History of Computing 64 (2002); THOMAS HAMILTON, IBM'S UNBUNDLING DECISION: CONSEQUENCES FOR USERS AND THE INDUSTRY (1969).

devices as well as what capabilities, applications and services they can access.[258] As such it now defines to a large extent the shape of the value chain and serves as a limiting factor to the power of other actors.[259]

The interplay between Google and Samsung is an interesting case study: Google provides the operating system (Android) that runs on top of Samsung's devices and both companies provide applications for Android, but the Android operating system has become such an important part of Samsung's devices that Google is now in the position to explicitly prioritize its own services over those of Samsung even on Samsung's phones to Samsung's detriment.[260] In a pre-smartphone era, when Samsung manufactured its own operating system for its devices, this was not a problem. The increasing pressure Samsung faces from Google explains why Samsung decided to experiment with switching back to an operating system of its own.[261] If Samsung's operating system proves a success the tables can once again be turned and Samsung will be able

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258 Adrian Holzer & Jan Ondrus, *Mobile Application Market: A Developer's Perspective*, 28 TELEMATICS AND INFORMATICS 22, 22 ("For many years, the development of mobile services was mostly controlled and managed by the mobile network operators (MNO), phone manufacturers, and some mobile application and content providers ... Recently, this has changed with the arrival of software companies with new mobile phones and platforms such as the iPhone and Android.").

259 Jeremy Wagstaff, *In a Samsung Galaxy Far, Far Away ... Will Android Still Rule?*, REUTERS, May 3, 2012 (where the author quotes analysts speculating that Samsung may just be "enabling someone else's ecosystem" and that "Microsoft had shown that whoever owned the operating system could relegate every hardware manufacturer to be a commodity player.").

260 *See* Ron Amadeo, *Google's Iron Grip on Android: Controlling Open Source by Any Means Necessary*, ARS TECHNICA, October 20, 2013. *See also* Haydn Shaughnessy, *Google, Pitting Itself Against Samsung, Prepares For Device War*, FORBES, August 31, 2013 (where the auhor describes how Google gained power through the proliferation of Android-powered devices).

261 Devindra Hardawar, *Samsung's Love/Hate Android Relationship Continues: Plans Tizen Phone, Android Wear Watch for This Year*, VENTURE BEAT, April 16, 2014; Tim Bajarin, Could Samsung Ditch Android for Tizen?, PC MAG, March 17, 2014. We don't mean to imply that the competitive pressure flows unidirectionally from Google to Samsung; both companies compete against each other over who will grab the biggest share of the value in the value chain. *See* Amir Efrati, *Samsung Sparks Anxiety at Google*, WALL STREET JOURNAL, February 25, 2013 ("Google executives worry that Samsung has become so big—the South Korean company sells about 40% of the gadgets that use Google's Android software—that it could flex its muscle to renegotiate their arrangement.").

to be the one that discriminates against Google's services and applications—if so it wills. The relationship between these two companies shows that the keystone element in a system can change, and once this happens the old reigning firm loses its ability to unilaterally impose its will and discriminate or exclude rivals' products.

Similar dynamics characterize the relationship between Apple and AT&T. While carriers were traditionally thought to be the dominant figure in the value chain,[262] the advent of the iPhone in 2007 which had the potential to drive up usage rates (as it did) and become a driving force for AT&T's data packages adoption, brought Apple up to a much stronger negotiating position.[263] This caused some power to shift to Apple, but—again—not permanently. A few years later, in 2013, AT&T flexed its muscles, and blocked Facetime, one of iPhone 4's flagship features, on its network, the reason being that Facetime was too bandwidth-demanding.[264] A possible parameter in AT&T's decision allowing it to oppose Apple was that AT&T was less dependent on Apple in 2013 than it was in 2007, because by 2013 AT&T had partnered with several other highly successful smartphones and Apple could no longer stop AT&T from blocking part of its system.

In all these examples, because the technical details and specifications of the end product and service that will be delivered to consumers are contributed by different and often competing firms, power is divided among them.[265] In this co-dependent relationship it is unknown ex ante

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262 *See, e.g.*, Jason Dedrick et al., *The Distribution of Value in the Mobile Phone Supply Chain*, 35 TELECOMMUNICATIONS POLICY 505 (2011).

263 Peter Cohan, *Project Vogue: Inside Apple's iPhone Deal With ATT*, FORBES, September 10, 2013; Amol Sharma et al., *How Steve Jobs Played Hardball in iPhone Birth*, WALL STREET JOURNAL, February 17, 2007; Edelman et al, *supra* note 224, at 5.

264 FCC Mobile Broadband Working Group - Open Internet Advisory Committee, AT&T/Facetime Case Study (2013), *available at* transition.fcc.gov/cgb/events/ATT-FaceTimeReport.pdf.

265 *See* MARTIN FRANSMAN, THE NEW ICT ECOSYSTEM 9-10 (“the four layers [networked elements, network

around which part of the value chain value will concentrate,[266] and in fact there is no reason why the distribution of power must remain fixed. Precisely because the industry is conducive to this kind of power reshuffling among actors, the observation of market power concentration in the hands of a certain actor should not inexorably point to the conclusion of a market failure in need of regulation, but it should rather provoke an inquiry into potential sources of counter-balancing competitive pressure, something that at first sight might not be immediately apparent.

For example, in the recent dispute between Netflix and Comcast, the majority of analysts seemed to think that Comcast used its power to force Netflix into a direct interconnection deal.[267] The premise was that until Netflix capitulated, Comcast would discriminate against Netflix traffic, which resulted in Netflix being even unusable in certain case. This account likely misrepresents the balance of power between the two companies: ISPs like Comcast have for years expressed their discontent with the fact that Netflix allegedly doesn't pay its fair share relative to the volume it offloads into ISPs' networks, but they only recently managed to enter into an agreement with Netflix. [268] This can be evidence that Netflix is such a valuable complement in the ISP ecosystem that ISPs cannot unilaterally decide against it. Also, the environment in which the Comcast-Netflix dispute arose is largely unregulated, which means

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operators, content and applications, consumers] of the system, although hierarchically structured, are interdependent. Each layer depends on the layer (or layers) adjacent to it. For the system as a whole to operate, each layer needs to do its own functional job.") (2010); Joe Peppard & Anna Rylander, *From Value Chain to Value Network: Insights for Mobile Operators*, 24 EUROPEAN MANAGEMENT JOURNAL 128 (2006) (examining the evolution of actors in the mobile industry).

266 Annabelle Gawer & Rebecca Henderson, *Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel*, 16 JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY 1, 1-3 (2007).

267 *See, e.g.*, Susan Crawford, *The Cliff and the Slope*, MEDIUM, October 30, 2014 (with other references).

268 *See* Karl Bode, *No, Netflix's New Deal With Comcast Probably Won't Destroy The Internet. Yet.*, TECHDIRT, February 24, 2014; Dan Raybum, *Inside The Netflix/Comcast Deal and What The Media Is Getting Very Wrong*, STREAMINGMEDIABLOG, Fubruary 23, 2014. *See also* Sue Zeidler, *Netflix Scrambles Future of TV and Films*, REUTERS, December 1, 2010.

that if indeed the power balance was clearly in favor of Comcast, it shouldn't have been too hard for it to exercise it.

What we mean to say here is not that market power is *irrelevant*, but rather that it is *impermanent and relative*. Firms are routinely constrained not only by their competitors but also by their partners (Comcast and Netflix are essentially partners in that both need each other the create value for consumers), and the balance of power among them can and does change. In observing—and regulating—market power one should keep in mind that close technological proximity and interdependencies may cause it to flow from one part of the value chain into another, and the new power balance distribution may be fairer. It may very well not be; but this is a conclusion that needs to be reached after correctly assessing the industry's state, not assumed by the static observation of perceived market power isolated from the context of the rest of the actors in the industry.

3.2.1.2.2 Networks Are the Result of a Continuous Tussle

The argument advanced here is more general in nature than those presented so far. It relates to the overall mode of existence of network industries, and describes how networks are the result of incessant battles of interests among all involved actors. While every industry is characterized by internal competing interests that shape the industry's organization, the technological interdependencies among market players in the wireless telecommunications industry, and the facilitating effect of technology on mobility as described previously, make market interactions and the "tussle" among actors more intense.

In a physical commodities market, changes in the production method or the transport modalities do not materially affect the operation of the store where the products will be sold. Supermarket shelves have remained the same over the years even though the products sold on them and the trucks that transport those products have changed. However, in the wireless communications world (and other technology-intensive and network driven industries), the introduction of—say—quality of service requires a series of changes along the value chain, including in the applications and the network layers; if only one part changes, the desired result will simply not be attained.[269] Such changes often materialize through the interactions of actors in the respective layers and not independently from each other, as could be the case in the example with produce and supermarkets, where actors can unilaterally change their product or service without that affecting or presupposing change in the value chain.

In an industry that consists of a plethora of participants at different levels of the value chain, each coming from a different place and each representing different interests, the services that reach end users are the denouement of either compromise or consensus,[270] but most likely not the unilateral will of one actor, unless that actor is so dominant as to be able to impose a de facto standard or technology.[271] In fact, negotiations and the attempts to strike the perfect balance can become so heated as to bring the evolution process to a stalemate.[272] But, whereas the possibility

269 This is the reason why IntServ and DiffServ have generally failed to solve the QoS problem on the Internet.

270 *Cf. also* LAURA DENARDIS (ED.), OPENING STANDARDS: THE GLOBAL POLITICS OF INTEROPERABILITY viii-ix (where the author explains how complex the standard-setting process is because of the different and competing priorities players bring to the table: "technical standards not only provide technological interoperability but also produce significant political and economic externalities. Battles over standards are sometimes market conflicts between technology companies ... [S]tandards are also political, making decisions about individual civil liberties online.").

271 *See* Besen & Saloner, *supra* note 194, at 181-182.

272 This risk is evidenced well by the very slow transition from IPv4 to IPv6 as well as by the slow-paced approval of other critical features in the Internet's infrastructure. *See*, *e.g.*, Mark Handley, *Why the Internet Only Just Works*, 24 BT TECHNOLOGY JOURNAL 119 (2006); Geoff Huston, *The Internet – 10 Years Later*, THE ISP

of a stalemate is real, the continuous tussle also means that various and competing interests are incorporated along the way.

In the context of exclusion, this means that the relevant decision to exclude is *not taken in vacuum*, but under the pressure of peers and complementors. These can span the entire industry and not even directly compete with each other but still be in the position to materially affect each other's position in the market and with regard to exclusion in particular.

An example that beautifully illustrates this point is the "openness" condition in the C Block of the 700 MHz spectrum that was auctioned in 2008. In that auction, on the insistence of major companies like Google and the Public Interest Spectrum Coalition, the FCC included a term requiring the licensee to provide open platforms for devices and applications, if the winning offer exceeded $4.6 billion.[273] If the offer did not exceed that price, the block would be re-auctioned without the openness requirement. Google was one of the most ardent supporters of this condition, because as a service (and later device) provider, it would benefit from end users being able to use its products and services freely without any limitations from the carriers. Google openly declared to the FCC that if and only if an openness requirement is included will it bid at the auction.[274] At the time, Google was not seriously considering becoming an infrastructure provider, and in any case it knew that other companies needed and were willing to pay more for

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COLUMN, June 2008, *available at* http://www.internetsociety.org/sites/default/files/10years.pdf.

273 In the Matter of Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, 22 FCC Rcd. 15258 et seq. (2007) (Second Report and Order). ("[W]e will require only C Block licensees to allow customers, device manufacturers, third-party application developers, and others to use or develop the devices and applications of their choosing in C Block networks, so long as they meet all applicable regulatory requirements and comply with reasonable conditions related to management of the wireless network (i.e., do not cause harm to the network) . Specifically, a C Block licensee may not block, degrade, or interfere with the ability of end users to download and utilize applications of their choosing on the licensee's C Block network, subject to reasonable network management," at 15365).

274 Eric Bangeman, *Google Announces Intent to Bid on 700MHz Spectrum Auction, If…*, ARS TECHNICA, July 20, 2007.

that part of the spectrum.[275] Indeed, Google bid just over the threshold price to make sure that the openness condition would be triggered, but not high enough to actually win the auction (Verizon, which won the C block paid a total of $9.6 billion for licenses including in the C block).[276]

The outcome of this power play was that Verizon committed to a non-exclusion policy at least for a part of its network, even though it initially opposed this term.[277] The conditions of openness that accompanied the 700 MHz C block were not activated because Verizon caved to competitive pressure by one of its direct competitors or some other player in the value chain. They were triggered by a combination of lobbying to convince the FCC to include the relevant terms in the auction rules,[278] and of a company's flexing its financial muscle to achieve favorable rules.[279]

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275 *Verizon, AT&T Win FCC Auction, Google Wins Open Spectrum*, AFP, March 20, 2008.

276 Sandro Brusco et al., *The "Google Effect" in the FCC's 700 MHz Auction*, 21 INFORMATION ECONOMICS AND POLICY 101 (2009); Saul Hansell, *Verizon and AT&T Win Big in Auction of Spectrum*, NEW YORK TIMES, March 21, 2008.

277 In the Matter of Service Rules, *supra* note 273, at 15360 et seq. (Verizon Wireless argues that imposing an open access business model undermines the auction process and competitive bidding ... . Verizon Wireless asserts that imposing open access regulations runs contrary to the Commission's "light regulatory touch" for wireless services generally ... . According to Verizon Wireless, requiring winners of licenses in the 22 MHz block to provide open access would impose an asymmetrical regulatory regime on only one segment of the industry, thus drawing arbitrary distinctions ... . Also, according to Verizon Wireless, the Commission cannot impose access requirements without violating various sections of the Communications Act and affecting the First Amendment rights of existing providers" (internal citations omitted)); Om Malik, *Verizon Sues, Google Expresses Dismay Over 700 MHz Auction*, GIGAOM, September 13, 2007.

278 The FCC started considering the conditions after the Public Interest Spectrum Coalition submitted a relevant proposal in its comments. *See* Ex Parte Comments of the Ad Hoc Public Interest Spectrum Coalition, PS Docket No. 06-229 and WT Docket Nos. 06-150, 05-211, 96-86, at 9, 18-19 (filed Apr. 3, 2007); In the Matter of Service Rules for the 698-746, 747-762 and 777-792 MHz Bands (Report for Order and Further Notice of Proposed Rulemaking), 22 FCC Rcd. 8064 (2007).

279 At least one analysis of the auction concludes that if it were not for Google's bidding, the openness condition would not have been triggered, because Verizon wasn't planning to meet the lowest threshold price. *See* Brusco et al., *supra* note 276 at 112, where: "We can speculate that Verizon's bidding strategy was not to bid on the C-block licenses if no other bidder bid up to the reserve price. Verizon's bidding in the early rounds of the auction is consistent with this. Thus, we speculate that, without Google's participation in the auction, the C-block reserve price would not have been met, triggering a re-auction of that block without the restrictions. In that case, we would expect prices for the C-block licenses that were more in line with the other blocks and other recent spectrum sales.".

What makes this kind of tussle rather effective is that it does not simply occur once the market is set up and ready, but rather throughout the development of the mobile telecommunications ecosystem, thereby continuously readjusting the balance of power between players. In telecommunications networks there is no final result or outcome (as opposed—say—to an architectural project), which once reached, the balance of power crystallizes. The power games are ongoing and the supply side map is subject to constant revision. In an influential paper, David Clark, who played a major role in the design of Internet protocols, eloquently talks about how engineers should design network elements and software not to accommodate all needs and goals but rather to accommodate indeterminacy. In his own words "[a]ny practicing engineer knows that the process of design is ... one of *balancing considerations* and resolving tensions to get an acceptable specification" (emphasis added).[280] Designing for tussle is to design for variation in outcome "so that the outcome can be different in different places, and [so that] the tussle takes place *within the design*" (emphasis added).[281]

Naturally, for the tussle to be effective the synthesis of the game should be such that competing interests are in fact adequately represented. This can either mean that there is a potent number of players, or that power along the value chain is not disproportionately concentrated in the hands of a single player or a class of players, who would therefore be in the position to dominate the tussle.

We think this is the case. The mobile telecommunications industry has grown vastly in complexity and scope with many more stages and actors in the value chain representing different

280 David D. Clark, *Tussle in Cyberspace: Defining Tomorrow's Internet*, 13 IEEE/ACM TRANSACTIONS ON NETWORKING 462, 463 (2005).

281 *Id*. at 466.

technologies and business arrangements,[282] so much indeed that a single actor rarely has the power and expertise to fully enforce his will.[283] In highly technical and sophisticated markets the degree of specialization and secularization is such as to lead to "an increase in the number of firms that possess the necessary technical knowledge and commercial capabilities to bring to market some component or service to … users."[284] Greenstein calls this "absense of unilateral bargaining" and brings it as a reason why the Internet, despite it accommodates dominant actors in every part of its value chain, is characterized by "innovative health:"

> "In a network with a high degree of technical interrelatedness, there are general gains to all parties from bringing routines into business processes and activities, much like there are gains to adopting standards and platforms to coordinate activities. While there may be no better way to reduce complexity, adopting such routines may require negotiation between multiple parties."[285]

Section 3.2.1 highlighted that in the decision-making process throughout the value chain many more actors than the direct competitors are implicated. And still more, the scope of the tussle as understood here goes even further to include the broader community of participating

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282 *Cf.* CHRISTOPHER S. YOO, THE DYNAMIC INTERNET 37-69 (2012) (chronicling the evolution of the broadband market from relatively homogeneous to deeply complex and diverse). On the vertical disintegration and increasing complexity of the wireless value chain *see infra* Chapter 4.

283 *See* George J. Stigler, *The Division of Labor Is Limited by the Extent of the Market*, 59 JOURNAL OF POLITICAL ECONOMY, 185 (1951) (where the author states that the higher the division of labor in an industry the more actors will be involved in the production and commercialization process).

284 Shane Greenstein, *Innovative Conduct in Computing and Internet Markets*, *in* HANDBOOK OF THE ECONOMICS OF INNOVATION VOLUME I 477, 492 (Bronwyn H. Hall & Nathan Rosenberg eds., 2010).

285 Shane Greenstein, *Glimmers and Signs of Innovative Health in the Commercial Internet*, 8 JOURNAL ON TELECOMMUNICATIONS AND HIGH TECHNOLOGY LAW 25, 63 (2010).

actors in the market. In the Google-Verizon example above the two companies were unrelated in terms of their competitive overlap. Similarly in some standard-setting proceedings, even consumers have a say. When Microsoft attempted to get the Office Open XML standard approved as an open standard, it faced the opposition of a variety of activists that feared that Microsoft would refuse to make its standard fully open and interoperable—as it pledged—and instead discriminate against or exclude competing software from reading OOXML files and competing open standards, such as the ODF.[286] In such situations, the ability or inability to exclude or discriminate is embedded in the design of the technology itself and the forces that affect the design can go well beyond the immediate competitors.

3.2.2 Demand Side Considerations

The previous part described how the technical realities of the wireless industry enable and facilitate competitive responses that limit the impact of exclusion in the market or have a dissuasive effect. This—we showed—can happen either due to technology-induced entry, or due to pressure from neighboring actors, or due to relocation of functionality or value along the production chain. Under these circumstances, the supply side of the wireless industry becomes more competitive and less likely to be conducive to the kind of exclusion that can distort the development and provision of services, applications and content.

In this part the focus is on how technology facilitates demand-side actors[287] in finding

286 *See* Ryan Paul, *OOXML Critics: ISO Approval Demonstrates The Need For Reform*, ARS TECHNICA, April 3, 2008; DeNardis, *supra* note 270, at vii-ix; Dylan Bushell-Embling, *Bias Claim on Big Office Vote*, SUNDAY MORNING HERALD, February 26, 2008;

287 In two sided platforms such as wireless telecommunications demand-side actors can be both end users and

alternatives and switching to competitors thusly bypassing exclusionary bottlenecks along the value chain. The analysis of the demand side is necessary because it is not enough for an option or alternative to be available; consumers must also be in the position to get to it. If there are multiple ways by which consumers can access their desired services, then exclusion as a strategy is rendered less effective and accordingly less of a threat in the industry.

For this conclusion to hold there need to be two conditions in place. The first one is that there are various options out there for consumers to choose from, so that if one is not available (:has been excluded) there is the possibility of switching to a substitute. This condition relates to the supply side, and as we showed previously, it appears that technology creates favorable conditions for the supply side to accommodate more entry and therefore more options for consumers.

An array of diverse options is indeed available throughout the value chain. Putting aside the applications and services layer which is where most of the heterogeneity occurs, there is also considerable variety in the application distribution layer (iPhone AppStore, Google Play, Amazon Apps, Windows Marketplace), operating systems (iOS, Andoid, Windows Phone), transmission intermediaries (cloud architectures, CDNs, IPX providers), service deployment architectures (IMS, SDNs, AaaS, NaaS), networks (cellular network, Internet, IMS, corporate intranets, other IP networks), mobile devices (phones, tablets, phablets, laptops), and last mile physical transmission technologies (cellular, femtocells, Wi-Fi, other radio bands).

All these options potentially open up multiple paths over which consumers and services and applications meet. Which brings us to the second condition, namely how easy it is to access these

service, application and content developers.

different options. If end users cannot take advantage of the alternatives in the market then there would be no way to bypass the bottleneck behind the exclusion. But we argue here that this is not the case and that through multihoming and the intricate interconnection matrix in the wireless industry consumers' ability to bypass the effect of exclusion is strengthened.

3.2.2.1 Multihoming

Multihoming is the ability of subscribers to join multiple systems (networks and platforms) at the same time. This allows them to access multiple environments and to draw complementary utility from all of them.[288] Under multihoming subscribers reap the benefits of multiple systems and do not depend exclusively on one of them. In essence, multihoming opens up multiple paths between a source (service or application developer) and a destination (end users) through the intermediaries along the value chain (operating systems, software delivery platforms, network operators, device manufacturers etc). An example of multihoming on the developers' side is the design of an application for more than one mobile operating systems (e.g. iOS and Android); an example of multihoming on the users' side is the ability to use both the cellular network and Wi-Fi on a mobile phone; an example of multihoming of players in the middle of the value chain is a device manufacturer partnering with more than one mobile operating system developers (e.g. HTC's mobile phones run Android or Windows Mobile).

Under multihoming exclusionary behavior by one system does not completely negate access to an input or distribution channel as long as one of the sides multihomes to another system. In

288 Jay Pil Choi, *Tying in Two-Sided Markets with Multi-Homing*, 58 JOURNAL OF INDUSTRIAL ECONOMICS 607, 607 (2010).

that case, actors on the demand side can turn to a competing input or distribution channel thereby bypassing the exclusionary actor. In essence, multihoming weakens the power position of bottlenecks and limits the effect of exclusionary practices, because it opens up alternative paths to connect actors in the industry.[289] The more extensive multihoming is in every level of the value chain the less power is concentrated in each link and the easier it becomes for actors to connect to each other.

The overlapping options thanks to multihoming create a form of redundancy in the market, such that market actors are not dependent on a specific device, mobile operating system, network or other element to access services, content and applications. The availability of multiple systems at the fingertips of subscribers means that multiple paths open up through which they can "meet," which reduces the possibility that they won't be able to access a service or application because of exclusionary practices.[290]

There is no doubt that multihoming is neither a perfect alternative to fully unobstructed competition nor that it guarantees that every combination of inputs and platforms will be possible, a result that could be obtained by the complete banning of exclusion. Multihoming potentially imposes a cost to subscribers (that of joining more than one systems),[291] and it can

289 *See* Nicholas Economides, *The Economics of the Internet Backbone*, *in* HANDBOOK OF TELECOMMUNICATIONS ECONOMICS 373, 383-385 (Sumit K. Majumdar et al. eds., 2006).

290 Competition is analogous to the degree of overlap between the networks subscribers multihome to. *See* Alexander Rasch, P*latform Competition with Partial Multihoming under Differentiation*, 12 ECONOMICS BULLETIN 1, 1-2 (2007).

291 Toker Doganoglu & Julian Wright, *Multihoming and Compatibility*, 24 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 45, 47; Jean J. Gabszewicz & Xavier Y. Wauthy, *Two-Sided Markets and Price Competition with Multi-homing*, at 2, *available a*t http://ssrn.com/abstract=975897; Sujit Chakravorti and Roberto Roson, *Platform Competition in Two-Sided Markets: The Case of Payment Networks*, Federal Bank of Chicago Working Paper 2004-09 (2004), at 24 et seq.. The cost does not have to be monetary. For example, when the FCC was scrutinizing the AOL – Time Warner merger, they were considering mandating that AOL Messenger be interoperable with other messengers, because AOL's argument that users can simply install and use more than one messengers (i.e. the cost of multihoming to multiple messengers) was deemed to be too

reduce welfare as well as competition under certain conditions.[292]

But its growing popularity is also a testament to the outweighing benefits both to subscribers and to platforms. Multihoming expands the potential adoption pool for developers and providers, it creates more options for end users to better serve their preferences, and it results in output increase, and price decrease in the market.[293] Additionally, multihoming creates strategic pressure on systems not to exclude for the following reason: in a two-sided system with developers on one side and users on the other side multihoming on one side reduces the incentives of multihoming on the other side, because access to the subscribers on the other side is guaranteed anyway.[294] That is, if users multihome, developers can switch from an exclusionary system to a non-exclusionary one, and they will still be able to reach all users. This creates incentives for the exclusionary system to refrain from this practice for fear of driving away developers.

For these reasons, multihoming has become prevalent throughout the mobile telecommunications value chain. ComScore reports that as of December 2013 56% of U.S. digital media consumers multihome (i.e. use more than one device to access services, content

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burdensome for users. *See* In the Matter of Applications for Consent to the Transfer of Control of Licenses and Section 214 Authorizations by Time Warner Inc. and America Online, Inc., Transferors, to AOL Time Warner Inc., Transferee, FCC 01-12, ¶ 153-174 (Memorandum Opinion and Order) (2000).

292 It can reduce competition because subscribers buy more than once and so systems don't compete for exclusivity. For the same reason it can also reduce compatibility incentives. Lack of competition can sustain prices at higher levels, and lack of compatibility can be welfare reducing when compatibility is desirable, i.e. when network effects are strong and the cost of achieving compatibility is low. *See* Doganoglu & Wright, *supra* note 291, passim.

293 *See supra* note 289, at 383-385; note 288, at 607-610.

294 This holds under the assumption that exclusive subscribers (end users or developers) to a network are more valuable than subscribers who multihome. *See* Attila Ambrus et al., *Either or Both Competition: A "Two-sided" Theory of Advertising with Overlapping Viewerships*, Working Paper, available at http://ftp.zew.de/pub/zew-docs/veranstaltungen/ICT2012/Papers/Reisinger_Ambrus_Calvano.pdf. Roson also concludes that multihoming on one side reduces the incentives to multihome on the other side. *See* Roberto Roson, *Platform Competition with Endogenous Multihoming*, Working Paper Nota di Lavoro 20.2005, *available at* ssrn.com/abstract=657901.

and applications), up from 48% earlier the same year.[295] Deloitte predicts that more than 50 million subscribers globally will receive premium programming from more than one source (e.g. pay TV and broadband).[296]

Android and Windows Mobile, which partner with multiple device manufacturers, unlike Apple or Blackberry, capture over 50% of the market.[297] Android supports alternative application platforms on top of the official Google Play (e.g. Amazon's AppStore) and installations from "unsupported" sources (e.g. a direct link from a website) which give yet another option to service and application developers to reach end users.

At the same time, most of the modern mobile communication devices support both licensed and unlicensed spectrum connectivity, doubling the channels through which consumers can access services and applications.[298] There is considerable evidence that the wireless future will be dominated by smart or cognitive radios, which allow devices to switch seamlessly between different bands of the spectrum—e.g. cellular, WiFi, WiMAX—and can represent different systems to which users can subscribe.[299]

As long as actors' needs and preferences in the telecommunications value chain remain

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295 ComScore, *U.S. Digital Future in Focus* 2014 (2014), at 7. *See also* ComScore, M*arketing to the Multi-Platform Majority* (2013).

296 Deloitte, *Technology, Media and Telecommunications Predictions 2014* (2014), at 26.

297 For a list of measurements see Wikipedia, Mobile Operating System, *available at* http://en.wikipedia.org/wiki/Mobile_operating_system#Market_share

298 Travis E. Litman, *Cognitive Radio: Moving Toward a Workable Framework for Commercial Leasing of Public Safety Spectrum*, 4 JOURNAL ON TELECOMMUNICATIONS AND HIGH TECHNOLOGY LAW 249, 256-258 (2005).

299 *See*, *e.g.*, NTIA's advisory panel opinion stating that "the communications industry is beginning the implementation of a new generation of cellular technology that incorporates smart antennas, Internet protocol, and other new techniques for content compression. Over the next 10 to 20 years, these new technologies will effectively multiply existing cellular-communications spectrum allocations by at least an additional 10 times." Michael Calabrese et al., Report from the Spectrum Inventory Working Group of the Commerce Spectrum Management Advisory Committee 4 (2010). *See also* J. Brad Bernthal et al., *Trends and Precedents Favoring a Regulatory Embrace of Smart Radio Technologies*, 2nd IEEE INTERNATIONAL SYMPOSIUM ON NEW FRONTIERS IN DYNAMIC SPECTRUM ACCESS NETWORKS, 2007.

heterogeneous and no single option can satisfy all of them, there will be room for multihoming, and as technology makes it easier, such as the case for smart radios, its relevance in the market will remain and affect the competitive abilities of players.

3.2.2.2 Interconnection and Compatibility

Multihoming as discussed previously represents a vertical relationship between actors in different levels of the value chain, and it demonstrates how the ability of a subscriber (e.g. application developer or end user) in one level to connect to multiple systems (e.g. network, platform) at another level limits the power of each individual system and makes exclusion less effective in the presence of other alternatives.

Instead of subscribers connecting to multiple systems a similar effect can be achieved horizontally by having systems in the same level connect to each other so that there are more than one path to reach a system. Several words are used to describe this arrangement but it is more commonly known as interconnection: the physical and logical connection between two actors/elements in a network for the purpose of exchanging traffic.[300] Interconnection technically presupposes that network elements "speak" the same language, otherwise they won't be able to communicate. The use of mutually agreed protocols that enable two different systems to communicate with each other makes them *compatible*,[301] and lack of compatibility is tantamount

300 *See* 47 C.F.R. 51.5; EU Directive 2002/19/EC on Access to, and Interconnection of, Electronic Communications Networks and Associated Facilities, Art. 2(b); ITU, *NGN Interconnection and Access*, GSR 2007 Discussion Paper, at 5 (2007); Daniel F. Spulber & Christopher S. Yoo, *Network Regulation: The Many Faces of Access*, 1 JOURNAL OF COMPETITION LAW AND ECONOMICS 635, 641 (2005); Gerald Faulhaber, *Access (Does not Equal) Access(1) + Access(2)*, 2002 MICHIGAN STATE DCL LAW REVIEW 677, 686 (2002).

301 Joseph Farrell & Timothy Simcoe, *Four Paths to Compatibility*, *in* THE OXFORD HANDBOOK OF THE DIGITAL

to exclusion.[302] In recent years a special kind of interconnection, known as peering, i.e. the exchange of IP traffic between providers without mutual remuneration, has surfaced as a common business settlement.[303]

What all these arrangements have in common is that they multiply the links between systems (and actors within systems) and, thereby, open up more paths through which end users can access services and applications.[304] As actors across systems become more interconnected with each other, the ability of each individual actor to affect how traffic flows decreases, because the availability of alternative paths through which data can be detoured undermines, much like multihoming, the power and effectiveness of bottlenecks and exclusionary behavior.[305] In fact, adequate interconnection has been recommended as the only necessary requirement for a network free of bottlenecks well-positioned to exclude or discriminate.[306]

Common knowledge, for example, suggests that one of the main reasons why the Internet is considered to be so resilient and also hard to regulate end to end is that it consists of several interconnected autonomous systems that are intricately linked to each other, so that if one of them fails or refuses to accept traffic, traffic can be routed around it to and from its destination.[307] As a general matter then, extensive interconnection and compatibility transform a purely vertical

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ECONOMY 34, 34-38 (Martin Peitz & Joel Waldfogel eds., 2012).

302 Nicholas Economides & Lawrence J. White, *Networks and Compatibility: Implications for Antitrust*, 38 EUROPEAN ECONOMIC REVIEW 651, 655 (1994) ("the decision to produce and sell a component that is incompatible with potentially complementary components is tantamount to exclusion.").

303 Geoff Huston, *Interconnection, Peering and Settlements*, 9 PROC. INET 1 (1999).

304 *See*, *e.g.*, David Gilo, *A Market-Based Approach to Telecom Interconnection*, 77 SOUTHERN CALIFORNIA LAW REVIEW 1, 6-7 (2003).

305 Kevin Werbach, *Only Connect*, 22 BERKELEY TECHNOLOGY LAW JOURNAL 1233, 1294-1297 (2007).

306 *Id*. at 1297 ("Interconnection, as a safety valve for routing around platform bottlenecks, is the best mechanism to tame anti-competitive behavior in such an environment.").

307 *See also* Yoo *supra* note 282, at 64 (where the author makes a similar point for secondary peering).

value chain into a “diagonal” ecosystem. If, for instance, network A blocks traffic that comes directly from source B, but is in a peering agreement with network C, which stipulates that A must accept all traffic from C (this is by definition the nature of peering agreements), then traffic from B can be rerouted through C to reach A's subscribers.[308]

The question now is whether interconnection and compatibility are dependable options in terms of their natural occurrence, that is whether industry dynamics do or will transition from a mere theoretical technical availability of interconnection and compatibility to actual implementation without the need for regulatory interference.

The prevailing line of thought suggests that as long as there are a few players of comparable size in the market, it is in their interest to interconnect and to achieve compatibility between their services.[309] The rationale is that with networks of roughly similar size none of them can unilaterally dominate the market through incompatibility or lack of interconnection, but to the contrary they can exploit stronger network effects if they combine their networks.[310] It would take indeed a rather dominant player in the market—and there is some disagreement as to the exact market share required—to make exclusion of other networks a profitable strategy.[311]

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308 *Cf*. Werbach, *supra* note 305, at 1294-1295.

309 Jacques Cremer et al., *Connectivity in the Commercial Internet*, 48 JOURNAL OF INDUSTRIAL ECONOMICS 433, *passim* (*see also* at 434 “degradation is more likely the larger the difference in installed bases.”) (2000); Michael Katz & Carl Shapiro, *Network Externalities, Competition and Compatibility*, 75 AMERICAN ECONOMIC REVIEW 424, 425 (“firms with good reputations or large existing networks will tend to be against compatibility, even when welfare is increased by the move to compatibility. In contrast, firms with small networks or weak reputations will tend to favor product compatibility...”) (1985).

310 *See* Interconnection and Resale Obligations Pertaining to Commerical Mobile Radio Services, 155 FCC Rcd. 15975, ¶ 24 (Third Report and Order) (2000). *See also* Automatic and Manual Roaming Obligations Pertaining to Commercial Mobile Radio Services, 15 FCC Rcd. 21628, ¶ 32 (Notice of Proposed Rulemaking) (2000).

311 *See* David Malueg & Marius Schwartz, *Interconnection Incentives of a Large Network*, Georgetown University Department of Economics Working Paper 1.05, at 38 (2001) (“Overall our analysis indicates that, for [given] parameter values ... global degradation is unlikely to be profitable unless the largest network controls substantially more than half the installed-base customers. Regarding targeted degradation, we found that it is profitable in CRT’s [:Cremer, Ray, Tirole] example only for a small set of parameter values.”).

Additionally, the observation that a dominant player blocks interconnection and compatibility with smaller rivals is not in itself enough to prove ability to harm smaller rivals without knowing their competitive strategy. For example, Malueg and Schwarz develop a model where competition between the excluded smaller rivals serves as a promise for higher quality to consumers and makes them more appealing than the larger network.[312] It is also known that the size of the network is not the only factor that weighs in in consumer choices; their expectations from the network as well as how well the network complements their existing choices and investments are also important.[313]

Further, even in the presence of a dominant player, refusal to interconnect or achieve compatibility does not inexorably result in anticompetitive effects. Ostensibly, a dominant player would want to block interconnection and compatibility to exclude the subscribers of the smaller networks and deprive them of positive network externalities with the ultimate goal to lure them into his own network. However, several factors need to be in place for subscribers to switch to another (even bigger) network: network effects must be strong, switching costs must be low, coordination between the smaller players must also be low[314], and subscribers must be unable or unwilling to internalize the positive externality that they will create for the network they join

312 *Id*. ("The logic is that a larger number of (Cournot) rivals implies stronger competition among them, which—for suitable consumer expectations—leads to more new subscribers being added and a concomitant increase in the relative quality of the rivals' network. Indeed, for some parameter values, if the largest network pursued global degradation then the only possible equilibrium would be tipping to the rivals. Competition among the rivals serves as a commitment to consumers that the rivals' network will expand more aggressively than would a single firm (for the same initial base), and this competition-based advantage of the rivals' network can overcome the disadvantage of its smaller installed base.").

313 Michael L. Katz & Carl Shapiro, *Systems Competition and Network Effects*, 8 JOURNAL OF ECONOMIC PERSPECTIVES 93, *passim* (1994).

314 Faulhaber, *supra* note 300, at 689-699 (where the author discusses the conditions that need to be present for anticompetitive behavior to arise. A dominant firm will opt to not interconnect if (a) it is substantially larger than its competitors, (b) there are strong network effects, (c) switching costs are low, (d) smaller players don't interconnect among themselves).

(excess momentum),[315] or the negative externality for the network they leave (excess inertia).[316] Given these factors it is entirely possible that subscribers of smaller networks do not want or do not need to switch to the larger network, and therefore the larger network's exclusionary policies are less effective causing an actor considering exclusion to steer away from it.

Moreover, a feature of interconnection and compatibility is that to achieve redundancy in the market not all actors have to be connected to all other actors. If network A interconnects with network B but not C, and C interconnects with B, subscribers of network C can still reach subscribers of network A (mutatis mutandis for compatibility). In that scenario C's bargaining position may not be in the position to strike a direct interconnection agreement with A, but the desired affect can be achieved with B's intermediation. Such indirect interconnection or compatibility may come with an additional cost, economic or technical, but this is not an issue that lends itself to ex ante regulation. Indeed, the Commission has so far refrained from specifying a particular type of interconnection (direct or indirect, IP or TDM) as evidenced by the still open debate on the transition from TDM to IP telephony in fixed and mobile networks.[317]

What the above analysis shows is first, that interconnection is an effective mechanism by which the power of each individual node in a network to serve as bottleneck is reduced, but also that for interconnection to break down to a point that actors are effectively excluded, a series of

315 Michael L. Katz, *Product Introduction with Network Externalities*, 40 JOURNAL OF INDUSTRIAL ECONOMICS 55, 55-56 (1992).

316 Joseph Farrell & Garth Saloner, *Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation*, 76 AMERICAN ECONOMIC REVIEW 940, 940-941 (1986).

317 *See, e.g.*, Reply Comments of Verizon, Connect America Fund, et al., WC Docket Nos. 10-90 et al. (Report and Order and Further Notice of Proposed Rulemaking), at 31-43 (2012) (stating that the Commission does not specify the details of interconnection) and Reply Comments of Sprint Nextel Corporation, Connect America Fund, et al., WC Docket Nos. 10-90 et al. (Report and Order and Further Notice of Proposed Rulemaking), at 19-22 (2012)(asking the Commission to adopt detailed interconnection rules).

market conditions must be in place. Are these conditions harder to encounter? Probably yes; as the telecommunications sector increases in scope and complexity we see signs of interconnection becoming denser.

The hierarchical structure of the early IP interconnection model is being supplanted by secondary peering,[318] and the generalized transition to IP multiplies the links among providers. Take for example data interconnection in the new wireless environment. On top of individually negotiated agreements directly between peers, operators can interconnect through the Internet (e.g. through VPN), but also through the so called IPX interconnection (IP eXchange), which is a collection of managed networks (IPX providers) that carry IP traffic globally among wireless operators.[319] IPX has many unique characteristics (e.g. assured QoS, cascading payments), which make it a popular and valuable market proposition.[320] In effect IPX creates an additional layer of interconnection, which in fact has many advantages over direct or Internet-mediated interconnection.[321] Because IPX is open to anyone who wants to participate, there are many IPX providers and there is competition among them. Refusal of one provider to interconnect does not, therefore, result in a network being effectively excluded from the rest of the ecosystem.

Considering that TDM service and interconnection is being phased out in favor of IP interconnection, the fact that operators have many options to choose from diminishes the

318 Yoo, *supra* note 282, at 55-69.

319 In fact, there are additional variations of IP interconnection. *See* International Interconnect Forum for Services over IP, Overview of Network Access Types for a Multiservice IP Interconnection (Release 1.1) (2012); *See, e.g*., K.R.Renjish Kumar, *International Mobile Data Roaming: Managed or Unmanaged?*, 9th IEEE Conference on Telecommunications Internet and Media Techno-Economics (CTTE), 1-9, 1-2 (2010).

320 GSM Association, Inter-Service Provider IP Backbone Guidelines 5.0, Official Document IR 34 (2011).

321 John Baldwin et al., *Evolution of the Voice Interconnection*, 2010(2) Ericsson Review 10 (2010). *See also* Natalija Gelvanovska, *Coexistence of Traditional and IP Interconnection*, ITU GSR Discussion Paper at 14-17 (2009).

emergence of real bottlenecks. And this, unlike TDM interconnection, doesn't only apply to voice service, but essentially to any type of service, application and content, since all traffic is IP traffic in next generation networks. Consequently, to the extent that the links between two points (nodes) in a network multiply, it becomes harder for each of them to acquire enough power to engage in anticompetitive exclusion. The market, instead, provides other routes to bypass it.

It is true that this may not always be the case. For instance, termination monopoly still poses a problem, because for every modality of network access, there is no route-around at the termination level.[322] But even in this case, the emergence of alternative ways of interconnection in other parts can still be helpful. There is a difference in the negotiation power vis-a-vis termination between a large operator and individual small operators (which is where the power of termination monopoly is expected to be exercised), and a large operator and an IPX provider who represents the aggregate traffic of a multitude of smaller (and/or large) operators. In the latter case, even small players can get a better deal through the collective bargaining power they can amass. Therefore, what we are suggesting here is not that new technical options for interconnection will eliminate the ability to exclude, but that they increase and enhance the bypassing mechanisms thus making aggregation of power harder.

322 *See* ERG Common Statement on Regulatory Principles of IP-IC/NGN Core, ERG (08) 26 Final NGN IP-IC CS 081016, at 78 (2008), where ERG (now BEREC) explains that "though this [:IP] ubiquitous connectivity in principle has the potential of breaking the termination monopoly for voice calls, the control functions on the service layer generally will prevent such procedure. VoIP calls are set up using higher-level protocols, e.g. SIP, that provide a translation from an individual customer's E.164 number or Intenet-style "user name" to an actual IP address that is needed for a call to be terminated. As this IP address is only known by the customer's VoIP provider, the termination monopoly is set to remain also in the NGN world as the called party's VoIP provider is still needed to terminate a call, even though only with regard to signalling matters."

3.2.3 Durability of Power

We have mentioned already that one of the factors influencing the degree of threat exclusionary power poses touches on its ability to persist in time. If it is simply transitory, regulatory or judicial measures might prove premature and unnecessarily burdensome.

The question before us now is whether we have good reasons to believe that market power in technology-intensive markets such as wireless telecommunications fades away faster than regulatory or judicial measures can meaningfully respond. This is not to say that market power is impossible to accrue in the mobile telecommunications industry,[323] but that the nature of the industry is such that some evidence of market power treated in isolation of the dynamic evolution of the industry should not be enough to substantiate concerns of dominance.[324] In this context the emergence of exclusionary practices can very well be transient and they will be eclipsed along with the market power on which they rely. As a result, the determination of harmful exclusionary conduct must rest on an elevated measure of scrutiny that can prove not only its existence, but also its ability to persist *despite* the high dynamism of the market in which it occurs.

We base this cautionary treatment of the power to exclude on the fact that technology-intensive industries, such as wireless telecommunications, exhibit strong network effects which

323 Even the most progressive of antitrust scholars consent that dominance and market distortions are a possibility that cannot be ignored and for that reason antitrust and market supervision still has a place and time. *See, e.g.*, Robert Pitofsky, *Antitrust Analysis in High-Tech Industries: A 19th Century Discipline Addresses 21st Century Problems*, 4 TEXAS REVIEW OF LAW & POLICY 129, 133 (1999) ("I believe antitrust should-indeed must-continue to apply. None of the 'high-tech differences' justifies a complete or even substantial exemption.").

324 David S. Evans & Richard Schmalensee, *Some Economic Aspects of Antitrust Analysis in Dynamically Competitive Industries, in* INNOVATION POLICY AND THE ECONOMY VOLUME II 1, 18-20 (Adam B. Jaffe et al. eds, 2002) (concluding that "a proper market-power inquiry in new-economy industries must include a serious analysis of the vigor of dynamic competition. This requires looking beyond current sales figures." *Id.* at 20).

accelerate market evolution, and on theoretical and empirical evidence that rapid technological progress undermines the competitive advantage of firms at least during the early stages of a market's development.

3.2.3.1 Network Effects in Technology-Intensive Industries

Network effects are a familiar concept in telecommunications and many of their implications are directly and widely applicable. It is well known, for example, that in network industries extreme market shares are normal, and so are unequal profits,[325] and also that network markets tend to tip, and so competition *for* the market is often fierce (and very productive).[326] These effects expose the re-enforcing nature of network effects within the industry. But taking it a step further, we will focus here on one of the lesser known aspects of network effects, which relates to their catalyzing impact on the speed of market power accumulation and loss. The argument is that network effects help firms gain market power faster than if network effects were not present, but the same reason can eventually result in the firms' own demise making market power volatile.[327] Therefore, any exclusionary practices that are enabled by such market power may be temporary and lacking the ability to inflict long-term harm on the industry.

A market is characterized by network effects when the participating players derive more

325 *See* Nicholas Economides & Frederick Flyer, *Compatibility and Market Structure for Network Goods*, Stern School of Business Discussion Paper EC-98-02 (1998).

326 Jeffrey H. Rohlfs & Hal R. Varian, BANDWAGON EFFECTS IN HIGH TECHNOLOGY INDUSTRIES 13-18 (2005); Michael L. Katz & Carl Shapiro, *Technology Adoption in the Presence of Network Externalities*, 94 JOURNAL OF POLITICAL ECONOMY 822 (1986).

327 *See* Nicholas Economides & Charles Himmelberg, *Critical Mass and Network Evolution in Telecommunications, in* TOWARD A COMPETITIVE TELECOMMUNICATIONS INDUSTRY: SELECTED PAPERS FROM THE 1994 TELECOMMUNICATIONS POLICY RESEARCH CONFERENCE 47 (Gerard Brock ed., 1995).

value from joining or participating as their number grows. This externality occurs either because the value of the market is directly tied to the number of players in it (e.g. a telephone network becomes more valuable as the number of subscribers that can be reached through it increases), or indirectly because the number of players in the market drives up the number of complements that will be created for the market making it more valuable (e.g. the value of an operating system increases with the applications that are written for it).[328]

The link between value and size means that size leads to value and value, in turn, causes size to grow in an ever-increasing feedback loop. This is also known as "the rich get richer effect" and demonstrates how network effects magnify the impact of the already installed base to attract even more players, and the larger the base becomes the greater the pull towards the network.[329] Consequentially, when network effects are involved the customers base grows faster than when network effects are absent. Therefore, large market shares build up and market evolution occurs at higher rates in network industries.[330] In the words of Economides and Himmelberg, who examine the growth of the fax market from introduction to maturity "the tremendous surge in demand was not driven as much by outside shifts in consumer demand and price reductions as much as it was driven by the 'feedback' effect induced by both past increases and anticipated future increases in the size of the installed base."[331]

However, the same goes for competitors. When an incumbent actor is challenged by a new

328 *See* Nicholas Economides, *The Economics of Networks*, 14 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 673, 675-699 (1996).

329 DAVID EASLEY & JON KLEINBERG, NETWORKS, CROWS & MARKETS: REASONING ABOUT A HIGHLY CONNECTED WORLD 479 et seq. (2010); Joseph Farrell & Paul Klemperer, *Coordination and Lock-In: Competition with Switching Costs and Network Effects, in* HANDBOOK OF INDUSTRIAL ORGANIZATION VOLUME III 1967, 1974 (Mark Armstrong & Robert Porter eds., 2007)

330 *See* Economides & Himmelberg, *supra* note 327, at 58.

331 *Id*.

entrant, any network effects that accrue to the entrant work to the disadvantage of the incumbent,[332] because they help the entrant grow faster. As this process repeats itself, players in network industries enjoy fast growth, but upon emergence of a competing wave of network effects, they also face *rapid displacement*.[333] To the extent that entry is possible and competitors are drawn into the market, even extreme market shares can dissipate quickly. Hence, the mere observation of market power in isolation of factors that can cause it to disappear rapidly, is not good evidence to fear persistent and harmful exclusionary behavior.[334]

Technology-intensive industries are good candidates for the kind of rapid succession of waves described here. Technological networks that are characterized by network effects are prevalent in every stage of the mobile telecommunications value chain. For example, Nokia's Symbian application ecosystem grew rapidly until 2008, when Apple's App Store was introduced and soon took the lead, until itself was undercut a few years later by competition from Android, today's largest application platform.[335] In a matter of less than a decade three major platforms succeeded each other as the leader in their relevant market.[336] In a similar manner, Facebook overthrew previous social networks that were already large and established in a matter of a few years, even though it was a late entrant in the social networks race.[337]

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332 The network effects that accrue to the entrant do not have to rely on the same factors as those that accrued to the incumbent.

333 *See* Sangin Park, *Quantitative Analysis of Network Externalities in Competing Technologies: The VCR Case*, 86 REVIEW OF ECONO STATISTICS 937 (2004) (where the author examines how network effects helped the VCR standard overtake the Betamax standard).

334 *See also* Evans & Schmalensee, *supra* note 324, at 14 ("the rational expectation of significant market power for some period of time is a necessary condition for dynamic competition to exist in high-technology industries. Thus if dynamic competition is healthy, the presence of short-run market power is not a symptom of a market failure that will harm consumers.").

335 For the relevant market shares see Wikipedia, List of mobile software distribution platforms

336 *See similarly* Evans & Schmalensee, *supra* note 324, at 12, 17.

337 Priit Kallas, *Top 10 Social Networking Sites by Market Share of Visits* [June 2013], DREAMGROW, *available at*

To be sure, network effects are not the only—perhaps not even the defining—factor of success; Facebook still dominates social networks not because of lack of newcomers, but, among others, because it is good at what it does. But the point here is that everything else equal, network effects accrue to extant players as well as entrants, and that can accelerate the cycle of creative destruction. Anyone concerned about market power in technological industries should be mindful of the inherent volatility of this kind of Schumpeterian competition. When the competitive advantage stems from a structural characteristic of the industry, as are network effects, any entrant is a potential candidate to exploit the same characteristic that boosted the incumbent leader in that position and replace him.

3.2.3.2 Rapid Progress in Technology-Intensive Industries

Exclusion is further hard to achieve when the advantage on which an actor relies to serve as a bottleneck is based on a technical design that can soon become obsolete. Acute technological dynamism in an industry can quickly render a player and his practices irrelevant. This is true for every industry that exhibits some measure of progress, but high technology industries are thought to progress even faster, with frequent new developments sending recurrent waves of pressure to existing players.[338]

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http://www.dreamgrow.com/top-10-social-networking-sites-by-market-share-of-visits-june-2013.

338 *See, e.g.*, Pitofsky, *supra* note 323, at 131 ("New generations of products, undermining existing market power, appear more frequently in high-tech than in mature industries. In the first half of the 20th century, firms in steel, oil and aluminum remained dominant for generations, but that is often not the case in many high-tech industries. An oft-cited example involves IBM, which probably was a dominant firm, if not a monopolist, in certain markets when the government initiated its case in 1969, but which had lost monopoly power in many of these markets when the case was abandoned thirteen years later.").

A variety of explanations has been offered in support of this view. Network effects, for the reasons explained previously, is one of them. Further, sectoral surveys over the past twenty years have suggested that traditional sources of advantage such as economies of scale, advertising, distribution systems, and R&D, albeit still important, can sometimes be trumped by such features of technology-intensive industries as lower barriers to entry, more frequent technological change, ease of switching on the side of consumers, the dominant role of intellectual property and high rates of patenting and cross-licensing.[339] These developments increase mobility in the market and allow only temporary advantage until competitors catch up with or outmaneuver aggressors.[340] In no small part because of the technological interdependence vehement standard competition and continuous experimentation are considered staple characteristics of high technology industries.[341] Some scholars have gone as far as to suggest that "hypercompetition"—the idea that the competitive advantage is getting harder to maintain in today's environment—characterizes not only technical industries, but industries across the board.[342] This should elevate the threshold of proof for when market power is resilient enough to be of concern.

It has also been noted that technology-intensive industries present greater product differentiation and are in a better position to address niche audiences and more specialized

339 *See, e.g.*, RICHARD D'AVENI, HYPERCOMPETITION: MANAGING THE DYNAMICS OF STRATEGIC MANEUVERING 4-10 (1994); Richard Schmalensee, *Antitrust Issues in Schumpeterian Industries*, 99 AMERICAN ECONOMIC REVIEW 192 (2000); Lacy Glenn Thomas, *The Two Faces of Competition: Dynamic Resourcefulness and The Hypercompetitive Shift*, 7 ORGANIZATION SCIENCE 221 (1996); Guy Gellatly & Valerie Peters, Understanding the Innovation Process: Innovation in Dynamic Service Industries 20 (Statistics Canada, Research Paper No. 127 (1990).

340 Bala Chakravarthy, *A New Strategy Framework for Coping with Turbulence*, 38 SLOAN MANAGEMENT REVIEW 69 (1997).

341 Greenstein, *supra* note 285, at 46-63.

342 Robert R. Wiggins & Timothy W Ruefli, *Schumpeter's Ghost: Is Hypercompetition Making the Best of Times Shorter?*, 26 STRATEGIC MANAGEMENT JOURNAL 887 (2005); Lacy Glenn Thomas & Richard D'Aveni, *The Rise of Hypercompetition from 1950 to 2002: Evidence of Increasing Industry Destabilization and Temporary Competitive Advantage*, Tuck School of Business Working Paper (2004).

consumer needs.[343] The larger scope of available solutions leads to higher "internal" competition, faster obsolescence and ultimately to new waves of innovation.[344] Lucrative niche markets can then serve as the source of funding for the new waves of innovation.[345]

Moreover, because in highly technical industries human capital and know-how often form a large part of the innovation cost, disruptive innovations that affect business models and organizational paradigms are easier to bring to the market compared to innovations that require primarily capital-intensive investments.[346] In such an environment market leaders may have a hard time maintaining their dominance against rivals.[347] It is true that along the wireless telecommunications value chain, the above conditions apply to some layers more than to others. For example, last mile infrastructure is traditionally considered capital-intensive even for wireless networks. However, as explained in more detail in Chapter 4, what we are noticing is that the stages in the production chain are becoming increasingly decoupled, which means that entering the market in one of those stages is cheaper, easier and more feasible, than if a firm had to enter at multiple levels. The ability to introduce localized innovations drops the cost and increases evolutionary vigor of the industry.[348]

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343 Eric H. Kessler & Alok K. Chakrabarti, *Innovation Speed: A Conceptual Model of Context, Antecedents, and Outcomes*, 21 ACADEMY OF MANAGEMENT REVIEW 1143, 1156–57 (1996).

344 Morton I. Kamien & Nancy L. Schwarz, Market Structure and Innovation 9-11 (1982); Ross Brennan, *Evolutionary Economics and the Markets-as-Networks Approach*, 35 Industrial Marketing Managemnt 829, 831–32 (2006).

345 Kessler & Chakrabarti, *supra* note 343.

346 Thomas F. Cooley & Mehmet Yorukoglu, *Innovation and Imitation in an Information Age*, 1 JOURNAL OF EUROPEAN ECONOMIC ASSOCIATION 406, 407 (2003).

347 *See* Walter J. Ferrier et al., *The Role of Competitive Action in Market Share Erosion and Industry Dethronement: A Study of Industry Leaders and Challengers*, 42 ACADEMY OF MANAGEMENT JOURNAL 372 (1999).

348 Dieter Elixmann et al., *"Next Generation Networks" and Challenges for Future Competition Policy and Regulation*, 50 COMMUNICATIONS AND STRATEGIES 239, 250-1 (2003); JYH-CHENG CHEN & TAO ZHANG, IP-BASED NEXT-GENERATION WIRELESS NETWORKS: SYSTEMS, ARCHITECTURES AND PROTOCOLS 20 (2004); BARBARA VAN SCHEWICK, INTERNET ARCHITECTURE AND INNOVATION 119-121 (2010).

The above theoretical arguments have been also been partly validated by empirical evidence, although the available literature is thinner than one would expect and some conflicting conclusions remain. From the relevant studies Thomas, and Wiggins & Ruefli corroborate the theoretical underpinnings of hypercompetition.[349] Thomas examined 200 manufacturing industries over the 1958–1991 interval and Wiggins and Ruefli examined over 40 industries from 1978 to 1997, and both found that sustained superior economic performance attenuates faster over time, which means that competitive advantage is harder to maintain.[350] Castrogiovanni, on the other hand, sampled 88 industries during the 1967–1992 time interval and found no support for the hypothesis that dynamism (which he defines as instability of sales, employment, value added and price-cost margin) in "new" industries increases.[351] Vaaler and McNamara, fall somewhat in the middle, finding statistically significant correlation between very high performing technical industries (as opposed to simply highly technical industries) and a decrease in abnormal returns, which they used as proxy for dominance.[352]

From the combination of the theoretical and empirical literature it is safe to say that technology-intensive industries are *at least* very *likely* to progress rapidly, and, at a minimum, faster than other industries. Therefore, one should remain wary toward the observation of significant market power or even abusive (read:exclusionary) practices based thereupon, because it may well mean either that this is the natural modus operandi of the industry or that the firm under scrutiny is simply trying to compete in the cutthroat environment of technology-intensive

349 Thomas, *supra* note 339; Wiggins & Ruefli, *supra* note 342.

350 *Id*.

351 Gary J. Castrogiovanni, *Organization Task Environments: Have They Changed Fundamentally Over Time?*, 28 JOURNAL OF MANAGEMENT 129 (2002).

352 Paul M. Vaaler & Gerry McNamara, *Are Technology-Intensive Industries More Dynamically Competitive? No and Yes*, 21 ORGANIZATION SCIENCE 271 (2010).

industries. Schmalensee in his defense of Microsoft's exclusionary practices against Netscape notes that

> "in a 'winner take most' business, any profit-seeking firm must have such an objective [i.e. to crush its competitors]. Microsoft' s intention to compete hard enough to maintain its market position necessarily entailed excluding Netscape from a major role in the platform business. Similarly, in 1995 Marc Andreessen, a founder of Netscape, expressed his intention to compete in the platform business by asserting that Netscape intended to reduce Windows to an unimportant collection of 'slightly buggy device drivers.'"[353]

We do not mean to say that the accumulation of market power is never a problem in high technology industries, but rather that an elevated measure of scrutiny and extreme caution are warranted in forming hypotheses and reaching conclusions as to when seemingly anticompetitive practices have the potential to inflict long-term harm and are worthy of regulatory or judicial response.

This is particularly true during the early stages of an industry's or product's development. While the literature discussed previously does not differentiate between the various phases in an industry's or product's evolution, there is additional evidence that young (as opposed to mature) industries are even more unstable and fast-changing, and the argument that caution should be exercised applies with greater vigor during that early phase.

353 Schmalensee, *supra* note 339, at 195.

As early as the 1950s the *product life cycle theory* introduced the familiar S-curve to describe how products and markets mature.[354] It distinguishes between four stages—introduction, growth, maturity and decline—[355]of which introduction is when the product develops its main qualities and characteristics, and innovation rates are high, as is risk.[356] Abernathy, Utterback and Dosi, also divide evolution in two phases, the *pre-paradigmatic* and the *paradigmatic*.[357] The pre-paradigmatic phase roughly corresponds to the introduction stage of the product life cycle theory, and is characterized by fluidity in design, high uncertainty, innovation and experimentation, small market size and low demand.[358] Once a *dominant design* emerges, the market moves to the paradigmatic phase, which sees increasing standardization around the dominant design and market expansion, much like the growth and maturity stages of the product life cycle theory predicts.[359]

Other theories prolong the phase during which products and markets are volatile and under

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354 Joel Dean, *Pricing Policies for New Products*, HARVARD BUSINESS REVIEW, November 1950, at 45. For a graphical summary of different curves of product life cycles *see* David R. Rink, & John E. Swan, *Product Life Cycle Research: A Literature Review*, 7 JOURNAL OF BUSINESS RESEARCH 219, 221-223 (1979). *See also* William E. Cox, Jr., *Product Life Cycles as Marketing Models*, 40 JOURNAL OF BUSINESS 375 (1967). The PLC theory is applicable to both individual products and markets; *see* Yoram Wind, *A Note on the Operationalization of the Product Life Cycle Concept*, Wharton Working Paper 3-4 (1975), *available at* https://marketing.wharton.upenn.edu/files/?whdmsaction*id*.=public:main.file&fileID=1884.

355 *See* MICHAEL PORTER, COMPETITIVE STRATEGY 158 (1980). *See also* PHILIP KOTLER & KEVIN LANE KELLER, MARKETING MANAGEMENT 571-574, 590 (13th ed. 2008).

356 *See* Porter, *id*. at 159-161.

357 James M. Utterback & William J. Abernathy, *A Dynamic Model of Process and Product Innovation*, 3 OMEGA: THE INTERNATIONAL JOURNAL OF MARKETING MANAGEMENT 639 (1975); Giovanni Dosi, *Sources, Procedures, and Microeconomic Effects of Innovation*, 26 JOURNAL OF ECONOMIC LITERATURE 1120 (1988). *See also* Michael L. Tushman & Philip Anderson, *Technological Discontinuities and Organizational Environments*, 31 ADMINISTRATIVE SCIENCE QUARTERLY 439, 441 (1986); Scott Gallagher & Seung Ho Park, *Innovation and Competition in Standard-based Industries: A Historical Analysis of the US Home Video Game Market*, 49 IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT 67 (2002). *See generally* DEVENDRA SAHAL, PATTERNS OF TECHNOLOGICAL INNOVATION (1981).

358 Utterback & Abernathy, *id.* at 643. Utterback & Abernathy, *id.* at 44-45.

359 *Utterback & Abernathy*, *id*. at 644-646. Utterback & Abernathy, *id*. at 44.

constant reshaping. In the *complex products and systems* (CoPS) literature, in which telecommunications is the paradigmatic example, the unit of analysis is a system made up of components that adhere to an overall architecture,[360] and it never really takes a final form due to the continuous recombinability of its components, and because not all of its parts develop at the same pace.[361] Similarly platform studies attempt to explain evolution of platform industries and products through a separation between the platform itself and its inputs/components, and note that initially the overall architecture of the platform is set up, then the ecosystem around the platform is mobilized to attract more complements and finally the platform matures and complements proliferate.[362]

Although the number of stages in these theories fluctuates,[363] there is a clear evolutionary path common to all of them: initially, new products, services and markets go through a flux stage during which they acquire the main characteristics that will define their form throughout their life cycle; then, they enter the phase where details in the design are filled in, the product or service takes its most representative form and the market expands around it.[364]

For the introductory phase they emphasize that it is highly experimental and fluid,[365] and

360 Mike Hobday, *Product Complexity, Innovation and Industrial Organization*, 26 RESEARCH POLICY 689, 691-692 (1998); Andrew Davies, *The Life Cycle of a Complex Product System*, 1 INTERNATIONAL JOURNAL OF INNOVATION MANAGEMENT 229, 230-232 (1997). *See also* Ying-Tao Ren & Khim-Teck Yeo , *Research Challenges on Complex Product Systems (CoPS) Innovation*, 23 JOURNAL OF THE CHINESE INSTITUTE OF INDUSTRIAL ENGINEERS 519, 521-523 (2006).

361 Davies, *id.* at 233-238; Hobday, *id.* at 700-701.

362 Thomas R. Eisenmann, *Managing Proprietary and Shared Platforms: A Life-Cycle View*, HBS Working Paper 07-105, at 2 (2007).

363 There are many other variations on top of those presented here. *See, e.g*, Pink & Swan, *supra* note 354, at 222; CHESTER WASSON, DYNAMIC COMPETITIVE STRATEGY AND PRODUCT LIFE CYCLES 3-10 (1978). Utterback & Abernathy, *supra* note 357, at 641–45.

364 *See* Dosi, *supra* note 1159-1163, at 157-158; Fernando F. Suarez, *Battles for Technological Dominance: An Integrative Framework*, 33 RESEARCH POLICY 271, 271 (2004); James M. Utterback & Fernando F. Suarez, I*nnovation, Competition, and Industry Structure*, 22 RESEARCH POLICY 1, 5-7 (1993).

365 Donald K. Clifford, Jr., *Leverage in the Product Life Cycle*, DUN'S REVIEW (May 1965), *passim*.

that there is constant redesign and adaptation to match market feedback, which itself is rudimentary, and to correct perceived errors in the initial design.[366] The inherent potentials of an innovation are unclear and so is consumer demand and needs.[367]

Accordingly, any market power that builds up during this phase is contingent upon the success of the proposed design, something that neither the firm not regulators or courts are in the position to know. During this phase the innovator should be let alone "[to] be intimately coupled to the market," which involves picking the right partners and, as a logical inference, excluding those that are deemed inappropriate or threatening.[368] The ability to move swiftly in the market without externally imposed obligations and restrictions enhances coordination, accelerates the emergence of standards and processes for resources to be able to work together, and attracts investment in necessary resources (if nothing else at least by diminishing free riding).[369]

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This chapter discussed the effect of technology on firms' ability to effectively exclude other firms in upstream or downstream markets. The overall conclusion is that it makes the buildup of the necessary power to exclude harder. This is because the technical nature of the industry makes entry and mobility along the value chain easier, which heightens the competitive forces firms are

366 Porter, *supra* note 355, at 159-161.

367 Trevor J. Pinch & Wiebe E. Bijker, *The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other*, 14 SOCIAL STUDIES OF SCIENCE 399, 421 et seq. (1984).

368 David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RESEARCH POLICY 285, 290-291 (1986).

369 *See* Eisenmann, *supra* note 362, at 3-6; *See also* Eisenmann et al., *Opening Platforms: How, When and Why?*, Harvard Business School Working Paper (2008), *passim*.

subject to. Further, it multiplies the links through which players in the industry can meet each other thereby limiting the exclusionary power of bottlenecks. Lastly, it makes market power more volatile and transitory because technological dynamism accelerates the evolution of the industry.

The ability to exclude is one of the primary considerations to assess the effect of exclusion in the industry. Together with the underlying incentives to exclude, and the possible offsetting efficiencies, they inform regulators on when exclusion can harm the competitive process in the market. Absent the required power for this, exclusionary practices will remain a limited scope inconvenience, which may not justify a generalized regulatory response.

4 . Vertical Specialization, Technical Interdependencies and the Incentives to Exclude

For regulators the ability of firms to amass the kind of market power that would allow them to foreclose a considerable line of commerce is perhaps the main indication of a problematic market structure that needs to be addressed. In the previous chapter we attempted to document how various technological characteristics of the wireless industry make the buildup of market power harder.

At the same time, however, industrial organization has taught us that ability doesn't equal implementation. Rather, the decision of firms to exclude is also co-determined by whether exclusion is a strategy that makes good business sense (in simple but not inaccurate terms this translates into profitability of the strategy).[370] And while—setting aside regulation and antitrust and assuming ability—the instinctive reaction to exclusion is often that it is desirable since it deprives competitors of essential channels upstream or downstream thereby being harmful to them, the reality is that firms do not always have the incentives to do so. Not only that, but to the contrary, it is well established that they may have incentives to voluntarily open up to other firms, even if they are or once were competitors. The reason for that is the complementary relationship that develops between firms. For instance, Skype (or similar applications) has for many years been considered a threat to wireless operators, which lead to a number of operators blocking it.[371] Today, not only is it permitted on wireless networks, but some operators have

370 *See supra* 2.2.2.

371 *See* In the Matter of Preserving the Open Internet Broadband Industry Practices, GN Docket No 09-191, at ¶ 35 et seq. (2010). Cf. BEREC, A View of Traffic Management and Other Practices Resulting in Restrictions to the Open Internet in Europe, BoR (12) 30, at 5 et seq (2012).

made it an integral part of their business model, by operating mainly as bit pipes and relying on Skype to provide the rest of the necessary functionality.[372] Evidently, for those operators exclusionary incentives against Skype transformed into cooperative incentives.

In this chapter we trace how the technological characteristics of the wireless telecommunications industry support and facilitate this transformation. We particularly focus on the role of technology as a factor that generates complementary relationships and interdependencies among firms, thusly weakening exclusionary incentives. Industry organization theories that date back to Stigler's vertical specialization hypothesis, and continue today with Jacobides' market formation theory and Langlois' market modularity theory demonstrate that interdependencies tend to arise as the industry's scope and specialization increase.[373] In this environment actors can find themselves moving from a state of self-sufficiency, where external actors can be seen as pure competitors and therefore as potential threats that are to be excluded, to a state of interdependency where actors need to work together to create and enlarge the market, and then compete in dividing it up. As we shall see, less than two decades ago, wireless operators and equipment manufacturers held all the necessary components to offer telecommunications services. Today, service development and deployment, operating systems, transport facilities, devices and spectrum can all be found separately in the market, and actors

372 We refer here to companies such as Scratch Wireless, TextNow, Republic Wireless, Cablevision Wi-Fi calling, and FON. For the relevant discussion *see infra* 4.2.2.2.2 .

373 George Stigler, *The Division of Labor is Limited by the Extent of the Market*, 59 JOURNAL OF POLITICAL ECONOMY 185 (1951); Michael Jacobides, *Industry Change Through Vertical Disintegration: How and Why Markets Emerged in Mortgage Banking*, 48 ACADEMY OF MANAGEMENT JOURNAL 465 (2005); Eugenia Cacciatori & Michael G. Jacobides, *The Dynamic Limits of Specialization: Vertical Integration Reconsidered*, 26 ORGANIZATION STUDIES 1851 (2005); Richard Langlois, *Modularity in Technology and Organization*, 49 JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION 19, 32-34 (2002); Paul L. Robertson & Richard N. Langlois, *Innovation, Networks and Vertical Integration*, 24 RESEARCH POLICY 543 (1995). For the relevant discussion *see infra* 4.2.2.1.

who used to internalize multiple components and functions and who competed as an integrated system with other similarly structured systems, can now turn to specialized segments of the market. For instance, when Nokia shipped its smartphones with its own Symbian OS, Android and Windows Phone were competitors and were shut out of Nokia's ecosystem. Once Nokia gave up Symbian, Android and Windows Phone, along with their service and applications ecosystems became complements. Again, in transitioning from an integrated and self-sufficient system to one that welcomes external inputs, there was a concomitant shift in the treatment of those inputs from potential competitors and therefore good candidates to exclude, to potential complements and therefore good candidates to embrace.

The chapter is structured as follows. We begin by laying down the economic theory behind the incentives to exclude. Exclusion can be a powerful strategy in the market but it isn't always the case that firms have something to gain from excluding competitors. As the adherents to the Chicago School suggested with the one monopoly rent theorem, if a firm can extract all the benefits of exclusion from other arrangements, it can forego risky exclusionary strategies. Further, exclusion can be motivated by pro-competitive efficiency gains, rather than anti-competitive aggressive ones. In the presence of efficiencies, while exclusion may disadvantage competitors, the overall effect in the market is a positive one. Lastly, as we've already suggested, the industry structure can change in a way that causes a partial shift from competition to cooperation and a concomitant shift from exclusionary to cooperative incentives. Various economic theories including co-opetition and platform studies have analyzed this phenomenon.

In the spirit of this thesis we then move to complement the economic analysis of exclusionary incentives with a technology-centric analysis. The technological realities of the

wireless industry affect both efficiency justifications and cooperative incentives. We examine efficiencies separately in Chapter 5, because their implications go beyond just incentives, and in this part we focus on the influence technology has on the intensification of actors' positive incentives to cooperate.

The argument can be summarized as follows: technological progress allows and causes greater specialization in the industry, which results in the emergence of specialized clusters of resources and knowledge along the value chain. As scale and scope grows, the production stages of the industry's value chain begin to become separable and to have the potential to form distinct markets to which formerly internalized activities can now be outsourced (the availability of applications like Skype as separate components is an example of a modularized production chain that was enabled, among others, by the transition to the IP protocol stack). Initially, when the industry is dominated by self-sufficient vertical systems of production, external competitors along the stages of production chain may be seen as a threat and therefore be excluded from the system. But as production stages become more clearly defined in the industry, and specialized clusters become increasingly efficient and they multiply, the incentives to exclude can be replaced by incentives to cooperate with them. As the decoupling between production stages increases, the necessary components of a system are to be found in different parts of the value chain, but because they still need to work together as parts of a system of production, interdependencies arise, and their resolution lies in the cooperation between the various actors and components.

4.1 An Overview of Firms' Economic Incentives to Exclude

One of the cornerstones of the free market is that firms are free to partner with whomever they wish.[374] In exercising this right firms will open up to some firms while excluding others, a decision that depends not only on what they can do (*ability*) but also on what they want to do (*incentive*). The incentive to exclude should not be assumed, because there are circumstances under which firms can get to the same result without resorting to risky exclusionary practices, or because they have positive incentives to cooperate. Additionally, industrial organization studies have documented how firms frequently engage in exclusion not so much with the intention to harm their competitors, but to achieve efficiencies that will likely prove welfare enhancing. To determine, then, the risk exclusion poses in the market, regulators need not only assess whether firms have the ability to perform it but also whether it makes business sense for them (usually measured in profitability), in other words whether they have an incentive to do so. Understanding the general economic theory around exclusionary incentives is essential in showing, then, how the technology-intensive nature of wireless telecommunications influences them.

4.1.1 Firms May Have an Incentive to Exclude But Not Always Primarily to Curb Competition

It is hard to deny that blocking a firm from accessing necessary inputs or distribution channels can bring it in a disadvantageous position. As mentioned supra in Chapter 2, exclusion

374 *See* U.S. v. Colgate & Co, 250 U.S. 300 (1919).

can raise competitors' costs, it can raise entry barriers, and it can cause firms to exit the market if they cannot secure the necessary inputs or access to markets. These are all good ways to gain a competitive advantage.

However, contrary to the intuitive assumption, market players' actions are not always motivated by the desire to disadvantage their competitors. It has long been shown that certain business practices that may appear anticompetitive on their face, in essence can have other underlying motivations, and mainly the achievement of efficiencies.[375] They can still have a negative impact on competitors, but this comes as a side-effect, not as the primary motivation. When the incentives to exclude are tied to efficiencies strong enough to countervail the negative effect of exclusion, the exclusionary strategy should not only be allowed, but even welcome.[376]

The discussion of efficiencies in industrial organization and antitrust is broad enough to warrant separate examination (see infra Chapter 5). Suffice is to note here that the motivation to exclude in order to achieve efficiencies is predicated on the belief that systems can benefit greatly from being very selective as to the inputs, functions and components that will be admitted into the system.[377] This is particularly true for efficiencies in complex technical systems that develop intricate interdependencies among their constituent parts. For such systems, looking at them as a whole and as the minimum unit of analysis (as opposed to looking at systems at the component level) helps discern how the ability to block out undesired elements and interactions

375 For a recent review *see* David Reiffen & Michael Vita, *Is There New Thinking on Vertical Mergers*, 63 ANTITRUST LAW JOURNAL 513 (1995).

376 *See*, *generally*, William Kolasky & Andrew Dick, *The Merger of Guidelines and the Integration of Efficiencies into Antitrust Review of Horizontal Mergers*, 71 ANTITRUST LAW JOURNAL 207, 213-217, 223-224, 231-235 (2003); Alan A. Fisher & Robert H. Lande, *Efficiency Considerations in Merger Enforcement*, 71 CALIFORNIA LAW REVIEW 1983 (1983).

377 *See* United States v. Jerrold Electronics Corp., 187 F. Supp. 545 (1960); Aspen Skiing Co. v. Aspen Highlands Skiing Corp., 472 U.S. 585 (1985).

from the system can have a positive effect on their integrity and cohesion, especially while the interactions among its parts have not yet stabilized.[378] Also, the ability to depart from uniform treatment of partners (i.e. exclude or discriminate against some while accepting others) is a necessary precondition for the formation of efficient interactions *among* industry players, when the interactions under consideration are still fluid. When such considerations are in place, the potentially adverse effect on the excluded firms is not the main incentive behind the excluding firm's decision, and therefore should not alarm regulators.

4.1.2 Firms May not Have an Incentive to Exclude If They Can Extract the Same Benefit Otherwise

In the original formulation of exclusion as a potentially anticompetitive strategy the goal was stated to be that a monopolist in one level of the value chain could leverage his power to gain dominance in another level, by not transacting with those firms that it sought to exclude, with the purpose (and effect) of depriving them from a necessary input or market or of raising their costs.[379] Consider for example a monopolist cable network provider which also owns an

378 *See* Andrew Davies, *Innovation in Large Technical Systems: The Case of Telecommunications*, 5 INDUSTRIAL AND CORPORATE CHANGE 1143 (1996); Bernward Joerges, *Large Technical Systems: Concepts and Issues*, *in* THE DEVELOPMENT OF LARGE TECHNICAL SYSTEMS 9, 23-24 (Renate Mayntz & Thomas P. Hughes eds., 1988).

379 The first case to introduce this theory was Motion Picture Patents Co. v. Universal Film Co., 243 U.S. 502, 518 (1917). Before that Justice White had offered a dissent where he set out the foundations of the theory using the example of a patent holder who uses the monopoly accorded to him by the patent in one market to extend power in another. Maybe this is why later the theoretical treatment of exclusion started with the case of a monopolist. *See* Henry v. A.B. Dick Company, 224 U.S. 1 (1912) ("Take a patentee selling a patented engine. He will now have the right by contract to bring under the patent laws all contracts for coal or electrical energy used to afford power to work the machine or even the lubricants employed in its operation."). For a theoretical treatment see RICHARD POSNER, ANTITRUST LAW: AN ECONOMIC PERSPECTIVE 171-72 (1976); James M. Ferguson, *Tying Arrangements and Reciprocity: An Economic Analysis*, 30 LAW & CONTEMPORARY PROBLEMS 552, 561-62 (1965).

upstream programming division that competes with another programming producer. The argument is that the cable network provider has an incentive to block the competing programming company, which, deprived now of any means to reach viewers, is driven in a disadvantageous position.[380]

This is an intuitive argument, but because it was formulated in an unqualified way it was quickly attacked and discredited. As the Chicago School explained, a monopolist (or a dominant player mutatis mutandis) in one level of the value chain does not have a reason to extend power in other levels too, because it can extract all the profit or exert all and any type of control in the monopoly level (*"one monopoly rent"* theorem).[381] In the example above, if viewers are willing to pay -say- up to $100 to get programming through the cable network, the network provider can extract the entire amount at the network provision level, which obviates the need or desire to exclude competing programming companies in the upstream part of the value chain.

In broader, non price terms, the theorem essentially suggests that as long as there is another, less controversial way to achieve a similar result, actors may not resort to exclusionary practices. That said, the theorem has not escaped criticism and is subject to important exceptions.[382]

First, the one monopoly rent theorem does not hold if the monopoly market is regulated (Baxter's Law).[383] Regulators may either cap the maximum price the monopolist can charge or

380 This situation is similar to the famous but now discredited decision Brown Shoe Company v. United States, 370 U.S. 294 (1962).

381 *See*, *among others*, ROBERT BORK, THE ANTITRUST PARADOX: A POLICY AT WAR WITH ITSELF 225, 372-374 (1978); W. KIP VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 249 (4th ed. 2005).

382 Louis Kaplow, defending the Harvard tradition, noted that "the fact that all these points [:the economic arguments advanced by the Chicago School] have long been understood intuitively by businesses, although perhaps only more recently bolstered by sophisticated economic analysis, suggests that conventional wisdom derived through experience, unrigorous as it might be, should not be rejected so quickly on the basis of elementary reasoning." *See* Louis Kaplow, *Extension of Monopoly Power Through Leverage*, 85 COLUMBIA LAW REVIEW 515, 555 (1985).

383 This theory was named after William Francis Baxter, who as an Assistant Attorney General from 1981 to 1983

impose terms that limit the monopolist's control of the product or service. In this case the monopolist can try to recoup the lost profit or bypass the regulatory terms by exercising *residual* control in the secondary market.

Second, if the product or service in the secondary market (the one that the dominant player supposedly does not have an incentive to expand power to) is valued by consumers not only as a complement to the dominant player's primary market, but also independently as a complement in neighboring markets, the dominant player can use his power in the primary market to expand power in those neighboring markets.[384] For example, iTunes is a complement to Macintosh computers, but also to iPods. Apple has an incentive to make consumers use iTunes on computers (and accordingly an incentive to block other music players on its system), because the ability to seamlessly transfer and synchronize their music to the iPod can serve as a reason to sell more iPods. Therefore, Apple, although it cannot benefit from excluding music players in the *computer market* (because it can extract the full price from the computer), it still has an incentive to block them in that market to enhance its position in a *neighboring market*.

Third, the one monopoly rent theorem holds only if the secondary markets is competitive, which signifies that players in that market lack power (vertical or horizontal), so that the dominant player *can in fact* extract the full monopoly amount.[385] If more than one levels of the

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oversaw the breakup of AT&T. *See* William F. Baxter, *Conditions Creating Antitrust Concern with Vertical Integration by Regulated Industries-"For Whom the Bell Tolls,"* 52 ANTITRUST LAW JOURNAL 243 (1983).

384 *See* Viscusi et al., *supra* note 381, at 275-278. *See also* Patrick Rey & Jean Tirole, *A Primer on Foreclosure*, *in* HANDBOOK OF INDUSTRIAL ORGANIZATION, VOL III, 2145, 2182 et seq. (2007).

385 PHILLIP E. AREEDA & HERBER HOVENKAMP, ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THE APPLICATION, ¶756b2 (3rd ed. 2008). *See also* Olympia Equipment Leasing Co v. Western Union Telegraph Co., 797 F.2d 370, 374 (1986) (where Judge Posner explains that "in general a monopolist like any other firm wants to minimize its input costs; the lower those costs are, the greater the monopoly profits it will be able to make. Therefore the rational monopolist will usually want his input markets to be competitive, for competition usually will minimize the costs the he has to pay for his inputs.").

value chain have dominant players, and therefore two sequential dominant players can charge supra-competitive prices, the result is two consecutive welfare losses (double marginalization).[386] In this case, the monopolist might have an incentive to exclude, but because of the market power of the other actor and in view of double marginalization, it is welfare enhancing to choose a cooperative strategy (see below) or vertical integration.[387]

4.1.3 Positive Incentives to Cooperate Rather Than to Exclude

A more recent turn in the study of firms' motivations in the market looks not so much into why firms would want to foreclose competitors from upstream or downstream markets, but rather why they would actively seek to cooperate with them. Because cooperation and exclusion can be seen as inversely correlated, the greater the incentives to collaborate, the lower the danger of exclusion. The two main lines of scholarship that have explored cooperative relations between competitors are the idea of co-opetition, and platform studies. Although not identical, both rely on the concept that interdependencies between market players can shift their incentives from keeping each other out of their respective line of business to trying to jointly enlarge the market and then compete in terms of how to divide it up among themselves.

The fact that exclusion and cooperation are inversely correlated means that in most of the cases both exclusion and cooperation will coexist on firm's spectrum of competitive strategy.[388]

386 Viscusi et al., *supra* note 381, at 238-240. Double marginalization is originally traced back to Cournot, see AUGUSTIN COURNOT, RESEARCHES INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH 103 (1838, reprinted in 1927).

387 Viscusi et al., *supra* note 381, at 240.

388 *See* Maria Bengtsson & Sören Kock, *Cooperation and Competition in Relationships Between Competitors in Business Networks*, 14 JOURNAL OF BUSINESS AND INDUSTRIAL MARKETING 178, 180-182 (1999) (where the

We note this to say that even if cooperative incentives are on the rise, stronger exclusionary incentives may still lead a firm to opt for an exclusionary strategy. Because it is uncertain which strategy prevails, incentives behind both should be examined.

4.1.3.1 From Pure Competition to Co-opetition

In the last two decades, industry analysis started moving away from the bipolar view that industry actors are either partners or competitors to embrace a larger and more nuanced spectrum of industry relationships. Surely, industry actors can often be pure competitors in the sense that they have nothing to gain from each other,[389] or that their products or services are developed independently and in isolation from each other but still compete for the same customers. In this case, it is true that they likely have no reason not to jump at every opportunity to disadvantage competitors, including by exclusionary practices.

However, what industrial organization analysis has started to notice more and more frequently is that industry players sometimes rely on each other in the process of developing and delivering their products and services.[390] The motivation behind the approximation of industry actors can be found in a variety of reasons, including the increased complexity and larger capital

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authors analyze the spectrum of relationships between firms in coexistence, cooperation, co-opetition, and competition).

389 One might disagree even with that seemingly intuitive description of competition in the market. In the words of Kohn who rejects pure competition: "The simplest way to understand why competition generally does not promote excellence is to realize that trying to do well and trying to beat others are two different things." ALFIE KOHN, NO CONTEST: THE CASE AGAINST COMPETITION 55 (1992).

390 Mosad Zineldin, *Co-opetition: The Organisation of the Future*, 22 MARKETING INTELLIGENCE AND PLANNING 780, 780-781 (2004) (where the author suggests that industry cooperation is based on "a value net of involved actors – suppliers, distributors, subcontractors, "complementors", competitors–who collectively add value to one another's organisations." at 781).

requirements of product and service development,[391] the focus on one's core abilities and the reduction of costs and risks,[392] and the synergies that can develop by combining resources from different actors.[393] Classic and unlikely partnerships include Microsoft "saving" Apple in 1997 by investing in it and by agreeing to make Microsoft Office—a key complement for operating systems—available for Mac OS for five years;[394] and Google teaming up with Mozilla to limit Internet Explorer's, Bing's and Yahoo!'s market share, even though Google and Mozilla both compete in the browser market.[395]

It is suggested that such economic motivations behind cooperation are even more pronounced in technology-intensive industries, including telecommunications,[396] for a variety of economic reasons that include the heavy research and development requirements, which sometimes force companies to seek cost-sharing agreements;[397] the reduced cost-recuperation period from products and services due to their short lifetime;[398] and the facilitating effect of

391 For a comprehensive overview see John Hagedoorn, *Understanding the Rationale of Strategic Technology Partnering: Interorganizational Modes of Cooperation and Sectoral Differences*, 14 STRATEGIC MANAGEMENT JOURNAL 371, 373-374 (1993). See also Gautam Ahuja, Collaboration Networks, *Structural Holes, and Innovation: A Longitudinal Study*, 45 ADMINISTRATIVE SCIENCE QUARTERLY 425 (2000);

392 James B. Quinn, *Strategic Outsourcing: Leveraging Knowledge Capabilities*, MIT SLOAN MANAGEMENT REVIEW, Summer 1999. Carmen Medina et al., *Characteristics of Innovative Companies: A Case Study of Companies in Different Sectors*, 14 CREATIVITY AND INNOVATION MANAGEMENT 272 (2005).

393 Lars Bengtsson & Christian Berggren, *The Integrator's New Advantage – The Reassessment of Outsourcing and Production Competence in a Global Telecom Firm*, 26 EUROPEAN MANAGEMENT JOURNAL 314, 316 (2008).

394 John C. Abell, *Aug. 6, 1997: Apple Rescued – By Microsoft*, WIRED, August 6, 2009. For more examples of Microsoft-Apple partnerships *see* Kevin McLaughlin, *Microsoft And Apple Actually Don't Loathe Each Other, And Here Are Examples Of Them Working Together*, BUSINESS INSIDER, June 28, 2013.

395 Kara Swisher, *Google Will Pay Mozilla Almost $300M Per Year in Search Deal, Besting Microsoft and Yahoo*, ALLTHINGSD, December 22, 2011.

396 *See, e.g.*, Medina et al., *supra* note 392, *passim.*

397 Devi R. Gnyawali & Byung-Jin Park, *Co-Opetition Between Giants: Collaboration with Competitors for Technological Innovation*, 40 RESEARCH POLICY 650, 652 (2011).

398 *Id*.

technology in reducing costs and risk.[399]

The coming-together of industry actors shifts their relationship from a purely competitive one to one that combines the characteristics of competition and cooperation, which has come to be known by the portmanteau co-opetition.[400] Such a relationship is not simply about the exchange of resources among actors, but about establishing *ties of interdependence*, which bind the fates of the actors together.[401] When this occurs actors form strategic groups, and the formation of groups in turn affects the intensity of competition within and between groups: competition within the group attenuates compared to competition with external actors, because of the mutual dependency and shared interests among group members.[402] In effect, among actors that develop a relationship of co-opetition it is expected to see a drop in incentives to disadvantage their partners.

Naturally, not all industry actors will want to engage in some sort of collaboration, and neither is the alignment of incentives a given.[403] A series of well-known transactional challenges

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399 Eric K. Clemons & Michael C. Row, *Information Technology and Industrial Cooperation: The Changing Economics of Coordination and Ownership*, 9 JOURNAL OF MANAGEMENT INFORMATION SYSTEMS 9 (1992).

400 ADAM M. BRANDENBURGER & BARRY J. NALEBUFF, CO-OPETITION (1997); Maria Bengtsson & Sören Kock, "*Coopetition" in Business Networks—to Cooperate and Compete Simultaneously*, 29 INDUSTRIAL MARKETING MANAGEMENT 411 (2000) distinguish between relationships that are dominated by cooperation, those where cooperation and competition are equally distributed and relationships that are dominated by competition, *id*. at 415-416.

401 Giovanni B. Dagnino, *Coopetition Strategy: A New Kind of Interfirm Dynamics for Value Creation*, *in* COOPETITION STRATEGY: THEORY, EXPERIMENTS AND CASES 25, 28 (Giovanni B. Dagnino & Elena Rocco eds., 1999).

402 Richard Caves & Michael Porter, *From Entry Barriers to Mobility Barriers: Conjectured Decisions and Contrived Deterrence to New Competition*, 91 QUARTERLY JOURNAL OF ECONOMICS 241 (1977). Gulati et al. see this as a result of the fact that actors have limited time and resources to form and serve the interests of alliances and by selecting to ally with some partners others are ipso facto excluded. Those who are excluded will not enjoy the fidelity and cooperative spirit of the alliance. *See* Ranjay Gulati et al., *Strategic Networks*, 21 STRATEGIC MANAGEMENT JOURNAL 203, 210-211 (2000).

403 For a list of conditions that need to be fulfilled *see* Zineldin, *supra* note 390, at 781-782 (including among others that each party wants to "give up" something of value, and that the parties are able to communicate their needs and requirements to each other).

place several obstacles along the way towards striking a partnership that will shift an actor's behavior from seeking to disadvantage a competitor to actually working with one: opportunism, bounded rationality and information asymmetry, the uncertainty stemming from asset specificity, all hinder the “meeting of minds” among actors.[404] However, co-opetition retains its usefulness as a concept with normative relevancy in telecommunications policy to the extent that it defines a considerable percent of industry relationships.[405]

The emergence of cooperative schemes in the industry should not be construed as that the institutional process of competition is weakened. It simply changes form, and moves away from seeking to disadvantage competitors in a zero-sum game (i.e. the gain of one player equals the loss of another),[406] and into jointly maximizing the market value and then *competing to divide it up*.[407]

For example, the establishment of common interfaces or compatibility that enables products and services by different actors to communicate, is a cooperative process that creates value for all involved players by maximizing the utility users draw from the devices (and the network that arises among them), while at the same time players compete by differentiating their devices on

404 *See* Ronan McIvor, *Outsourcing: Insights from the Telecommunications Industry*, 8 SUPPLY CHAIN MANAGEMENT: AN INTERNATIONAL JOURNAL 380, 381-382 (2003); Medina et al., *supra* note 392, at 317. *See also* Zineldin, *supra* note 390, at 786-787.

405 *See supra* note 4.1.3.1.

406 At the 1997 Macworld Expo, when the landmark mutually supportive deal between Apple and Microsoft was announced, Steve Jobs famously stated “If we want to move forward and see Apple healthy and prospering again, we have to let go of this notion that for Apple to win, Microsoft has to lose.” *See* Alyson Shontell, *TIP OF THE DAY: "We Have To Let Go Of This Notion That For Apple To Win, Microsoft Has To Lose*," BUSINESS INSIDER, *available at* http://www.businessinsider.com/tip-of-the-day-we-have-to-let-go-of-this-notion-that-for-apple-to-win-microsoft-has-to-lose-2010-9.

407 Devi R. Gnyawali & Byung-Jin Park, *Co-Opetition Between Giants: Collaboration with Competitors for Technological Innovation*, 40 RESEARCH POLICY 650, 652 (2011). *See also* Joseph Farrell et al., *The Vertical Organization of Industry: Systems Competition Versus Component Competition*, 7 JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY 143 (1998).

quality or price.[408] In this context, not only do actors refrain from excluding others, but they are actively trying to engage them to enlarge the value of the network and subsequently of the market. In another example, a roaming agreement between two otherwise competing operators helps both of them expand their footprint. In turn, the expanded presence in new areas can help an operator build the necessary capital, clientèle and brand name to solidify in the future its presence with facilities investment in those areas that until that point were served by virtue of roaming agreements. In effect the cooperative roaming agreement will have helped a competitor become stronger.

In Part 4.2 below, where we focus on the relationship between the technical nature of mobile telecommunications and incentives, we complement the economic reasoning here with the argument that the disintegration of the industry's production chain assisted by the technological decoupling of intermediate stages of production and the resulting technical interdependencies shift the industry actors' incentives from exclusion to cooperation.

4.1.3.2 Insights from the Platform Theory

The early industrial economics thinking as presented previously took a somewhat insular approach as to the value of each level in the value chain. A retail store that carried ten products

408 Think for example two media players that initially only play proprietary media files, but then become compatible. This not only expands each player's market, but it can also increase media production because the market for media players is not fragmented and media files can reach more people. The overall gains and losses from compatibility are assessed on the basis of whether one values more differentiation or adoption scale. *See* Jeffrey Church & Neil Gandal, *Platform Competition in Telecommunications*, *in* THE HANDBOOK OF TELECOMMUNICATIONS ECONOMICS (VOLUME 2): TECHNOLOGY EVOLUTION AND THE INTERNET 119 (Martin Cave et al. eds., 2006); Ramón Casadesus-Masanell & Francisco Ruiz-Aliseda, *Platform Competition, Compatibility and Social Efficiency*, *available at* http://ssrn.com/abstract=1287439.

from the upstream to the downstream market was of the same value (to consumers) as a retail store that carried a hundred products. The value of the downstream market did not change in response to what was happening in the upstream market and the total value to consumers in both cases was simply the sum of the value of the purchased product and that of the services offered by the retail store (distribution).

Along came platform studies, which tied the value of the platform to its complements. Most network elements in the telecommunications value chain function as platforms in the sense that they provide common services to other elements for the completion of functions and operations; as such platforms are by nature in a co-dependent relationship with their complements.[409] In fact, a common conceptualization of networks is that they are essentially a series of platforms built one on top of another, and the service that reaches the end user comes as the result of the combination of various resources along the value chain.[410]

Platform theory suggests that the value of a platform is dynamically adjusted based on the quantity, and in more sophisticated models the quality, of the complements that run on top of the platform. Here, we use the same argument on the nature of platforms to make a point about the *incentives* a platform owner might have to exclude.[411]

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409 Annabelle Gawer & Rebecca Henderson, *Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel*, 16 JOURNAL OF ECONOMICS & MANAGEMENT STRATEGY 1, 1-3 (2007); Geoffrey G. Parker & Marshall W. Van Alstyne, *Innovation, Openness and Platform Control*, PROCEEDINGS OF THE 11TH ACM CONFERENCE ON ELECTRONIC COMMERCE (June 7-10, 2010), at 95.

410 Phil J. Weiser, *Law and Information Platforms*, 1 TELECOMMUNICATIONS AND HIGH TECHNOLOGY LAW JOURNAL 1, 3 (2002)

411 Note that we are using the platform argument here in it simplest form, whereby the nature and capabilities of the platform and complements are irrelevant factors. We don't account here for circumstances where, for example, the complements and the platform do not work well together due to technical incompatibility. In reality, the decision of a platform to open up to complements is more strategic and considers among others on the nature of the end product, the capabilities of the platform, the diseconomies of having too many complements, the risks involved, the maturity of the platform and the complements market and others. For now we are not interested in these internal-to-the-firm considerations. *See, e.g.*, Joel West, *How Open Is Open Enough? Melding Proprietary*

The basic intuition regarding incentives flows directly from the value argument: Because the value of the platform grows with the number of complements it can accommodate, it is in the interest of the platform owner to allow as many complements as possible. Farrell and Weiser call this theory *"internalizing complementary efficiencies"* (ICE) and propose that the interest of the platform owner consists in that it can internalize the value created by the complements through the pricing system.[412] Speta has supported a similar theory of *"indirect network externalities,"* whereby platform owners have an incentive to provide the most valuable set of complements, from which consumers derive value allowing the platform owner in turn to charge more for the platform.[413] By extension, these theories say that, everything else equal, value grows with the number or quality of complements and this is to the benefit of the entire system, including complementors, platform owners and consumers, because all these actors share the generated value.[414]

The incentives stemming from platform theories are not without limitations. Much like the original set of arguments that did not account for platform dynamics, there are circumstances under which a platform owner will not be able to internalize the externalities generated by

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and Open Source Platform Strategies, 32 RESEARCH POLICY 1259 (2003); Thomas R. Eisenmann, *Opening Platforms: How, When and Why*, *in* PLATFORMS, MARKETS AND INNOVATION 131 (Annabelle Gawer ed., 2009); Kevin Boudreau, *The Boundaries of the Platform: Vertical Integration and Economic Incentives in Mobile Computing*, MIT Sloan School of Management Working Paper 4565-05 (October 2005).

412 Joseph Farrell & Philip J. Weiser, *Modularity, Integration, and Open Access Policies: Toward a Convergence of Antitrust and Regulation in the Internet Age*, 17 HARVARD JOURNAL OF LAW AND TECHNOLOGY 85, 100-105 (2001).

413 James B. Speta, *Handicapping the Race for the Last Mile?: A Critique of Open Access Rules for Broadband Platforms*, 17 YALE JOURNAL ON REGULATION 39, 76-77 (2000). The theory of complements reaches the same results. *See* Brandenburger & Nalebuff, *supra* note 400, at 12 et seq..

414 *See also* ANNABELLE GAWER & MICHAEL A. CUSUMANO, PLATFORM LEADERSHIP: HOW INTEL, MICROSOFT, AND CISCO DRIVE INDUSTRY INNOVATION 1-14 (2002); MARCO IANSITI & ROY LEVIEN, THE KEYSTONE ADVANTAGE: WHAT THE NEW DYNAMICS OF BUSINESS ECOSYSTEMS MEAN FOR STRATEGY, INNOVATION, AND SUSTAINABILITY (2004).

inputs, and so the incentive not to exclude disappears.[415]

A major exception emerges when the platform is regulated or generally when it is not free to choose its pricing system (e.g. because of competitive pressures).[416] Unable to extract higher rents from complements, the platform owner loses the incentive to nurture the complements market. Farell and Weiser further theorize that the platform owner, by expanding into the upstream market can more easily price discriminate.[417] Price discrimination is not usually seen as a means to exclude, but the ability of an actor to capture more market segments by virtue of price discrimination can make it harder for other players to compete effectively (and are consequently excluded).[418] This statement only says that by means of price discrimination an actor can expand into more markets and as a result leave out other players; it is silent as to whether this is welfare enhancing or desirable in the eyes of consumers or developers.[419] Lastly, a platform owner can have an incentive to use its power at the platform level to raise barriers of entry in the complements market if it fears that a complement might threaten the platform market.[420] In this

415 *See generally* Farell & Weiser, *supra* note 412, at 105 et seq. *See also* Lawrence Lessig & Mark Lemley, *End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era*, 48 UCLA LAW REVIEW 925, 947-949 (2000) (citing support from Mark Cooper, *Open Access to the Broadband Internet: Technical and Economic Discrimination in Closed, Proprietary Networks*, 71 UNIVERSITY OF COLORADO LAW REVIEW 1011 (2000)).

416 *See* Farell & Weiser, *supra* note 412, at 105-107.

417 *Id.* at 107-109.

418 Areeda & Hovenkamp, *supra* note 385, at 318.

419 *See* Farell & Weiser, *supra* note 412, at 108 (where they note that "the platform monopolist's desire to price discriminate can outweigh ICE and lead it to exclude efficient innovation or price competition in complementary products.")

420 This theory found prominent application in the Microsoft Case. *See* United States v. Microsoft Corp., 87 F. Supp. 2D 30, 38 ("In this case, Microsoft early on recognized middleware as the Trojan horse that, once having, in effect, infiltrated the applications barrier, could enable rival operating systems to enter the market for Intel-compatible PC operating systems unimpeded. Simply put, middleware threatened to demolish Microsoft's coveted monopoly power."). See also the related concept of X-Inefficiency, according to which a dominant player may not always act to maximize profits or efficiency, but instead pursue tactics whose sole purpose is to perpetuate market power. *See* Harvey Liebenstein, *Allocative Efficiency vs. X-Inefficiency*, 56 AMERICAN ECONOMIC REVIEW 392 (1966).

case the platform owner can sacrifice the value added by that additional complement to save the greater value of maintaining the dominant position in the platform market.

Both supporters and opponents of the symbiotic relationship between industry players see the positive argument but also the limitations of it.[421] For regulators, the holy grail would be to locate the exact point where cooperative incentives stop and exclusionary incentives begin, and regulate accordingly. While this is clearly unrealistic, simply identifying whether there is a trend towards one side or the other is still useful to inform regulators, because it tells them to what extent forward-looking precautionary measures are appropriate, and also helps them contextualize existing industry practices. What we attempt to do below is to demonstrate that the technological characteristics of the wireless telecommunications industry are such that generate more interdependent relationships and cooperative incentives today than in the past. As a consequence the type of exclusion that aims at undermining the competitive conditions in the market is limited.

4.2 VERTICAL SPECIALIZATION, TECHNICAL INTERDEPENDENCIES AND THE SHIFT FROM EXCLUSIONARY TO COOPERATIVE INCENTIVES

The positive economic incentives discussed previously demonstrate that even in highly competitive markets there is often room for cooperation. The theories of co-opetition and platforms highlight how firms sometimes need each other to complement their own products or services thereby making them more valuable to consumers, expanding the market and increasing

421 *See, e.g.*, C. Scott Hemphill, N*etwork Neutrality and the False Promise of Zero-Price Regulation*, 25 YALE JOURNAL ON REGULATION 135 (2008), and *contra* Robin S. Lee & Tim Wu, *Subsidizing Creativity Through Network Design: Zero-Pricing and Net Neutrality*, 23 JOURNAL OF ECONOMIC PERSPECTIVES 61 (2009).

profitability. It is an open issue to what extent firms will transition from insular competition to interdependent and co-opetitive relationships, but we posit that the industry seems to be on a path towards the latter. This trend, we submit, is motivated by the economic and technological characteristics of the wireless telecommunications value chain which induce the *disaggregation* of the industry value chain and generate technical interdependencies among actors as a product or service is being developed and delivered to end users.

Disaggregation of the industry's value chain is the process by which the production stages and components of telecommunications services and products are decoupled from each other so that they can exist outside of a vertically integrated system and can be procured separately from the market. [422] For example, mobile telephony as a service/application was once available only through vertically integrated carriers that owned most of the necessary components along the value chain to make mobile telephony possible: the intelligence for the service/application and the rest of the network management and routing functions all resided in the four layers of the SS7 protocol suite and were integrated in the operators' network equipment; the actual transport facilities were also owned by operators, as well as the spectrum through which consumers connected to the network.[423] The one last component that was necessary was the mobile device

422 A disaggregation process similar to the one described in this chapter has been documented for the personal computer industry by Bresnahan and Greenstein *in* Timothy F. Bresnahan & Shane Greenstein, *Technological Competition and the Structure of the Computer Industry*, 47 JOURNAL OF INDUSTRIAL ECONOMICS 1, 37-38 (1999); Timothy Bresnahan, *New Modes of Competition*, *in* COMPETITION, INNOVATION AND THE MICROSOFT MONOPOLY: ANTITRUST IN THE DIGITAL MARKETPLACE, 155 (Jeffrey Eisenach and Thomas M. Lenard eds., 1999).

423 RAY HORAK, TELECOMMUNICATIONS AND DATA COMMUNICATIONS HANDBOOK 182 (2007) ("An IP-based system is fundamentally quite different from one based on TDM. A conventional TDM system is monolithic in nature, much like a special-purpose mainframe computer associated with a circuit switch. Such a system is designed as a stand-alone computer with a proprietary operating system and closed APIs to interface adjunct computers for voice mail and other messaging applications. Trunk-side signaling and control protocols are SS7 and QSIG. As the intelligence and databases associated with a conventional TDM system resides in the centralized CPU, the telephones essentially are dumb voice terminals.").

and this combined the actual device and the operating system. Today, all of those production elements are to a smaller or greater degree available separately in the market and the provision of mobile telephony is possible by combining from different players the voice call service/application, the service delivery architecture (e.g. IMS, network-as-a-service (NaaS), infrastructure-as-a-service (IaaS)), transport facilities, spectrum, mobile device and operating system. Placing a Skype call on an Android device by Samsung on an MVNO's network is an example of how disaggregated elements come together for the purposes of a service that was once centralized and integrated.

When the industry is dominated by self-sufficient integrated systems the relationship they develop is a competitive one, because they serve the same market and they don't need each other. Each system possesses the necessary components to offer services and they compete with each other to attract consumers.[424] But when some of the components become separately available in the market, competition can be both between systems and between components.[425] For example, two wireless operators compete with each other as systems but their voice service competes with Skype as components. In this relationship, there are likely exclusionary incentives against Skype. These incentives however can turn into cooperative ones under two circumstances: first if the complement grows in value so much as to raise the overall value of the system more than it detracts by competing with the system's own offerings. This is the case with MVNOs which, although typically compete with the host MNO, MNOs seem to think that MVNOs better utilize the leased spectrum because of their novel business models or niche access. Second, when a

424 CARL SHAPIRO & HAL VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY 232-233 (1999).

425 Farrell, *supra* note 407; *See also* Michael Katz & Carl Shapiro, *Systems Competition and Network Effects*, 8 JOURNAL OF ECONOMIC PERSPECTIVES 93 (1994); Shapiro & Varian, *id*.

vertically integrated system completely gives up a formerly internalized component and instead procures it from the market. Some operators, for instance, promote Skype and similar solutions as the default dialing application, instead of the traditional embedded phone capability.[426] In a sense, they promote the replacement of a formerly integrated component (voice telephony application) with a third-party application, making it a complement, not a competitor.

For these transformations to take place, the production layers must become clearly defined and modular, otherwise they won't be able to exist separately. This process requires the technical delineations of their functions and limits as well as the development of interfaces that specify their interactions with the rest of the value chain and reflect the interdependencies among them. The transition to IP-based networks, the new architecture of wireless networks, and the increasing importance of software-defined functionality, all help in that direction.

It is important to address here two points. First, the fact that the steps of the production process become decoupled in a way that allows them to form separate modules does not mean that firms may not elect to keep that part of the production process internalized. Industry disintegration, which we examine here, is not the same as firm disintegration.[427] This is to say that, while an industry's value chain can comprise clearly discernible and separable levels with specialized actors in each of them, which gives the *option* to procure something externally, some firms may still find it preferable (for economic or technological reasons—and indeed there are many)[428] to keep that part of the production process internalized and remain (to a larger degree)

426 *See* the detailed discussion *infra* at 4.2.2.2.2.

427 *See* Rahul Kapoor, *Persistence of Integration in the Face of Specialization: How Firms Navigated the Winds of Disintegration and Shaped the Architecture of the Semiconductor Industry*, 24 ORGANIZATION SCIENCE 1195, 1197-1198 (2013).

428 For an overview *see* Medina et al., *supra* note 392, at 322.

integrated. As mentioned previously integrated wireless operators representing the traditional business model coexist with the new disintegrated service provision model that relies on a combination of third-party components.

Second, the gradual disaggregation documented in more detail below and the resulting technical interdependencies may create incentives for collaboration but they do not ipso facto completely preclude exclusionary practices for as long as integration remains a common, indeed the predominant, industry structure. But at the same, even though some actors may retain overarching control over the production process, the production stages gradually decouple, and actors increasingly procure the necessary knowledge, resources, components and services they need from specialized actors. As the industry's production process moves from insular systems that compete en bloc, each producing what they need internally for the most part, to an amalgam of specialized actors, the interdependencies and cooperative incentives multiply the same way the economic incentives based on platform theories encourage firms to open up to inputs and complements, and the same way the economic incentives of co-opetition cause firms to collaborate towards creating and enlarging markets before they compete to capture a share.

We proceed as follows. Part 4.2.1 explains that technical interdependencies develop among the various parts of the wireless telecommunications value chain because the functionality and operation of one part in a system is affected by the functionality and operation of other parts. These interdependencies make complementarities between different layers vital to the success of the actors in each layer and strengthens the incentives for mutually beneficial relationships. Then, Part 4.2.2 traces the greater disaggregation of the telecommunications industry's production chain today compared to only a couple of decades ago. In a disaggregated value chain

where there are more decoupled components, interdependencies intensify. Similarly to the economic interdependencies that arise in platform and co-opetitive relationships, technical interdependencies create a mutual interest to match the interdependent parties' needs, goals and capabilities, marking a turn to cooperation.

4.2.1 Technical Interdependencies Among Components and the Need for Cooperation

As mentioned previously, firms can have positive economic incentives to cooperate rather than to exclude when they see other firms not exclusively as competitors but also as complementors too: firms need each other’s productive capabilities to deliver a finished product or service to end users (unless they can internalize the entire production chain). Such complementarities generate *economic interdependencies* between firms in the industry and make them allies to the extent that their business plans are intertwined towards offering a finished product or service.

At the same time, in highly technical industries actors also develop *technical interdependencies*, which means that how one actor positions itself in the market in terms of the technology, design, specifications and architecture of its products and services is a function of what other actors do in the market. When the technological choices and capabilities of one actor are tied to those of others, strong incentives are developed for cooperation, and indeed stronger than in other industries where the technological choices of one actor may not have as noticeable

an impact on the fate of others upstream and downstream in the value chain.[429] For example, the relationship between network operators and manufacturers of operators' equipment is not simply one of buyer-seller, but more *symbiotic,* to the extent that many of the technical specifications that go into the products are co-decided with the network operators (as well as with actors from other parts of the value chain).[430]

To work out dependencies actors need to jointly establish *common interfaces* that will allow the exchange of technical information, expertise and resources among components.[431] Much like other systems, telecommunications systems are composed of multiple interconnected components that interact to achieve stated purposes.[432] The particular way they are linked together and the common "language" they use to be able to interact defines the system's architecture,[433] and in turn much of a system's purpose, operation, performance, capabilities and requirements.[434]

The development of interfaces requires, naturally, the collaboration of all parties that are seeking to become interoperable. Collaboration can either be embedded in the design of the system or brought about by ensuring that "each participant's well-being is partially dependent on

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429 MARTIN FRANSMAN, THE NEW ICT ECOSYSTEM: IMPLICATIONS FOR POLICY AND REGULATION 41-42 (2010).

430 *See id.*

431 The particular selection and configuration of links and interfaces among components can have a significant impact on the system and they can be responsible for the creation of new capabilities and limitations. As Maier and Rechtin have put it "the greatest leverage in system architecting is at the interfaces." MARK W. MAIER & EBERHARDT RECHTIN, THE ART OF SYSTEMS ARCHITECTING 128 (2nd ed. 2000).

432 INTERNATIONAL COUNCIL ON SYSTEM ENGINEERING, SYSTEMS ENGINEERING HANDBOOK 11 (2nd ed. 2004); THOMAS P. HUGHES, NETWORKS OF POWER: ELECTRIFICATION IN WESTERN SOCIETY, 1880-1930 ix (1983); Mike Hobday, *Product Complexity, Innovation and Industrial Organization*, 26 RESEARCH POLICY 689, 690-698 (1998). *See also* Ying-Tao Ren & Khim-Teck Yeo, *Research Challenges on Complex Product Systems (CoPS) Innovation*, 23 JOURNAL OF THE CHINESE INSTITUTE OF INDUSTRIAL ENGINEERS 519 (2006).

433 *Id*. at 12.

434 STEVEN D. EPPINGER & TYSON R. BROWNING, DESIGN STRUCTURE MATRIX METHODS AND APPLICATIONS 8-9 (2012).

the well-being of the other participants."[435] When a single firm controls all the necessary components in a system, embedding collaboration rules in the system's design is an option. However, when the components that need to be linked together belong to different firms the input of all involved parties is required, which creates strong incentives for firms to cooperate.

The effect is exacerbated as the number of components, resources and actors that need to be linked together and work together grows. The heightened disaggregation of the necessary resources, components and technical expertise creates greater mutual *dependencies* among actors. If all necessary resources and functions could be subsumed under the umbrella of a single actor, that actor would have little incentive (economic or technological) to cooperate with anyone else in the industry. But to the extent that the necessary components are to be found in different parts of the value chain, actors cease to be self-sufficient.

4.2.2 The Vertical Specialization and Disintegration of the Mobile Industry

The next step now is to examine whether the mobile telecommunications industry is home to interdependencies of the kind that creates disincentives to exclude. In answering affirmatively, the basic idea that we are advancing here is that the mobile telecommunications industry is increasingly structured in a way that allows players to procure necessary components from the market instead of having to produce them internally, a trend that can partly replace exclusionary practices with cooperative practices.

As we show below the mobile telecommunications industry has grown in scope and

435 Maier & Rechtin, *supra* note 431, at 129.

deepened in specialization, which in turn caused parts of the production process to become decoupled and more clearly defined and components and expertise to spread across a multitude of actors. When the production process is integrated, external knowledge, components and resources might be seen as a threat to the integrated system, and therefore be subject to exclusionary practices. As specialization and decoupling make specialized (sub)markets more efficient, demand for them grows and they ultimately solidify as a separate specialized production stage in the industry. While this process unfolds it puts pressure on systems of integrated production to embrace the external specialized markets. To the extend they do, the initial incentives to exclude are transformed into incentives to cooperate with actors in that market in order to work out the technical and economic interdependencies that arise.

We proceed in two steps; first, we lay down the theoretical foundations on how industries disaggregate and then we examine this process in the mobile telecommunications industry.

4.2.2.1 The Vertical Specialization Hypothesis

Any inquiry into industry disintegration is bound to have as its starting point Stigler's hypothesis that vertical disintegration is the typical development of growing industries, due to the emergence of specialized firms that can provide more efficiently what integrated firms had to produce internally in lack of other alternatives.[436] The pattern that flows from Stigler's theory is that industries are initially dominated by vertically integration of production, and over time, they

436 George Stigler, *The Division of Labor is Limited by the Extent of the Market*, 59 JOURNAL OF POLITICAL ECONOMY 185, 189-190 (1951). *See also* Steven Klepper, *Industry Life Cycles*, 6 INDUSTRIAL AND CORPORATE CHANGE 145 (1997).

transform into a vertically specialized structure with new entrants that specialize in a specific stage of production.[437] In their decline, industries revert back to integration, because demand shrinks, and along with it scope and the need for specialization and division of labor.[438] The disintegration of the production chain doesn't inexorably result in the disintegration of firms as well. In fact, in many industries where the stages of the production chain were decoupled, "integrator" firms emerged, whose purpose is to help actors navigate the industry and collaborate.[439] They do so by helping them find the required components, partners and know-how, and combine them all together towards the desired business plan.

As a general matter, Stigler's hypothesis has not escaped criticism,[440] but its core has been

437 Various key words have been used to describe this trend including vertical specialization, outsourcing, disintegration, disaggregation, lean production, refocusing on core skills and competencies, deconstruction of the value chain. While differences remain, we use those words interchangeably, except where context requires greater precision.

438 Eugenia Cacciatori & Michael G. Jacobides, *The Dynamic Limits of Specialization: Vertical Integration Reconsidered*, 26 ORGANIZATION STUDIES 1851 (2005) ("We argue that when a disintegrated system starts to become inadequate to meet demands … firms respond by trying to provide new services. … [E]ach firm will advocate a type of reintegration that preserves its original competencies and advantages."). *See also* Jackie Krafft, *Vertical Structure of the Industry and Competition: An Analysis of the Evolution of the Info-Communications Industry* 27 TELECOMMUNICATIONS POLICY 625 (2003); Nick Argyres & Lyda Bigelow, *Innovation, Modularity, and Vertical Deintegration: Evidence From The Early U.S. Auto Industry*, 21 ORGANIZATION SCIENCE 842 (2010); Constance Helfat & Miguel Angel Campo-Rembado, *Integrative Capabilities, Vertical Integration, and Innovation Over Successive Technology Life-Cycles*, Working Paper, Tuck School of Business at Dartmouth (2010).

439 The characterization of industry integrator has been used in the past to describe the role of network operators semiconductor manufacturers, and mobile device manufacturers. At their respective era of development each of these roles assumed the role of bringing together the contributions of different actors. *See* respectively Bryn Williams & Jamie Anderson, *Unbundling the Mobile Value Chain*, BUSINESS STRATEGY REVIEW, Autumn 2004, at 51, 51-53; Martin Zander & Jamie Anderson, *Breaking Up Mobile: Implications for Firm Strategy*, 10 INFO 3 (2008) (claiming that the success of Nokia is attributable to its ability to leverage complementary assets around it); Ludovic Dibiaggio & Maryam Nasiriyar, *Knowledge Integration and Vertical Specialization in the Semiconductor Industry*, 6 EUROPEAN MANAGEMENT REVIEW 265 (2009) (where the authors explain how successful firms in the industry manage to combine harmoniously distinct clusters of specialized knowledge).

440 Timothy Bresnahan & Alfonso Gambardella, *The Division of Inventive Labor and the Extent of the Market, in* GENERAL PURPOSE TECHNOLOGIES AND ECONOMIC GROWTH 253 (Elhanan Helpman, ed. 1998) (criticizing how Stigler reaches his conclusion, but not refuting the conclusion itself); Paul L. Robertson & Richard N. Langlois, *Innovation, Networks and Vertical Integration*, 24 RESEARCH POLICY 543, 552-553 (1995) (claiming that industry disintegration at least vis-a-vis innovation will depend on the systemic needs of innovation).

documented in and validated by a number of related theories, including product life cycle and platform evolution,[441] as well as empirical studies that span industries as diverse as telecommunications,[442] personal computers and stereos[443], disk drives,[444] software,[445] machine tools,[446] commercial aircrafts[447] and mortgage banking.[448] It is more correct to talk about *degrees* of industry disintegration, rather than a bipolar distinction, and in every industry cited above, findings show that there has been at least some degree of disaggregation of the production process, including the mobile telecommunications industry, as we discuss in more detail below.

For an industry's production process to become disintegrated a number of conditions need to be in place. To begin with, the *aggregate economic* considerations, priorities and capabilities of market actors serve as the primary driving force behind the (dis)integration of the production process: first, the cost of procuring goods or services from the market must be lower than the cost producing them internally.[449] Transaction costs here include both problems of information

441 David R. Rink, & John E. Swan, *Product Life Cycle Research: A Literature Review*, 7 JOURNAL OF BUSINESS RESEARCH 219, 221-223 (1979); Michael Porter, Competitive Strategy 157-162 (1980).

442 *See infra* 4.2.2.2.

443 Richard Langlois & Paul Robertson, *Networks and Innovation in a Modular system: Lessons from the Microcomputer and Stereo Component Industries*, 21 RESEARCH POLICY 297 (1992).

444 Clayton Christensen, *The Rigid Disk-drive Industry: A History of Commercial and Technological Turbulence*, 67 BUSINESS HISTORY REVIEW 531 (1993).

445 David Mowery, *The U.S. Software Industry: An Analysis and Interpretative History, in* THE INTERNATIONAL COMPUTER SOFTWARE INDUSTRY 15 (David Mowery ed., 1996).

446 Nathan Rosenberg, *Technological Change in the Machine Tool Industry, 1840–1910*, 23 JOURNAL OF ECONOMIC HISTORY 414 (1963).

447 DAVID MOWERY & NATHAN ROSENBERG, THE COMMERCIAL AIRCRAFT INDUSTRY: GOVERNMENT AND TECHNOLOGICAL PROGRESS (1982)

448 Jacobides, *supra* note 373.

449 Ronald Coase, *The Nature of the Firm*, 4 ECONOMICA 386. 390 (1937).

misrepresentation before or during the exchange,[450] and asset-specificity concerns.[451] Second, there must be a dependable supplier tier for every downstream market.[452] Third, there must be sufficient capital to support each distinct tier in the value chain.[453]

However, these economic conditions cannot arise unless the constituent parts of a product, process, or service can "talk" to each other and work together outside the boundaries of a unified module in the production process. Intertwined with economic decoupling is t*echnological decoupling*, which by creating a working interface between distinct parts, allows the market to gravitate toward a more disintegrated model. This is the so called "mirroring *hypothesis*,"[454] which describes the idea that "the [loosely coupled] standardized component interfaces in a modular product architecture ... [make] possible the concurrent and autonomous development of components by loosely coupled organization structures."[455]In a way, technological decoupling is the precondition to a potential organizational decoupling.

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450 Yoram Barzel, *Measurement Cost and the Organization of Markets*, 25 JOURNAL OF LAW AND ECONOMICS 27 (1982).

451 Benjamin Klein et al., *Vertical Integration, Appropriable Rents and the Competitive Contracting Process*, 21 JOURNAL OF LAW AND ECONOMICS 297 (1978); Paul L. Joskow, *Asset Specificity and the Structure of Vertical Relationships: Empirical Evidence*, 4 JOURNAL OF LAW, ECONOMICS, AND ORGANIZATION 95 (1988); Benjamin Klein, *Vertical Integration as Organizational Ownership: The Fisher Body – General Motors Relationship Revisited*, 4 JOURNAL OF LAW, ECONOMICS, AND ORGANIZATION 199 (1988); Sandford Grossman & Oliver Hart, *The Cost and Benefit of Ownership: A Theory of Vertical and Latter Integration*, 94 JOURNAL OF POLITICAL ECNOMY 691 (1986).

452 Henry Chesbrough, *Towards a Dynamics of Modularity: A Cyclical Model of Technical Advance, in* THE BUSINESS OF SYSTEMS INTEGRATION 174, 178 (Andrea Prencipe et al. eds., 2005).

453 *Id*.

454 Lyra Colfer & Carliss Baldwin, *The Mirroring Hypothesis: Theory, Evidence and Exceptions*, Harvard Business School Finance Working Paper 10-058 (2010). *See also* Alan MacCormack et al., *Exploring the Duality Between Product and Organizational Architectures: A Test of the "Mirroring" Hypothesis*, 41 RESEARCH POLICY 1309 (2012); Anna Cabigiosu & Arnaldo Camuffo, *Beyond the "Mirroring" Hypothesis: Product Modularity and Interorganizational Relations in the Air Conditioning Industry*, 23 ORGANIZATION SCIENCE 686 (2012); Stefano Brusoni & Andrea Prencipe, U*npacking the Black Box of Modularity: Technologies, Products and Organizations*, 10 INDUSTRIAL AND CORPORATE CHANGE 179 (2001).

455 Ron Sanchez & Joseph T. Mahoney, *Modularity, Flexibility, and Knowledge Management in Product and Organization Design*, 17 STRATEGIC MANAGEMENT JOURNAL 63, 64 (1996).

For this to happen, information, knowledge and skills division must take place, so that each part performs a specific and well defined function in the market.[456] Formerly tacit knowledge must be codified so that it can be transferable.[457] Once information and knowledge become transferable and appropriate linkage mechanisms to identify and surround their transfer exist, the opportunities offered by the market can be realized.[458] This will result in the emergence of what Jacobides calls *intermediate* markets.[459] Further, the required attributes of components in the system must be able to be clearly specified so that transacting actors can clearly communicate their requirements to their complementors, and actors must have the tools and equipment to codify information and to verify that the required attributes of components have been met.[460] This results in (a certain degree of) standardization among components and interfaces, which facilitates separation as it minimizes the amount of information that has to pass through the different stages of the production chain.[461]

When the above conditions are in place division of labor can begin and formerly unified production processes can be broken down in finer slices. Specialized entry in separate production layers is then possible. In this context, some of the existing integrated firms in the market will

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456 J. Douglas Orton, & Karl E. Weick, *Loosely Coupled Systems—a Reconceptualization*, 15 ACADEMY OF MANAGEMENT REVIEW 203 (1990); Colfer & Baldwin, *supra* note 454, at 4. *See also* Eric von Hippel, *Task Partitioning: An Innovation Process Variable*, 19 RESEARCH POLICY 407 (1990).

457 Jeffrey T. Macher & David C. Mowery, V*ertical Specialization and Industry Structure in High Technology Industries*, 21 ADVANCES IN STRATEGIC MANAGEMENT 317, 324 (2004)

458 David J. Teece, *The Market for Know-How and the Efficient International Transfer of Technology*, *in* ESSAYS IN TECHNOLOGY MANAGEMENT AND POLICY: SELECTED PAPERS OF DAVID J. TEECE 243, 247 (David J. Teece ed., 2003). Otherwise, without information and knowledge division, markets will likely remain thin and trading may be impaired. As Teece notes "unassisted markets are seriously faulted as institutional devices for facilitating trading in many kinds of technological and managerial know-how." *Id*.

459 Jacobides, *supra* note 373, at 465, 485-487.

460 Chesbrough, *supra* note 452.

461 Richard Langlois, *The Vanishing Hand: The Changing Dynamics of Industrial Capitalism*, 12 INDUSTRIAL AND CORPORATE CHANGE 351, 374 (2003); Jacobides, *supra* note 373, at 480-482.

want to realize the efficiencies of specialized production, and will turn either exclusively or complementarily to specialized actors.[462] Other firms will prefer to remain integrated if they cannot realize any benefits of specialization or if the benefits of internal coordination outweigh the losses from foregoing the more efficient production of specialized actors.[463] Overall, to the extent that specialization has occurred, the specialized actors necessarily need to work together, as none of them is individually equipped to deliver a full product or service in the market.[464] The cooperation is deeper when technical specifications are involved, because actors often have to co-develop the specifications to ensure better interoperation of their products and services,[465] and because the technical capabilities of one component directly affect and constrain the capabilities of the others.[466]

4.2.2.2 Vertical Specialization of the Mobile Telecommunications Industry's Production Chain and Shifting Incentives from Exclusion to Cooperation

We can now turn to the empirical part of our inquiry and the question of whether the stages

462 Langlois, supra note 373, 32-34 (2002). *See also* David Hummels et al., *The Nature and Growth of Vertical Specialization in World Trade*, 54 JOURNAL OF INTERNATIONAL ECONOMICS 75 (2001) (who transfer the cooperation argument in international trade, where the equivalent of firms is countries).

463 *See notably*, ALFRED CHANLDER, THE VISIBLE HAND: THE MANAGERIAL REVOLUTION IN AMERICAN BUSINESS (1977).

464 Langlois, *supra* note 373. *See also* Charles Sabel & Jonathan Zeitlin, *Neither Modularity nor Relational Contracting: Inter-Firm Collaboration in the New Economy*, 5 ENTERPRISE & SOCIETY 388 (2004) (who extend Langlois' theory); Shapiro & Varian, *supra* note 424.

465 The co-development of the specifications is not the same as the co-development of the product or service itself. Our argument here refers to the former only. Co-development of a product/service can be a result of industry disintegration but industry disintegration is not the main parameter that influences it, and that is why we don't focus on that here. *See, e.g.*, Cohen & Levinthal, *Innovation and Learning: The Two Faces of R&D*, 99 ECONOMIC JOURNAL 569 (1989).

466 *See supra* note 45-50 and accompanying text.

of the telecommunications industry's production chain have been more decoupled and populated with distinct separate players. This would imply that more than in the past, firms have the option today to procure from the market components that they once had to develop internally.[467] The way this affects their incentives to exclude is that when a component is produced internally, every other firm that produces the same component is potentially a competitor vis-a-vis that component, whereas when a component is to be procured from the market, the producing firms become complements. Therefore, as the industry moves to a state where more components in the stages of the production chain can be acquired individually, firms lose the incentive to exclude to the extent the incentive was predicated on a competitive relationship between firms vis-a-vis once internalized components.

This trend, as we will attempt to show in the following pages, has affected various parts of the value chain. Compared to a vertically integrated production system that still dominates but is losing ground, we are now seeing signs of independent production in the applications layer, the operating system layer, the service and application platform architecture, and the spectrum layer. As this process unfolds firms have to option and the incentive to open up to other firms in the

467 It is important to note again that industry disintegration, which is our focus here, is not the same as firm disintegration. The fact that some firms choose to remain integrated does not mean that the levels of the production process have not been sufficiently separated from each other; it merely shows a preference for internalizing the production of what is also available to procure externally, an option that would be unavailable in the case of a vertically integrated industry. For example in the late 90s Ericsson outsourced its production, only to reintegrate again after a few years partly because it was not satisfied with the quality of its agreements with external partners. This, however, did not have a significant impact on the disaggregation of the production of components in the industry's value chain. *See* Medina et al., *supra* note 392, at 318-320. *See also* Jamie Anderson & Martin E. Jonsson, *The Mobile Handset Industry in Transition: The PC Industry Revisited?: Understanding the Drivers of Dynamic Change and Implications for Firm Strategy*, European School of Management and Technology Working Paper, 18 et seq. (2006), where the authors specify that the mid-tier phones and smartphones sub-markets have acquired a more horizontally stratified structure than the entry level phones market. This is likely because in more sophisticated markets firms are in greater need to purchase specialized components, whereas in the simpler entry level market they can still develop the necessary expertise and achieve production internally.

market instead of being standalone and introvert. To see how the industry has disaggregated and what this means for the industry players' incentives we trace the evolution of the production chain.

4.2.2.2.1 The First Steps

In the early stages of the mobile telecommunications industry's development there were mainly two clusters of operations wherein market actors would focus their resources and apply their expertise: on the one hand there were the equipment manufacturers, who marketed and sold end user devices and network elements to carriers, but were not involved in network operations, or network management.[468] Major players such as Motorola, Ericsson, Nokia and Siemens each maintained their own ecosystem, and controlled not only "the design, production and marketing of mobile phones, but also the mobile communications infrastructure business," which supported essentially the entire spectrum of operations of telecommunications carriers.[469] In the United States Motorola, in constant and close cooperation with AT&T (and Bell Labs), produced the terminal equipment for many major "firsts" in mobile telecommunications history, including the first mobile service (AT&T's Mobile Telephone Service), and the first handheld mobile phone (Motorola's DynaTAC phone).[470] Standardization remained low, independent component

468 *See* Fransman, *supra* note 429, at 109-112.

469 Kai Bruehl, & Nils Stieglitz, *Deep Impact: Technological Change And The Vertical Boundaries Of The Firm In Deconstructing Industries*, Paper prepared for the Annual Conference on Corporate Strategy (2005). *See also* Martin Fransman, *AT&T, BT and NTT: A Comparison of Vision, Strategy and Competence*, 18 TELECOMMUNICATIONS POLICY 137 (1994).

470 Motorola Milestones, *available at* http://www.motorola.com/us/Corporate-Motorola-History-Timely-Achievement.html.

manufacturers were scarce and unable to meet the technical requirements of large manufacturers, and as a result manufacturers did not have the option to assemble devices from off-the-shelf components.[471]

Then, there were the network operators who performed all other key functions in the mobile value chain, including network operations and management, customer relations, sales and marketing and even technical support to users.[472] Even after the transition from 1G to 2G and the beginning of the industry's regulatory liberalization, and the ensuing entry of some peripheral actors, network operators and equipment manufacturers remained the only key players.[473]

Gradually, a series of factors led up to the deconstruction of the value chain: mobile devices and networks accumulated an increasing number of functions, thus becoming more complex and sophisticated;[474] economies of specialization started accruing to more focused firms or industry associations;[475] increasing standardization of components and interfaces enlarged specialized firms' target audience, reduced costs for network operators, and made interoperation among

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471 JEFFREY FUNK, GLOBAL COMPETITION BETWEEN AND WITHIN STANDARDS: THE CASE OF MOBILE PHONES 36-84 (where the author documents the fragmented standards market in early mobile networks and the gradual approximation of standards later) (2002); Anderson & Jonsson, *supra* note 467, at 7-8 ("There were few suppliers of modular components at this time, resulting in difficulties in sourcing quality mobile phone parts, high bill of materials (BOM) costs and strong supplier power. … Firms, such as consumer electronics giant Sony, which tried to enter the market without deep expertise in core mobile technologies such as Radio Frequency (RF) modules or cellular protocol stacks also found the going tough. … After being beset by quality problems, Sony eventually merged its mobile phone operations with Ericsson," at 8).

472 PASI TYRVAINEN & OLEKSIY MAZHELIS, VERTICAL SOFTWARE INDUSTRY EVOLUTION: ANALYSIS OF TELECOM OPERATOR SOFTWARE 67-68 (2009); Williams & Anderson, *supra* note 439, at 51-52, 69.

473 David Tilson & Kalle Lyytinen, *The 3G Transition: Changes in the US Wireless Industry*, 30 TELECOMMUNICATIONS POLICY 569, 571 (2006).

474 *See, e.g.*, Zander & Anderson, *supra* note 439 at 6; Tyrvainen & Mazhelis, *supra* note 472. *See also* Rahul C. Basole, *Visualization of Interfirm Relations in a Converging Mobile Ecosystem*, 24 JOURNAL OF INFORMATION TECHNOLOGY 144 (2009) (documenting and visualizing an explosion of specialized firms and their relationships in the mobile industry).

475 See, e.g., Sadahiko Kano, *Technical Innovations, Standardization and Regional Comparison—A case Study in Mobile Communications*, 24 TELECOMMUNICATIONS POLICY 305 (2000); Krafft, *supra* note 69.

components and actors more feasible.[476]

In this environment specialization quickly increased. Initially, specialization emerged in narrow tranches of the production chain, mainly with firms that licensed their products and designs to original equipment manufacturers. These included radio-frequency chips, power management and audio components, embedded software such as codecs or protocol stacks, and peripheral components.[477] Later, some firms started spinning off entire departments when they realized that those parts of the production process were better and more efficiently provided by specialized actors. Qualcomm, for example, gave up handset division is a good example).[478]

In a matter of a few decades Original Device Manufacturers, which are companies that design and manufacture handsets for other companies, grew dramatically to cover the outsourcing needs of many major device manufacturers (which have included Motorola, Siemens, and Sony-Ericsson among others).[479] Fransman notes that, indicative of how

476 Williams & Anderson, *supra* note 439, 51, 52-53 ("One of the key drivers for value chain unbundling in the mobile industry has been the emergence of technological standards in maturing formats …, not just for network infrastructure but also billing enablement, IT and other busienss critical processes."); Macher & Mowery, *supra* note 457; Andreson & Jonsson, *supra* note 467, at 19 ("Large operators such as Vodafone, T- Mobile and NTT DoCoMo represent the distribution channel for tens of millions of handsets and therefore have significant bargaining power in negotiations with handset vendors. These firms are looking for commonality between different phones in order to reduce their costs for testing, porting applications, training and support."); Tyrvainen & Mazhelis, *supra* note 472, at 79-80; David Tilson & Kalle Lyytinen, *The 3G Transition: Changes in the US Wireless Industry*, 30 TELECOMMUNICATIONS POLICY 569 (2006); P.M. Rao, *Structural Change And Innovation In U.S. Telecommunications*, 10 ECONOMICS OF INNOVATION AND NEW TECHNOLOGY 169 (2001).

477 *See, e.g.*, Masanori Yasumoto & Jing Ming Shiu, *Why Is Interfirm Collaboration Called for in Novel Technology Platform Adoption?: Cases from the the Japanese, Taiwanese, and Chinese Mobile Phone Industries*, University of Tokyo MMRC Discussion Paper No. 225 (2008) (where the authors discuss the emergence of specialized baseband processor chip firms, which provided this core component in a basic form and then device manufacturers customized it to match their needs); Andreson & Jonsson, *supra* note 467, at 11

478 Qualcomm, whose core product is the CDMA technology, launched in 1998 the first CDMA-enabled smartphone, but span off its handset division a year later to focus on the development of the CDMA technology. *See* http://www.qualcomm.com/about/history. *See also* Anderson & Jonsson, *supra* note 467, at 9 (noting that "as of mid 2005, Nokia was virtually the only remaining manufacturer that did not rely on third-party platforms to some extent, with reference designs and platform solutions still developed in-house across all product segments.").

479 *See* Goldman Sachs Global Equity Research, 2011.

modularized and standardized the industry's production chain had become, was that firms that "kn[e]w nothing about telecommunications [became] telecom operators."[480]

While the deconstruction of the production chain up to this point was already a significant departure from earlier states of the industry, it still only applied to numerous but minor parts of the production process. It was toward the end of the 90s and afterwards that we started seeing key elements of the wireless value chain being decoupled, resulting in a noticeable shift in incentives. We identify four major clusters in which this is taking place: services and applications, service and application deployment architectures/platforms, operating systems, and spectrum.

4.2.2.2.2 The Trend Continues Today

Imagine a value chain where the four clusters/layers of services and applications, service and application deployment architectures/platforms, operating systems, and spectrum can exist separately so that the offering of wireless telecommunications services to end users could be effectuated through successive contractual agreements among actors in each of those layers (these are not the only stages of the wireless chain production process but here we focus on these for illustration purposes). In this scenario the primary vertical relationship among layers is complementary and actors have an incentive to work together. For instance, the relationship of

480 Martin Fransman, *Evolution of the Telecommunications Industry Into the Internet Age*, 43 COMMUNICATIONS AND STRATEGIES 57, 74 (2001) (citing the examples of "Bernard Ebbers who was one of the founders of WorldCom but had a background as a football coach and motel operator; COLT (City of London Telecommunications), one of the main challengers to BT in the UK, which was established by Fidelity, the largest mutual fund in the US (that earlier had established Teleport, a competitive local exchange carrier in New York and Boston that was later sold to AT&T); Qwest, established by Philip Anschutz, a billionaire with a background in ranching, oil, and railroads.").

an MVNO with wireless operators who lease their spectrum wholesale is one of partnership vis-a-vis the physical layer, not competitive. This limits exclusionary incentives, because, in the example of the MVNO, the MVNO doesn't have anything to gain from excluding a certain operator's spectrum. In principle, then, as we noted earlier, a disaggregated industry structure will yield less incentives for vertical exclusion compared to an industry structure dominated by vertically integrated systems (this is unrelated to the overall competitiveness levels of the industry).

We notice that in the four clusters of services and applications, service and application deployment architectures, operating systems, and spectrum, modular solutions become increasingly available. Starting with services and applications, it is well known that in legacy communications networks there was tight integration between the services/applications layer, the platform/architecture on which services and applications were developed and deployed, and the transport layer.[481] But towards the end of the 90s a trend towards decoupling of the services and applications from the rest of the value chain emerged and continues. The first major wave was the popularization of WAP and i-mode as modes to access Internet content, services and applications.[482] The WAP protocol and gated implementations like i-mode and Vodafone Live allowed users to access additional services and applications on their phone through the Internet, i.e. distinct and decoupled from the phone network. Yet, due to bandwidth and phone capabilities limitations, WAP services and applications could not yet substitute phone functionality and hence could not serve as an alternative proposition for that layer.

481 *See supra* note 423.

482 Pieter Ballon, *The Platformization of the European Mobile Industry*, 75 COMMUNICATIONS AND STRATEGIES 15, 17 (2009).

But this changed with the advent of mobile broadband and smartphones. The combination of higher network speeds, smartphones, and greater adoption and reliance on IP, allowed the emergence of alternative propositions in varying forms that enable users to replace traditional phone functionalities with over the top services like Skype and Whatsapp,[483] or even with applications that fully replace a phone's native calling features (e.g. Scratch Wireless and TextNow are mobile operators that only secondarily rely on the cellular network and the phone's native dial and SMS functions (both partner with Sprint), and instead urge users to use third part applications such as Skype, or their own application.).[484] To an extent, these operators are adopting the business model of a dumb pipe, which represents a disconnect between transport and service, and has until now been a fearful prospect for integrated operators.[485] Under this new business model, not only are applications like Skype not a threat any more, but they become a necessary complement and their active participation in the operator's business model is sought after.[486] This transforms potentially exclusionary incentives stemming from a vertically competitive relationship to cooperative incentives based on a relationship of complements.[487]

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483 JYH-CHENG CHEN & TAO ZHANG, IP-BASED NEXT-GENERATION WIRELESS NETWORKS: SYSTEMS, ARCHITECTURES AND PROTOCOLS 20 (2004).

484 Scratch Wireless, and TextNow. *See* http://www.scratchwireless.com and http://www.textnow.com. Republic Wireless is another example of a "Wi-Fi first" operator. *See* http://www.republicwireless.com.

485 *See, e.g.*, Robert Clark, *Getting It Right on Mobile Broadband*, 2009 TELECOM ASIA 38 (2009) (quoting Huawei "If operators simply expand capacity to keep up with demand… including everything from streaming video to P2P downloads, they will never be able to achieve profitable operations."). But *see contra* Stan Hubbard, Value Your Bit Pipes, LIGHT READING, August 1, 2008, *available at* http://www.lightreading.com/document.asp?doc_id=160607.

486 This model is sometimes called "aggregator centric" or "service centric." *See* Pieter Ballon & Nils Walravens, *Competing Platform Models for Mobile Service Delivery: The Importance of Gatekeeper Roles*, Paper Presented 7th International Conference on Mobile Business (2008).

487 A survey of the relationships that developed among applications, services and operating systems in the wireless industry over a period of almost a decade, between 1998 and 2006, showed that more than half of them are shared between different ecosystems, providing support for the the idea that co-opetitive relationships are thickening. *See* Gaël Gueguen & Thierry Isckia, *The Borders of Mobile Handset Ecosystems: Is Coopetition Inevitable?*, 28 TELEMATICS AND INFORMATICS 5 (2011). *See also generally* Van Alstyne et al., *Platform*

Moreover, while the above-mentioned alternatives rely on the Internet to run, it doesn't necessarily have to be so. New service and application delivery architectures are underway, providing new ground for development. In Chapter 3 we saw that network-as-a-service (NaaS) and infrastructure-as-a-service (IaaS) are architectures that provide an environment for service and application development and deployment that is independent from the actual transport network; the same goes for independent IMS providers.[488] As long as a transport medium is provided, NaaS and IaaS solutions can modularly attach on top of it and provide the intelligence necessary to develop and offer various services and applications.[489]

AT&T, for instance, is transforming its infrastructure into a software-defined network (SDN), which makes the hardware programmable and the intelligence functions (like application development, deployment, and data routing) virtual, not embedded in the hardware, and therefore flexible.[490] And Nokia, offering similar solutions, explains that "[t]he easiest way to

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Networks—Core Concepts, MIT Ctr. for Digital Bus. Working Paper No. 232 (2007).

488 Alexander Harrowell, *IMS: Two Visions of the Telecoms Future*, 130 MOBILE TELECOMMUNICATIONS INTERNATIONAL 1 (2006).

489 AJAY R. MISHRA, CELLULAR TECHNOLOGIES FOR EMERGING MARKETS 206-208 (2010); Paolo Fogliata & Marco Torquato Mussini, *Intelligence-Ready Network Infrastructure: An Ecosystem to Control Third-Party Intelligence Distribution Close to Nomadic Users*, 13 BELL LABS TECHNICAL JOURNAL 105, 107 (" A network operator running an 'open platform' for network-distributed computing (OPNDC) may offer several competing service providers an opportunity to deploy their software modules, loading the desired service logic directly onto network equipment or network management system nodes. Such a separation of roles allows both the network operator and the service provider to focus on its respective core mission and makes it faster and easier to deploy new network-intensive services packaged as plug-ins independent of network infrastructure upgrades. … The resulting secondary market of value-added services, provided by a constellation of smaller and dynamic partner companies through the deployment of plug-in software for the standard platform of network machines, can expand the offer of new value-added services, relying on network-based information to create a common user context across the services.").

490 *See AT&T Vision Alignment Challenge Technology Survey*, AT&T Domain 2.0 Vision White Paper (2013. *See also* News Release, AT&T Introduces the "User-Defined Network Cloud": A Vision for the Network of the Future, *available at* http://www.att.com/gen/press-room?pid=25274&cdvn=news&newsarticleid=37439 ("The User-Defined Network Cloud is a transformative initiative. Integrated through AT&T's Wide Area Network (WAN) and utilizing Network Function Virtualization (NFV) and Software Defined Networks (SDN), as well as modern architectural and operational approaches, AT&T plans to simplify and scale its network by: Separating hardware and software functionality; Separating network control plane and forwarding planes; and Improving management of functionality in the software layer. Software Defined Networks shifts control of the network

scale a network function from now on will be if it is hosted on a private cloud infrastructure, so all you have to do is activate new blades and create new virtual machines to host the service."[491]

By separating software from hardware, services can for the first time be developed, deployed and offered by third parties who control the software but not the hardware, which in fact can be shared by more than one parties. This opens the door for facilities operators to become "wholesalers" of the necessary hardware to support all the intelligence and functionalities needed by another operator, but it also makes it easier to become a facilities operator in the core segment because the generalization of hardware. As a Heavy Reading study explains

> "[o]ne of the attractions of a virtualized, cloud-based IMS core is the capability to support the multi-tenant model. This takes various forms, which can be summarized as follows: The ability for multinational operators to host national operating companies on a centrally managed infrastructure. …; an operator (or third party such as a roaming hub provider) can offer wholesale IMS services to other operators. In Europe, for example, RCS may launch in this way in some countries as not all operators are ready to invest in an owned IMS core; The ability to create programmable, virtualized IMS instances is emerging as area of great potential. It is similar to the MVNO model, but different in that virtual IMS cores could be specified according to the customer's particular call model or use case. Because it is a new investment for mobile operators, IMS represents a chance to cast off legacy operating modes and implement a forward-looking architecture that aligns with the broader trend toward programmable networks. The nature of the application itself also makes it a prime candidate for virtualization and deployment into a cloud infrastructure."[492]

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from hardware to software to remove physical limitations. This creates a programmable network that is more flexible, efficient and aware of applications. Network Function Virtualization moves network functions from hardware-based operations into something that can be done via software. This means that we can update network tasks remotely and more quickly without having to rely on specialized equipment.").

491 Tammy Parker, *Nokia Claims Its Commercial NFV Solution Is Ready To Run VoLTE and More*, FIERCE WIRELESS, September 4, 2014.

492 Heavy Reading, *Virtualization of IMS & VoLTE in Mobile Operator Core Networks*, White Paper, at 5-6 (2013).

These options highlight that it is not only applications and services, but also the underlying platform on which they are built and deployed in the network that becomes a separate module distinct from the actual transport infrastructure. As the Heavy Reading study suggested this can open the door for MVNO-like co-opetitive relationships, but at the network intelligence layer, not just the transport layer. Similar to the decoupling of the applications layer, owners of core network equipment can find new partners where there were none, because it was technically impossible to share their hardware up till recently.

Another key production element that was also decoupled from the rest of the production chain was the mobile operating system. Early handsets carried operating systems that were designed by the same manufacturer. Towards the end of the 90s Symbian and Windows Mobile became the first major operating systems that could run on devices by different manufacturers, followed more recently by Android and Windows Phone. The availability of "decoupled" operating systems meant that, much like the case of the services and applications layer, formerly integrated players for whom other operating systems were competitors, could, if they so desired, switch to another operating system thusly turning it from a competitor into a complement.[493] This would help limit exclusionary practices and correspondingly increase cooperative ones.

For example, between 2007 and 2009, the industry was dominated by three vertically integrated OS platforms (device and operating system), namely iPhone with iOS, Blackberry with Blackberry OS, and Nokia with Symbian (which in 2007 was acquired by Nokia and it was reserved only for Nokia products).[494] As a result the industry structure was characterized by

493 Feida Lin & Weiguo Ye, Operating System Battle in the Ecosystem of Smartphone Industry, 2009 International Symposium on Information Engineering and Electronic Commerce 617, 619-620 (2009).

494 *See* Wikipedia, Mobile Operating System – Market Share, http://en.wikipedia.org/wiki/Mobile_operating_system#Market_share (with links to sources).

competition among vertically integrated systems and consequently vertical exclusion (this, again, is not in itself indicative of the competitiveness levels of the sector). But in 2011 Nokia decided to switch from its own operating system to Microsoft's Windows Phone, due to steady declining market share since.[495] Eventually, Microsoft bought Nokia's handset division. Up until that point Nokia and Microsoft were in a competing relationship since Microsoft supplied with the Windows Phone operating system many of Nokia's major competitors, including Samsung, HTC and LG. The option to rely on the operating system from a third party enabled Nokia to shift from an integrated strategy to a complementary strategy with Microsoft. This changed Nokia's incentives from exclusion of Microsoft from its ecosystem,[496] to incentives to cooperate with it (and later with Android) as a partner. While such developments do not mean that incentives for exclusion are eliminated, they serve as evidence that industry disaggregation aided by technological decoupling, and the resulting availability of external solutions in the market, can sometimes cause firms to re-examine their strategy and move from excluding inputs to working with them.[497]

Similar shifts can be observed in the physical transmission layer as well, and in particular with the increasing availability of spectrum—a necessary component in the offering of communication services—as a standalone product. While standalone spectrum is not a mature

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495 *See, e.g.*, Jo Best, *'Android Before Android': The Long, Strange History of Symbian And Why It Matters for Nokia's Future*, ZDNET, April 4, 2013.

496 With the exception of some of its products, and also the low-end Asha platform, which, interestingly, Nokia later replaced as well with Nokia X, based on Android

497 Although not something poised to happen soon, Steve Wozniac suggested that it may be good strategy for Apple to make an Android phone. This would be a significant departure from Apple's notoriously closed policy. We make no judgment as to the merits of this suggestion, we are merely noting that the idea shows further and serious consideration into the direction of co-opetition. *See* Mat Honan, *Steve Wozniak: Apple Should Make an Android Phone*, WIRED, February 6, 2014.

business proposition yet, certain technological developments documented below assist in the emergence and establishment of a distinct class of operators collectively called thin or light operators, who exist in a co-opetitive relationship with full mobile network operators (MNOs), which dilutes exclusionary incentives because of their mutual dependence.[498]

In wireless communications the norm has traditionally been that the owner of spectrum also provides voice and data services on top. In this an end-to-end telecommunications model the spectrum and the rest of the necessary infrastructure (e.g. services/applications, services/applications deployment architecture) are integrated and carriers see each other as competitors and not as complements, since each owns all the components needed to offer voice and data services (they still need each other to expand their presence through interconnection and roaming but this doesn't touch on the structure of the value chain, which is what we study here).

The decoupling of the physical layer is associated with the emergence of Mobile Virtual Network Operators (MVNOs), which are firms that buy wholesale spectrum from MNOs, who own spectrum, and attach their own infrastructure on top to offer voice and data services. Because MNOs give up part of their assets (spectrum) to firms that normally function as competitors, there is a shift from a competitive relationship to a complementary one. For instance, Clearwire was a telecommunications provider on its own right but gradually transformed into more of a wholesaler than retailer. It went from serving 46 thousands wholesale devices in 2009 to 9.3 million wholesale devices right before it was acquired by Sprint in 2012, at which point Clearwire was serving among others Comcast, Time Warner, and Best Buy, firms

498 For an overview *see* IDATE, *Light Operators: Maturing and Putting on Weight*, Market Report M14505IN1 (2014).

that one normally would identify as Clearwire's competitors.[499] Leasing “raw” spectrum (without services on top) helped Clearwire shift its strategy from competing as an integrated system with other carriers to seeking their business as a complement and at the same time competing with them at the retail level. Sprint has rather ambitiously continued Clearwire's business model, and other major carriers have significantly expanded their MVNOs agreements, although overall still on a limited scale.[500]

Light operators come in other flavors as well and in a great variety depending on how much they rely on MNOs. For many years (and even today), the decoupling of the spectrum as a separate product to be sold in the market, was incomplete, as the rights of light operators on the spectrum were very limited,[501] and wholesale spectrum transactions were also limited.[502] There are two reasons that have prevented spectrum from achieving so far full modularity as a component in the value chain, but technological developments slowly bridge the gap. One reason is that the vast majority of spectrum has traditionally been reserved for licensed operators and therefore has formed part of a vertically integrated system. The other reason is that regardless of spectrum availability, the state of the technology so far did not enable thin operators to develop a valuable business proposition on top of the spectrum they secured (product/service differentiation), thus limiting the utility of spectrum for them and the MNOs.

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499 Clearwire, SEC Form 10-K, filed February 16, 2012, at 2-3, 7-8.

500 *See* Kevin Fitchard, *Why Are MVNOs So Hot Right Now? Thank the Carriers*, GIGAOM, June 25, 2012; Tsahi Levent-Levi, *Will MVNOs Live Long and Prosper?*, AMDOCS VOICES, June 4, 2013.

501 Limitations affected among others network management and the devices that the MVNO could sell, but also extended to the financial details of the agreement between the MVNO and the host carrier. *See* Fitchard, *supra* note 500.

502 *See, e.g.*, Malcolm Dowden, *United Kingdom: Bold Approaches To Network Sharing Could Transform Mobile Economics*, Mondaq, May 28, 2014; Telco 2.0 Research, *LTE & Wholesale: Time to Get Aggressive?*, *available at* http://www.telco2research.com/articles/AN_LTE-wholesale-aggressive_Full.

Both reasons contributed to the same outcome, which is the preservation of non-optimal conditions for the modularization of spectrum. But we suggest that to the extent these conditions fade away as we attempt to show below, the market around that business model will thicken. This is because as independent light operators enhance their business propositions, they will become more valuable complements to vertically integrated operators,[503] giving them more reasons to seek each other's business and conversely steer away from vertical exclusion or discrimination.[504] This isn't to say that closed vertically integrated models will go away, but that as a distinct market forms around spectrum as a separate component, the improving value proposition will create a reinforcing effect.

Based on the factors we identified this can happen if the ways by which a firm can get access to spectrum multiply, and if technology facilitates thin operators to become something more mere resellers. As to the first factor one can indeed observe various and novel ways of accessing spectrum. One is the growing willingness of MNOs to make part of their spectrum available to MVNOs.[505] The scheme is mutually beneficial because MVNOs gain access to

503 Ralf Dewenter & Justus Haucap, *Incentives to License Mobile Virtual Network Operators (MVNOs)*, *in* ACCESS PRICING: THEORY AND PRACTICE 322 (Ralf Dewenter & Justus Haucap eds., 2007) where the authors emphasize the importance of differentiation as a source of value creation for both MNOs and MVNOs ("MNOs will voluntarily provide network access if the services offered by the candidate MVNOs are sufficiently differentiated, as with a high degree of product differentiation the revenue effects outweigh the competition (or cannibalization) effects. Furthermore, MNOs will always invite MVNOs onto their network under Cournot competition if the market is sufficiently large, even if MVNOs offer homogeneous products. In contrast, the incentives to voluntarily grant MVNO access are lower under Bertrand competition and decline even further under Stackelberg competition. Under Bertrand and Stackelberg competition voluntary MVNO access is only granted if the services offered by MVNOs are sufficiently differentiated.").

504 *See* William Lehr & Jon Crowcroft, *Managing Shared Access to a Spectrum Commons*, PROCEEDINGS OF THE FIRST IEEE INTERNATIONAL SYMPOSIUM ON NEW FRONTIERS IN DYNAMIC SPECTRUM ACCESS NETWORKS, at 420, 441-442 (2005); Paul Milgrom et al., *The Case for Unlicensed Spectrum*, Stanford Institute for Economic Policy Research Discussion Paper No. 11-002, at 17, 23-24, 29-30, *available at* http://www-siepr.stanford.edu/RePEc/sip/11-002.pdf.

505 *See, e.g.*, Mike Conradi, *MVNO—Trends and Contracts*, DLA Piper Technology's Legal Edge Blog, July 8, 2014.

spectrum, while MNOs benefit from MVNOs' business plans, which increase use and penetration of MNOs' networks. Recently, aided by the novelties of LTE/EPC (i.e. the flat architecture of the network and the separation of transport and services) innovative propositions of *pure spectrum wholesalers* emerged, which completely decouple the wireless infrastructure layer from the rest of the value chain and offer it as a standalone product. LightSquared is the most well known example,[506] but it's not the only one (see, e.g., UK Broadband, Yota).[507]

Alongside cellular spectrum, operators can also rely, albeit for the moment not exclusively, on Wi-Fi, which can and does act as a complement and in fact in increasing rates.[508] On top of the "Wi-Fi first" examples we mentioned previously (Republic Wireless, TextNow, Scratch Wireless), another interesting proposition is the use of subscribers' Wi-Fi routers as open hotspots for other subscribers to connect to when they are in radius. FON, a pioneer in this field, saw explosive growth in the past few years, reaching today more than 12 million hotspots,[509] partly also relying on agreements with carriers to use their Wi-Fi hotspots.[510] Recently,

506 LightSquared ran into legal problems on the grounds of its technology interfering with the GPS frequencies, and it never actually launched its service. David Goldman, *FCC Bans LightSquared Over GPS Interference*, CNN February 15, 2012.

507 *See* UK Broadband, Our 4G Network, *available at* http://www.ukbroadband.com/4g-networks/our-4g-network; *Yota to build wholesale LTE network for Russian operators*, TELECOMPAPER, March 3, 2011. *See also* Wholesale LTE network launches in Rwanda, POLICY TRACKER, September 16, 2014. *See also* Sami Tabbane, *LTE Advanced and the Evolving Telecom Business Models*, Presentation at the ITU/BDT Arab Regional Forum for ARAB Region on IMT Systems Technology, Evolution and Implementation (2013).

508 Daniel Frankel, *Cable Sees Big Future in Wi-Fi as Video Gives Way to OTT, High Programming Costs*, FIERCE CABLE, October 23, 2014; Growing Demand for Mobility will Boost Global Wi-Fi Hotspots to Reach 6.3 Million in 2013, ABI Research, *available at* https://www.abiresearch.com/press/growing-demand-for-mobility-will-boost-global-wi-f. Another similar proposition is unlicensed LTE, which is an example of a new scheme of providing unlicened access, called License Assisted Access (LAA). *See, e.g.*, Monica Alleven, *Confirmed: T-Mobile to Launch Unlicensed LTE at 5 GHz, Possibly Next Year*, FIERCE WIRELESS, December 17, 2014.

509 Ingrid Lunden, *Crowdsourced WiFi Network Fon Picks Up $14M Led By Qualcomm, Adds Facebook Integration*, TECHCRUNCH, January 20, 2014;

510 *See, e.g.*, David Meyer, *Fon Breaks Into the U.S. With AT&T Wi-Fi Roaming Deal*, GIGAOM, September 24, 2013.

Cablevision, a cable company, started offering its own Wi-Fi only mobile service,[511] following another new entrant, FreedomPop, whose service runs on Sprint's network, and allows users to connect to 10 million hot spots.[512]

In the near future more spectrum is also expected to become available in the 3.5 GHz band. Regulatory authorities around the world, including in the United States,[513] and the European Union,[514] are freeing up spectrum for shared opportunistic use, which allows various classes of users (such as commercial light operators) to flexibly share spectrum.[515] Much like WiMAX and Wi-Fi, the 3.5GHz band will interoperate with cellular frequencies, thereby serving also as a complement to them.[516] For MNOs this is an opportunity to drive up the use of their existing spectrum holdings. As Milgrom et al. note

> "complementarity between licensed and unlicensed spectrum can lead to a situation where unlicensed spectrum applications increase the demand for licensed spectrum applications and lead to higher license prices. One example is consumer wireless broadband services. The ability of smartphones and tablets to

511 Don Reisinger, *Cablevision Sets Sights on Mobile Carriers with Wi-Fi-only Service*, CNET, January 26, 2015.

512 Lance Whitney, *FreedomPop Rolls out Unlimited Wi-Fi for $5 a Month*, CNET, January 21, 2015.

513 *See* In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket FCC 12-354 (2014) (Further Notice of Proposed Rulemaking).

514 *See* European Commission Radio Spectrum Policy Group, Opinion on Licensed Shared Access (RSPG13-538) (2013).

515 *See, e.g.*, Commercial Operations 3550-3650 MHz Band, *supra* note 513, at ¶ 7: "We propose to structure the Citizens Broadband Service according to a multi-tiered shared access model that reflects the PCAST recommendation. … The three tiers of service would be: (1) Incumbent Access; (2) Priority Access; and (3) General Authorized Access (GAA)." By no means are we suggesting that FCC's propositions are uncontroversial, but the shared access regime is seriously contemplated and desired by most stakeholders. *See* Tammy Parker, *AT&T, Google and Others Pick apart FCC's 3.5 GHz Spectrum-Sharing Scheme*, FIERCEWIRELESS, July 16, 2014.

516 *See* Lehr & Crowcroft, *supra* note 504, at 441-442. *See also* GSMA, Licensed Shared Access (LSA) and Authorised Shared Access (ASA), Public Policy Position , at 4-5.

> connect to Wi-Fi networks increases the value of these products to consumers, which, in turn, can increase the sales of mobile data services and therefore the revenues obtained from selling licensed spectrum."[517]

In fact the more successful the 3.5GHz band the greater the synergies between it and cellular frequencies. This brings us to the issue of whether light operators can actually enhance their model and business proposition, something that is largely dependent on what the state of technology allows them to do. Perhaps the most commonly cited reason for the limited success of light operators is their inability to differentiate themselves from MNOs, while at the same time being squeezed by them.[518] To the contrary, those light operators that have succeeded are the ones who have invested heavily in network infrastructure that spans the entire production chain except the spectrum, which allows them to regain full control of developing, deploying and providing services and applications.[519] Yet, considering the service/application development and deployment features of next-generation networks, an end-to-end network is no longer necessary to achieve differentiation. The separation of the transport and the service functionality allows novel business propositions that can help light operators establish better business models.[520] As

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517 Milgrom et al., *supra* note 504, at 23.

518 *See* Dong-Hee Shin, *MVNO Services: Policy Implications for Promoting MVNO Diffusion*, 34 TELECOMMUNICATIONS POLICY 616, 617-619 (2010).

519 *Id*.

520 Dieter Elixmann et al., *"Next Generation Networks" and Challenges for Future Competition Policy and Regulation*, 50 COMMUNICATIONS AND STRATEGIES 239, 250-1 (2003) ("Due to the distributed structure of functions, there are opportunities for market players to separately operate specific network elements (e.g. gateways, call servers, application servers) and the related functions they need to provide services (provided this is economically viable). The separation of the control and the transport layers opens up opportunities for competitors to carry out the control functions they need to provide services autonomously. Thus, services can be introduced into the market independent of the operator of the transport network. Entities offering services have a choice between different architectures capable of supporting their specific service offerings. In particular, there should be room for non-facilities based service providers, i.e. those developing services on top of an

explained previously the virtualization of network functions, and the transition to software-defined functionality, as well as the multiplication of service/application development platforms, increases the modularity of the network functions layer, and nurtures an environment of much greater flexibility for operators that partly rely on other operators' infrastructure to develop and deploy services and applications independent of those of the host operator. By doing so, they become more valuable complements for MNOs, which in turn can bolster a co-opetitive relationship between them.[521]

The fertile conditions for MVNOs these past years and their proliferation has given rise to third-party vendors known as mobile virtual network enablers (MVNEs), who handle technical and other aspects of the shared-services arrangements, and by working with multiple virtual operators, they establish economies of scale on their technology platforms. This leads to a reduction of costs for MVNEs and MVNOs, which helps them succeed, and in turn leads to further micro-segmentation in the market.[522]

Such transformative developments culminated in the creation of industry associations that facilitate specialization, disaggregation and collaboration among the various parts and clusters in the industry. The Mobile Industry Interface Alliance (MIPI Alliance) and the Open Mobile Alliance are such examples, both bringing together actors that belong in different parts of the

existing network and to some extent also redefining the characteristics of the underlying network as a result."). *See also* Evolution of the Mobile Network, Cisco White Paper (2010), at 9-13, *available at* http://www.cisco.com/en/US/solutions/collateral/ns341/ns973/white_paper_c11-624446.pdf. *See also* BMI TechKnowledge, Open Access LTE Network: Intriguing but not Without Pitfalls, *available at* http://www.bmi-t.co.za/content/open-access-lte-network-intriguing-not-without-pitfalls.

521 *See* Dewenter & Haucap, *supra* note 503.

522 *See* Strategy& (formerly Booz & Company), Mobile Virtual Network Operators at the Gate: The Rise of Service-Based Competition in the MENA Region, *available at* http://www.strategyand.pwc.com/me/home/press_media/management_consulting_press_releases/article/50186497.

value chain, including semiconductor companies, software vendors, IP providers, peripheral manufacturers, test labs and end product OEMs. Such associations are not concerned with standardizing or commoditizing products or services; their goal is to define the boundaries of each part and component, standardize the interfaces among them and resolve any technical difficulties that prevent parts and components from interoperating, all that with the view to more clearly define the roles and the links between components.[523] The practical consequence of that is that actors remain free to diversify their products, services and strategies and therefore compete effectively, but at the same, as long as they abide by the set specifications, benefit from the ability to procure inputs and complements from all other actors.

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Overall, considering the above developments, what is noticeable in the industry is an increasing modularization and disintegration of the value chain, which moves the industry from a structure of vertically insular systems to a structure where interdependencies are more common. Insular systems, because they encompass all the necessary components, they are more likely to see external actors as competitors and therefore have an incentive to exclude or discriminate against them. On the other hand, in a disaggregated industry structure, because the vertical structure does not revolve around self-sufficient systems but rather interdependent clusters of actors along the value chain, cooperation becomes more common. Both systems of organization can co-exist in the market; the purpose of this chapter was to demonstrate that there has been at

523 *See* MIPI Alliance, Momentum, *available at* http://mipi.org/momentum; Open Mobile Alliance, About OMA, *available at* http://openmobilealliance.org/about-oma/.

least a partial shift in the wireless industry from the insular to the disaggregated model, and a concomitant shift in incentives. This shift should inform regulators about how much of a threat exclusion is in the market, since if the incentives behind it are diminished, then it is less likely to arise.

5 . Complex Technical Systems and the Efficiencies Defense

In the previous chapters we began to put together the elements of a framework aimed at complementing the mainstream analysis on exclusion by highlighting how the technology-intensive nature of mobile telecommunications influences the relevant parameters. We showed that in the environment of mobile telecommunications the ability of market players to effectively shut out or discriminate against other players upstream or downstream is weakened because of the increased competitive sources and pressure, and that the incentives of market players to engage in anticompetitive acts may be reduced, because of the disaggregation of the industry and the ensuing interdependencies and complementarities that arise among the necessary components of a service, product or application along the value chain.

However, neither one of those conclusions can be taken to mean that exclusionary practices will *not* arise in the market. Technological competition and incentives may discourage exclusionary practices, but business decisions come as the result of a multitude of factors, of which technological considerations are only one. Therefore, while under the conditions discussed here exclusion is less likely to occur and less likely to harm the competitive vigor of the market, it can still occur.

But before one can conclusively state that exclusionary practices are undesirable in the market because of their negative effect, any offsetting conditions should also be examined. If positive results can flow from a practice, it is only right to study them as well before condemning the practice, because we may in fact discover that they outweigh the cons of blocking or

discriminating against an actor. We can collectively call such positive effects *efficiencies*.

In the following pages we discuss the concept of efficiencies to show that practices that are on first impression harmful can in reality serve the competitive process in the market, when one accounts for the improvements they introduce; we link exclusion to efficiencies to demonstrate how one can result from the other; and we detail how certain engineering aspects of wireless telecommunications can yield efficiencies from exclusion, that may not be immediately apparent, but can still have a significant impact on the health of a system.

5.1 THE CONCEPT OF EFFICIENCIES AND THEIR LINK TO EXCLUSION

If one of the major contributions of modern industrial economics was to spell out the structural preconditions that needed to be in place for exclusion to have anti-competitive effects, the other was the development of the efficiencies defense.[524] Up until the middle of the previous century exclusionary practices were seen as just that, namely an effort to exclude competitors and consequentially harm competition; it is not that efficiencies were never recognized as a possible side effect, but they were treated with an air of skepticism, as they were difficult to prove and measure,[525] and they suffered from the perceived internal inconsistency that the

524 Professor Hovenkamp put it thusly: "Undoubtedly the most lasting legacy of the problems attending the New Deal and the recovery was the increasing attempt by antitrust policy makers after World War II to take efficiency concerns more seriously, and to recognize that bigness and even a certain amount of oligopoly were a fact of life." *See* HERBERT HOVENKAMP, FEDERAL ANTITRUST POLICY: THE LAW OF COMPETITION AND ITS PRACTICE 67 (3rd ed. 2005). *See also* William Kolasky & Andrew Dick, *The Merger of Guidelines and the Integration of Efficiencies into Antitrust Review of Horizontal Mergers*, 71 ANTITRUST LAW JOURNAL 207 (2003); Alan A. Fisher & Robert H. Lande, *Efficiency Considerations in Merger Enforcement*, 71 CALIFORNIA LAW REVIEW 1983 (1983).

525 *See*, *e.g.*, Derek C. Bok, *Section 7 of the Clayton Act and the Merging of Law and Economics*, 74 HARVARD LAW REVIEW 226, 236 (1960) ("To anyone used to the preoccupation of professors and administrators with the economic consequences of monopoly power, the curious aspect of the debates is the paucity of remarks having

practices under scrutiny (:exclusion) could not simultaneously increase efficiency *and* market power of the participating firms.[526]

But for the past several decades it is accepted that a prima facie anti-competitive strategy can be excused if it results in productivity or efficiency gains for the producer, consumer or both.[527] The efficiencies defense changed economic thinking in that it convinced judges and authorities that seemingly anti-competitive practices should not only be tolerable but even encouraged, if they increased productive or transactional efficiency.[528] Indeed, antitrust litigation underwent a sea change in the past half century, from considering many business practices per se illegal to deciding that the proper treatment is to examine them under the rule of reason, frequently citing their pro-competitive impact.[529]

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to do with the effects of concentration on prices, innovation, distribution, and efficiency."). Throughout the paper the author chronicles the evolution and (hostile) treatment of the efficiency argument especially by the Congress. *See also* United States v. Philadelphia National Bank, 374 U.S. 321, 371 (1963) (where the Court decided that "[A] merger the effect of which 'may be substantially to lessen competition' is not saved because, on some ultimate reckoning of social or economic debits and credits, it may be deemed beneficial."); U.S. Department of Justice & Federal Trade Commission, Horizontal Merger Guidelines, at ¶ 10 (where it is acknowledged that "efficiencies are difficult to verify and quantify" and that "efficiency claims will not be considered if the are vague, speculative or otherwise cannot be verified by reasonable means."). Even today, efficiencies may not be a game-changing factor. *See* Joseph Kattan, *Efficiencies and Merger Analysis*, 62 ANTITRUST LAW JOURNAL 513, 514 (1994) ("The problem of proof is the principal reason why, in an antitrust era that has been quite hospitable to efficiencies claims in a wide variety of other contexts, efficiencies have yet to play an outcome-determinative role in any litigated merger case.").

526 Hovenkamp, *supra* note 524, at 715. *See also* Robert Pitofsky, *A Framework for Antitrust Analysis of Joint Ventures*, 74 GEORGETOWN LAW JOURNAL 1605, 1622-1623 (1985).

527 We are skipping here one of the hard philosophical questions of the admissibility of efficiency as a potential line of defense, namely whether efficiencies should be factored in only if they are passed on to consumers, as opposed to benefiting only the producer. It is dubious whether an efficiency gain that is used by the producer only to foreclose competition without that translating into any sort of consumer benefits (one could call that an X-Efficiency) should be acknowledged. *See* LAWRENCE A. SULLIVAN & WARREN S. GRIMES, THE LAW OF ANTITRUST: AN INTEGRATED HANDBOOK 608-612 (2000).

528 A big part of why certain exclusionary practices were considered anti-competitive was—surprisingly enough—that they accorded the firm an "unfair advantage" by lowering its productive or transactional costs thereby making it more competitive. *See, e.g.*, Brown Show Co., Inc. v. United States, 370 U.S. 294 (1962). However, it has long now been recognized that economic policy's goal is not to condemn cost-reducing practices or to protect inefficient competitors. See PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THEIR APPLICATION §757a (2006).

529 For a succinct review *see* Kolasky & Dick, *supra* note 524, at 213-217, 223-224, 231-235.

Efficiencies are usually discussed in the context of mergers or integration to demonstrate to authorities or courts that the proposed action will produce offsetting benefits to the firm or to consumers. They are equally relevant, though, to exclusionary practices, because—as we shall see—the decision to block an input/actor (foreclosure) or to block all of them except for one (tying) is not necessarily predicated on anti-competitive intentions, but can be motivated by the desire to increase cohesion, coordination, productivity and quality.[530] In both cases the excluding firm establishes a more controlled relationship with its partners, which in turn can translate into a substantial improvement of the production process. To the extent this positive effect can generalize in the industry, exclusionary practices not only become less harmful, even falling below the threshold of necessity for rules, but they may even be welcome. Further, assuming that there are rules in place that ban exclusionary behavior, the existence of efficiencies should be accounted for in applying the rules, so that they limit only those cases in which despite some efficiencies the negative effect of exclusion still dominates.

The manufacture of even the simplest product or the provision of the simplest service requires the bringing together of inputs, expertise, human capital and management skills.[531] In the process, the ability to choose partners, and its corollary, the ability to exclude unwanted partners is key to the success of the business enterprise.[532] Effective control over the production process

530 *See* DANIEL F. SPULBER & CHRISTOPHER S. YOO, NETWORKS IN TELECOMMUNICATIONS: ECONOMICS AND LAW 146-151 (2009).

531 In the theory of the firm Alchian and Demsetz have described this as a "team productive process." See Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AMERICAN ECONOMIC REVIEW 777, 778 (1972). They identify the main elements of the process to be 1) joint input production, 2) several input owners, 3) one party who is common to all the contracts of the joint inputs, 4) who has rights to renegotiate any input's contract independently of contracts with other input owners, 5) who holds the residual claim, 6) who has the right to sell his central contractual residual status. Id. at 794.

532 *Cf.* the "Colgate Doctrine" which states that traders have the right to "freely exercise [their] own independent discretion as to parties with whom [they] will deal." United States v. Colgate & Co., 250 U.S. 300, 307 (1919).

has several advantages:[533] it lowers transaction costs because it allows players to screen out costly transactions (the extreme form of that is integration), it enhances cooperation, coordination and synergies among resources not only because it allows management to choose the appropriate resources but also because it endows it with the power to dictate the terms of their operation and resolve conflicts and differences, it speeds up the production process, and it reduces waste by filtering out unwanted interactions among resources.

These efficiencies have rich theoretical foundations in a body of literature that spans more than half a century. They go back to the theory of the firm which suggests that the boundaries of the firm are determined by whether it is cheaper to perform a task internally or in the context of the market.[534] The firm as an institutional organization exercises control over its production process by selecting which tasks to internalize, which tasks to procure from the market, and which tasks not to perform at all.[535] A firm may find, for example, that it operates optimally when it works with only one input, and that accommodating more than one would ruin its business model. Think, here, of Apple or Blackberry, which tie their devices to one mobile operating system. The ability to choose only that set of partners that keep a firm's transaction costs at a minimum is at the heart of efficient operation.

Moreover, shutting out inputs and partners that can be a source of "interference" in the operation of a system, also increases efficiency. Several economists, led by Penrose, Nelson,

533 *See infra* at 5.2.1.

534 Ronald H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386, 397 (1937); Steven N.S. Cheung, *The Contractual Nature of the Firm*, 26 JOURNAL OF LAW AND ECONOMICS 1 (1983).

535 *See* Sidney Winter & Michael Jacobides, *The Co-Evolution of Capabilities and Transaction Costs: Explaining the Institutional Structure of Production*, 26 STRATEGIC MANAGEMENT JOURNAL 395, 398 (2005) (characterizing the market as the thin interface through which the product or service of another firm is purchased").

Winter and Williamson, have pointed out how tight control over a system of production (which in the extreme form is an integrated firm) can help competencies, complementarities and synergies among the different parts emerge;[536] how certain routines and operational skills are put into place among a select group of inputs and actors in an organization,[537] and how managerial control can substitute for missing knowledge,[538] swiftly resolve conflicts and dilemmas[539] and overall generate and implement a grand scheme and retain overview of the entire process.

In this process the ability to include and exclude partners should not be underestimated. Some projects require a very particular combination of actors and resources (which can even mean only one input) and forced inclusion can jeopardize it. Even when it appears that the motivation is purely monetary (as opposed to efficiency), an exclusionary strategy can mean that the business plan depends on the participation of a select group of actors, because that particular group matches the goals, needs and risk assessment behind the business plan.[540] In such cases deviation from the group synthesis will not only lower profits (a goal that industrial organization policy does not care to advance in and by itself), but might result in the failure of the project as a whole, which harms both static competition, and dynamic efficiency, two central tenets of

536 EDITH PENROSE, THE THEORY OF THE GROWTH OF THE FIRM (4th ed. 2009); Kathleen R. Conner & C. K. Prahalad, *A Resource-Based Theory of the Firm: Knowledge versus Opportunism*, 7 ORGANIZATION SCIENCE 477, 485-486 (1996);

537 Richard Nelson & Sidney Winter, *Evolutionary Theorizing in Economics*, 16 JOURNAL OF ECONOMIC PERSPECTIVES 23 (2002) (with references to their earlier relevant work).

538 Harold Demsetz, *The Theory of the Firm Revisited*, 4 JOURNAL OF LAW AND ECONOMIC ORGANIZATION 141, 157 (1988) (where he states that "direction substitutes for education").

539 *See* Oliver E. Williamson, *The Vertical Integration of Production: Market Failure Considerations*, 61 AMERICAN ECONOMIC REVIEW 112, 112-114 (1971); Andrew Whinston, *Price Guides in Decentralized Organizations*, *in* NEW PERSPECTIVES IN ORGANIZATION RESEARCH 405, 410-414 (William W. Cooper et al. Eds., 1964).

540 *Cf.* Pitofsky, supra note 526, at 1623, where the author explains that the assumption that "higher levels of integration are likely to be associated with more substantial efficiencies ... is a premise [that] underl[ies] all of antitrust...."

industrial organization policy. As a general matter then, the freedom to choose one's partners grants firms flexibility and efficiency in planning and execution, and industrial organization policy geared as it is toward competition and innovation has an interest to protect that.[541]

It follows also, a maiore ad minus, that if the selection of one's right partners is key to the general efficiency of a system, it can also guarantee higher quality standards, and greater resource economization. One of the most famous cases that successfully raised the quality defense was Jerrold Electronics, involving a cable television system manufacturer, Jerrold Electronics.[542] Jerrold refused to sell separately the components of its systems, effectively excluding all other suppliers from offering complementary services to Jerrold systems. The court concluded that this exclusionary practice rested on a sound business reason, namely that "Jerrold could not render the service it promised and deemed necessary if the customer could purchase any kind of equipment he desired."[543]

On a higher level the establishment of a selection mechanism has been known in economics to also help with quality assurance and resource economization. The selection mechanism consists in a hierarchically constructed system which comes with the authority to exclude inputs if they are deemed to have low chances of succeeding in a project.[544] Systems that are allowed to exclude unwanted inputs or to partner with only one input may be less open and permissive but

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541 *See* Colgate case, *supra* note 532. This right was reaffirmed in the Aspen case but the circumstances of the termination were different, which explains the different outcome. *See* Aspen Skiing Co. v. Aspen Highlands Skiing Corp., 472 U.S. 585 (1985).

542 United States v. Jerrold Electronics Corp., 187 F. Supp. 545 (1960).

543 Jerrold Electronics, *id.*, at 560. The court wisely noted that this business justification could not hold up forever. "As the circumstances changed and the need for compulsory service contracts disappeared, the economic reasons for exclusively selling complete systems were eliminated.

544 Raaj K. Sah & Joseph Stiglitz, *The Architecture of Economic Systems: Hierarchies and Polyarchies*, 76 AMERICAN ECONOMIC REVIEW 716, 716 (1986). *See also* Winston T.H. Koh, *Human Fallibillity and Sequential Decision Making: Hierarchy Versus Polyarchy*, 18 JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION 317 (1992).

at the same time are less prone to type II errors (false negatives) and as a result increase the ratio of resources investment to successful outcomes (everything else equal).[545]

It appears, therefore, that decades of economic and policy research have gravitated toward the conclusion that exclusionary practices can well enhance efficiency and increase welfare. These efficiencies can be of various kinds such as novel business agreements and strategies, enhancements in processes, managerial innovations, but also technical advancements. Below, we trace the ways the technology-intensive nature of the mobile telecommunications industry causes efficiencies to materialize, and we focus in particular on the kind of technological efficiencies that arise when treating wireless telecommunications systems as a whole, and not regarding them simply as a collection of components and sub-parts.

5.2 Exclusion and the Achievement of Technological Efficiencies

Of the entire spectrum of efficiencies, we are interested here in technological efficiencies. The idea that the technical design of a production process determines its efficiency is not new. The classic example of technological efficiency cited in the literature is the processing of steel ingot and steel plates.[546] For steel to be made more flexible for processing it is melted and then cast into a bar shape (ingot). To produce steel plates, one needs to take the ingots, reheat them

545 *See* Tim Wu, *Intellectual Property, Innovation and Decentralized Decisions*, 92 VIRGINIA LAW REVIEW 123, 130–31 (2006); *See also* Raaj Kumar Sah & Joseph E. Stiglitz, *Committees, Hierarchies and Polyarchies*, 98 ECONOMIC JOURNAL 451 (1988). We are assuming here that the selection mechanism is effective. If not, no safe conclusion can be reached. *See* Raaj K. Sah, *Fallibility in Human Organizations and Political Systems*, 5 JOURNAL OF ECONOMIC PERSPECTIVES 67, 69–71 (1991).

546 G. E. Hale, *Vertical Integration: Impact of the Antitrust Laws Upon Combinations of Successive Stages of Production and Distribution*, 921 COLUMBIA LAW REVIEW 921 (1949).

and then shape them into plates. Because heating steel is expensive, the factory can save resources by melting the steel once and then combine the production of ingots and plates while the steel is still hot thus skipping the intermediate step of reheating it.

The production design by which steel ingots and plates are produced by the same factory—a form of integration of two production steps in one—is an improvement over the technological conditions of ingot and plate production, which results is cost-savings. Other technological efficiencies go even further than cost savings, and enable innovations that wouldn't have emerged without them. These “pure” technological efficiencies, while not an innovation themselves, serve as a precondition for a new process, product or service to come to life, or at the very least, significantly facilitate their emergence. They are, therefore, of particular interest when examining industries characterized by innovative intensity, as their effect on the conditions giving rise to innovation can be catalytic.

We distinguish between two types of efficiencies that are grounded in the technical nature and peculiarities of the mobile telecommunications networks. First, technical efficiencies that emerge by treating mobile telecommunications systems as a whole and as the minimum unit of analysis (as opposed to looking at it at the component level). Because of the technical interdependencies and complexities, a *systemic approach* is oftentimes necessary to see how certain performance or productive gains can be attained. As we shall see, the systemic approach encompasses the ability to block out undesired elements and interactions from the system, with the aim to protect its integrity, especially while the interactions among its parts have not yet stabilized. Second, we suggest that the ability to depart from uniform treatment of partners (i.e. exclude or discriminate against some while accepting others) is a necessary precondition for the

formation of efficient interactions *among industry players*, when the interactions under consideration are still fluid. While the first type of efficiency identified here is internal as it refers to the optimal operation of a given system, the second type is industry-wide as it affects how industry players interact with each other. Efficient interactions among players will in turn will allow the industry to gravitate to its optimal state.

5.2.1 Systemic Treatment of Mobile Telecommunications Networks and Resulting Efficiencies

Oftentimes the effects of a particular strategy (in our case exclusion) are studied at a localized level without taking into account the broader and often harder to discern effects to other remote and seemingly unrelated parts of the system, network or value chain. This may not only introduce inefficiencies by "breaking" a part in an effort to optimize another, but it also prevents systemic efficiencies from emerging, that is efficiencies that occur when the unit of analysis is the whole system, network or value chain and it is optimized globally. Such efficiencies are more common and more needed in complex technical networks. In the following pages we explain what we mean by systemic approach, and how it is applied to wireless telecommunications. The purpose is to show that oftentimes allowing system architects to exercise end-to-end control as to which inputs and complements will be included in the system while others are shut out, can give rise to properties and features that affect the entire system and create value and efficiencies for it and for the ecosystem around it.

5.2.1.1 The Meaning of Systemic Approach: Global Optimum, Local Optimum and the Pursuit of Efficiency In Interdependencies

In the vast literature that studies systems organization there is a type of system that exhibits extensive and complex interdependencies among the constituent parts of the system. Such systems have been studied under different names, but they all express the same underlying notion of structural complexity and intricate inter-relationships between different actors, parts and resources in the system under study.[547] These systems are most commonly referred to as *large technical systems* (LTS), i.e. large "coherent structures comprised of interacting, interconnected components"[548], or *complex products and systems* (CoPS), a similar category that is characterized by a fair amount of specialized components and sub-systems, that are usually hierarchically organized and present a high degree of technological novelty.[549]

Telecommunications networks are commonly brought as an archetypal example of a complex system,[550] although it would be a gross generalization to say that all subsystems, constituent elements and organizational forms in the telecommunications ecosystem rise up to

547 Rebecca Henderson & Kim Clark, *Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms*, 35 ADMINISTRATIVE SCIENCE QUARTERLY 9, 11 (1990).

548 THOMAS P. HUGHES, NETWORKS OF POWER: ELECTRIFICATION IN WESTERN SOCIETY, 1880-1930 ix (1983). Thomas Hughes popularized the term "large technical systems" and his case studies included electricity networks, railroads and telecommunications networks. Joerges defines LTS as "systems of machineries and freestanding structures performing, more or less reliably and predictably, complex standardized operations by virtue of being integrated with other social processes, governed and legitimated by formal, knowledge-intensive, impersonal rationalities. The guiding idea in determining the scale of such systems would then be to determine (a) the relative quantity (complexity, speed, rate of growth, etc.) of activities materialized in such systems, and (b) the quantity (complexity, speed, rate of growth) of other social processes necessitated by (a) in order to function." *See* Bernward Joerges, *Large Technical Systems: Concepts and Issues*, *in* THE DEVELOPMENT OF LARGE TECHNICAL SYSTEMS 9, 23-24 (Renate Mayntz & Thomas P. Hughes eds., 1988).

549 Mike Hobday, *Product Complexity, Innovation and Industrial Organization*, 26 RESEARCH POLICY 689, 690-698 (1998). *See also* Ying-Tao Ren & Khim-Teck Yeo, *Research Challenges on Complex Product Systems (CoPS) Innovation*, 23 JOURNAL OF THE CHINESE INSTITUTE OF INDUSTRIAL ENGINEERS 519 (2006).

550 *See infra* 5.2.1.2.1.

the level of complexity of LTS or CoPS. Which (sub-)systems, architectures, services, products, and functions involve the kind of systemic interactions that we describe here is an empirical assessment issue and does not lend itself to ex ante designation. Despite the (inevitable) definitional uncertainty, the reason why it is nevertheless important to analyze efficiencies in complex systems is that oftentimes the scope of interconnectedness among all the parts of a complex system makes it hard to discern them and take them into consideration, which may result in an inaccurate assessment of why certain choices to include or exclude elements from the process were made.

This is particularly relevant in the development and provision of services, applications and content in complex systems, where innovations can often be *systemic* (also known as architectural or generalized), meaning that they affect multiple and dispersed parts of the system which are characterized by high interconnectedness, so that changes in one component causes the need for substantial modifications in other components throughout the system or a readjustment of the whole system.[551] Systemic changes and innovations are known to "sweep away much of [an organization's] existing investment in technical skills and knowledge, designs, production technique, plant and equipment,"[552] to be "game changers"[553] and to result in new

551 David J. Teece, *Technological Change and the Nature of the Firm*, *in* TECHNICAL CHANGE AND ECONOMIC THEORY 268-269 (Giovanni Dosi et al. eds., 1988); Richard Langlois, *Economic Change and the Boundaries of the Firm*, 144 JOURNAL OF INSTITUTIONAL AND THEORETICAL ECONOMICS, 635, 639-640 (1988). Henderson & Clark, *supra* note 547, at 12. *See also* Andrew Davies, *The Life Cycle of a Complex Product System*, 1 INTERNATIONAL JOURNAL OF INNOVATION MANAGEMENT 229, 234-5 (1997) (where he states that architectural innovations refer to "changes in the functions of components and subsystems and how they are controlled to realize a common system goal.").

552 JAMES M. UTTERBACK, MASTERING THE DYNAMICS OF INNOVATION 200 (1996); Henderson & Clark, *supra* note 547, at 13.

553 Mark P. Rice et al., *Managing Discontinuous Innovation*, 41 RESEARCH TECHNOLOGY MANAGEMENT 52, 52 (1998) (such innovations have the potential (a) for a 5–10 times improvement in performance compared to existing products; (b) to create the basis for a 30 –50% reduction in costs; (c) or to have new-to-the world performance features.").

products or markets.[554]

Extensive system-wide innovations and changes can benefit from a controlling authority that has system-wide reach, absent which the system or the proposed innovation may collapse under its own complexity. The kind of control that traverses a system as a whole and tightly binds the constituent parts together in a "team productive process" facilitates the exchange of the necessary technological knowledge, know-how and generally interactions that require a closely-knit relationship, for technology "is rarely reducible to mere information to be passed on but consists also of experience and skills."[555] Indeed, technology consists of much more than facts, including specialized knowledge, skills, experience, but also goals, strategies and visions that are sometimes hard to communicate to outsiders.[556] This added value that comes with highly controlled closed systems endows a system with a certain culture, a set of competencies[557] and routines,[558] which are not only transactional or organizational, but also technological (i.e. the particular selection or configuration of an organization's technological base),[559] and serve as a unifying force that stitches together the system's resources and capabilities into a harmonious whole.

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554 Colarelli G. O'Connor, *Market Learning and Radical Innovation: A Cross Case Comparison of Eight Radical Innovation Projects*, 15 JOURNAL OF PRODUCT INNOVATION MANAGEMENT 151 (1998); XM Song & Mitzi Montoya-Weiss, *Critical Development Activities for Really New Versus Incremental Products*, 15 JOURNAL OF PRODUCT INNOVATION MANAGEMENT 124 (1998).

555 George B. Richardson, *The Organization of Industry*, 82 The Economic Journal 883, 895 and 889-890 (1972), referencing Gilbert Ryle's classic distinction between "knowledge how" and "knowledge that." *See* Gilber Ryle, *Knowing How and Knowing That*, *in* COLLECTED PAPERS 212 (1994)).

556 MORRIS SILVER, ENTERPRISE AND THE SCOPE OF THE FIRM: THE ROLE OF VERTICAL INTEGRATION 17 (1984) ("[The entrepreneur's] problem is that he cannot, at reasonable cost, convey his implausible "secret" to those with the technical capabilities needed to produce the required operations at the lowest cost.").

557 EDITH PENROSE, THE THEORY OF THE GROWTH OF THE FIRM (4th ed. 2009).

558 Sidney Winter, *Understanding Dynamic Capabilities*, 24 STRATEGIC MANAGEMENT JOURNAL 991 (2003).

559 David Teece et al., *Understanding Corporate Coherence*, JOURNAL OF ECONOMIC BEHAVIOR AND ORGANIZATION 1, 18-19 (1994). *See also* Pavel Pelikan, *Can the Innovation System of Capitalism Be Outperformed*, *in* Technical CHANGE AND ECONOMIC THEORY (Giovanni Dosi et al. eds., 1988).

This is a good moment to note that the kind of control described here is not an absolute necessity for large complex systems. It is easy to point to cases of systems where centralized control and exclusionary practices played a smaller role without this affecting their success (e.g. Linux, Android). And there is no denying that open inclusive systems can have significant advantages over exclusionary tightly control ones.[560] But the fact that an open strategy can also work in certain cases, under certain circumstances and for certain goals does not make exclusionary systems suspect of anticompetitive or harmful effects. While this may sound like an obvious statement, the need to underscore it stems from the fact that open inclusive systems never face scrutiny, while closed exclusionary systems do. And the argument here is precisely that, because of the significant efficiencies that can result from exclusionary practices, the decision to design and implement an exclusionary system not only isn't anticompetitive per se, but it may under circumstances be necessary to achieve the kind of results that comes only through such policies.

Indeed, it is sometimes necessary to carefully select the participants and under what conditions they join the system, and in the process some actors, inputs and resources may be blocked or discriminated against. It is only then that the remaining parts and resources in a system or network can achieve what Schilling calls *synergistic specificity*, a state where resources optimally fit together and complement each other to maximize each other's

560 Kevin Boudreau, *Open Platform Strategies and Innovation: Granting Access vs. Devolving Control*, 56 MANAGEMENT SCIENCE 1849, 1850 ("I find that granting access to independent hardware developers was associated with a dramatic increase in the rate at which new devices were developed—up to a fivefold acceleration."); CARL SHAPIRO & HAL VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY 229-230 (where the authors identify as benefits of openness the expanded network externalities, reduced uncertainly, and reduced customer lock-in).

functionality and utility.[561]

Otherwise, some parts may behave individualistically, optimizing locally to the expense of the global optimum.[562] This is not always detrimental to the health of the system, but it does create complications for systems where the global optimum is prioritized over local optimum states. This trade-off between the prioritization of *local* and *system-wide (global)* efficiency is a well known debate in the circles of technologists. As Skyttner notes "if each *subsystem*, regarded separately, is made to operate with maximum efficiency, *the system as a whole* will not operate with utmost efficiency." (emphasis added).[563] CoPS and LTS are prone to this kind of weakness because they are made up of several subsystems. While each subsystem may have been designed with its own internal architecture and efficiency rules, the system superstructure is largely dependent on the interactions of the subsystems with each other. This is why the element of a control authority, which can supervise the entire system and coordinate the subsystems to serve a common interest, is so prominent in CoPS and LTS.[564]

Similar insights can be found in modularity theory, which suggests that the modules in a system generally tend to focus on their own interests to the expense of the performance of the system as a whole. To overcome this shortcoming the system's architect can assign coordination to a centralized authority, or he can embed testing and coordination procedures in modules while

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561 Melissa A. Schilling, *Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity* , 25 ACADEMY OF MANAGEMENT REVIEW 312, 320-323 (2000).

562 Cf. Esteve Almirall & Ramon Casadesus-Masanell, *Open Versus Closed Innovation: A Model of Discovery and Divergence*, 35 ACADEMY OF MANAGEMENT REVIEW 27, 27-28 (2010) ("[S]uppliers and complementors are likely to maximize their own payoffs, not those of the original designer. And while there may be some positive correlation between the interests of different industry players, goals generally will not be perfectly aligned. We refer to this effect as divergence."). Henry W. Chesbrough & David J. Teece, *When Is Virtual Virtuous?: Organizing for Innovation*, HARVARD BUSINESS REVIEW, Jan.–Feb. 1996, at 65, 66.

563 LARS SKYTTNER, GENERAL SYSTEMS THEORY: IDEAS AND APPLICATIONS 93 (2001).

564 *See* Hughes, *supra* note 548 at 5-6; Andrew Davies, *Innovation in Large Technical Systems: The Case of Telecommunications*, 5 INDUSTRIAL AND CORPORATE CHANGE 1143, 1147-1148 (1996)

the system is still being designed.[565] In either case it is obvious that the subsystems or modules cannot be dealt with in isolation of each other when considering system-wide effects.

To ask that a measure in one part of a system be implemented without regard to collateral effects in other parts would perhaps solve a problem locally but jeopardize the health and efficiency of the system generally.[566] The systemic approach presented here asks that when a system's operation stands to gain from considering and handling scattered interactions throughout the system, the ability to to choose the suitable partners and resources, and by extension to exclude or discriminate against others, becomes essential because it increases the effective control over the chain of interactions among the involved parts. In the cases we discuss below, we attempt to show how practices that have been considered controversial can either be explained on the grounds of technological efficiencies, or have a substantial component of technological efficiencies in them that has contributed in the relevant decision.

5.2.1.2 Application and Relevancy of the Systemic Approach to Mobile Telecommunications Networks

5.2.1.2.1 A Recurrent Argument in Telecommunications

565 *See* BALDWIN & CLARK, DESIGN RULES (VOLUME I): THE POWER OF MODULARITY 77 (2000). Cf. In economic theory Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARVARD LAW REVIEW 621, 640 (1998) (where the author explains how unifying fragmented property rights into a single bundle can help overcome the problem of unusable property when it is owned by multiple uncoordinated property holders. The analogy here is between modules and property fragments.).

566 Randy Bush & David Meyer, Some Internet Architectural Guidelines and Philosophy, at 7–8 (IETF Network Working Group Request for Comments 3439, Dec. 2002); Jon Crowcroft et al., *Is Layering Harmful?*, 6 IEEE NETWORK 20, 23–24 (1992).

Before we look into mobile telecommunications, it is worth noting that the systemic approach is no stranger to the broader telecommunications sector. It is not hard to see why telecommunications systems are commonly discussed as a paradigmatic case of a large and complex technical system, since they exhibit all relevant characteristics: they are usually made up of a large number of components, which present great technical depth, and which are extensively linked together in the process of furnishing a service or completing an operation.[567]

Because of these characteristics telecommunications systems can often benefit from being treated as an undivided whole, their various parts considered together and in conjunction with each other to account for the interactions among them. This holistic treatment is meant to minimize unintended consequences, which can occur when attempting to tinker with a part that is intricately tied to other parts, or to introduce an innovation which relies on various, dispersed and interconnected components.[568]

Elements of this type of reasoning can be traced back to the early days of the industry and throughout its evolution. The reception of the systemic approach varied from time to time, but as the technology of telecommunications networks evolved and new systems appeared, the argument kept resurfacing. This can be seen as a sign of resilience of the argument, but at the same time it shows the potentials (and maybe tendency) for abuse.

An early application of the emergence of systemic efficiencies came during the era of

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567 *See* Roger Miller et al., *Innovation in Complex Systems Industries: The Case of Flight Simulation*, 4 INDUSTRIAL AND CORPORATE CHANGE 363, 363 et seq. (1995).

568 *Cf*. the law of unintended consequences: Robert K. Merton, *The Unanticipated Consequences of Purposeful Social Action*, 1 AMERICAN SOCIOLOGICAL REVIEW 894, 895 (1936) ("Rigorously speaking, the *consequences* of purposive action are limited to those elements in the resulting situation which are exclusively the outcome of the action. ... Concretely, however, the consequences result from the interplay of the action and the objective situation, the conditions of action.") (emphasis in the original). *See also* Rob Norton, *Unintended Consequences*, *in* CONCISE ENCYCLOPEDIA OF ECONOMICS (David R. Henderson ed., 2nd ed. 2008).

AT&T's transformation to national monopoly and consolidation during the first two decades of the twentieth century. This transformation was in part motivated by the desire to create a uniform, insular, and extremely reliable network, which was immortalized in Theodore Vail's, AT&T's legendary president, motto "one system, one policy, universal service."[569] The policy consisted essentially in a single ubiquitous network that did not have to interconnect with any other network, services, or devices. The complete end-to-end control allowed AT&T to construct a universally-acclaimed robust network free from external interference of any kind.

The policy didn't go unchallenged. The Kingsbury Commitment was a first step in limiting AT&T's expansion, despite the proven efficiencies.[570] Later, in another challenge a claim was brought to allow third party equipment to connect to AT&T's network, which until then was only open to AT&T's own equipment, and AT&T defended its policy by stating that the reliability, efficiency and security of AT&T's nationwide network was precisely attributable to its ability to block out third parties.[571] The same reason was not upheld about a decade later, when the Commission was faced with the famous Carterfone case;[572] this time, possibly influenced by the rise of the computer industry, the Commission opined that AT&T's restrictions were "unreasonable and unduly discriminatory."[573]

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569 AT&T Annual Report for the Year 1909, at 22-23 ("The position of the Bell System is well known. It is believed that the telephone system should be universal, independent and intercommunicating …. It is not believed that this can be accomplished by separately controlled or distinct systems nor that there can be competition in the accepted sense of competition.").

570 *See* Letter from American Telephone & Telegraph Co. to Attorney General, Outlining a Course of Action Which It Has Been Determined Upon; Attorney General's Reply (Dept. of Justice, 1914).

571 *See* the famous Hush-a-Phone case where the court sided with AT&T in that foreign devices could be "deleterious to the telephone system." Hush-a-Phone Corp. v. United States, 238 F.2d 266, 268 (1956). The Hush-a-Phone case was appealed to the District of Columbia Court of Appeals, which remanded the case for lack of "findings to support these conclusions of systemic or public injury," but not because the prohibition for security reasons was itself unlawful. *See also* Jordaphone Corp. of America v. AT&T, 18 F.C.C. 644 (1954).

572 Carter v. AT&T, 13 F.C.C. 2d 420 (1968).

573 In re Use of the Carterfone Device in Message Toll Telephone Service, 13 F.C.C. 2d 420, 423–26 (1968). After

A similar argument (i.e. network continuity and efficiency) was raised by wireless common carriers when private users requested to use part of the spectrum in the late 1950s as the microwave technology started to become commercially viable. But with the *Above 890* decision the FCC put an end to common carriers' fears that opening microwaves to private users would adversely affect their ability to serve the general public or provide a nationwide communications service.[574]

Several years later during another wave of attempting to break up what was left of a former monopoly, the government mandated that incumbent local exchange carriers (ILECs) unbundle their network to allow competitors to lease individual network elements.[575] This, again, meant that a hitherto closed system would have to be opened up and its parts made available individually "at any technically feasible point."[576] ILECS claimed that the a la carte invasion of third parties to their network disrupted the continuity of their network, and long court battles were fought as to what is "technically feasible."[577] Eventually, unbundling obligations were phased out without ever reaching maturity in the market.

AT&T was forced to abandon the tariffs, it replaced them with a more flexible policy, the protective connecting arrangements (PCA), ostensibly to protect the network's viability. Years later, when the Commission seemed to realize that AT&T's protectionism was likely aimed at achieving equipment monopoly and not network security, it adopted its own product certification policy by instituting the FCC Certification process. *See* CHRISTOPHER STERLING ET AL., SHAPING AMERICAN TELECOMMUNICATIONS: A HISTORY OF TECHNOLOGY, POLICY AND ECONOMICS 124–27 (2006).

574 Allocation of Frequencies in the Bands Above 890 Mcs, 27 F.C.C. 359, §147-148 (1959).

575 47 U.S.C §§ 251.

576 *Id*.

577 ILECs insisted that "feasible" should not be understood to mean "possible" or "imaginable" while entrants pushed for an "extremely broad and dynamic definition." *See* In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, 11 F.C.C.R. 15499, at 15600-15602. FCC's attempts to set down relevant rules and recommendations were stricken down three times by the courts until they were concrete and reasonable enough to withstand judicial review. *See* AT&T Corp. v. Iowa Utils. Bd., 525 U.S. 366 (1999); U.S. Telecom Ass'n v. FCC (USTA I), 290 F.3d 415 (2002); U.S. Telecom Ass'n v. FCC, 359 F.3d 554, 571–73 (2004).

It is evident that throughout the history of telecommunications systemic efficiencies have emerged multiple times with varying degrees of relevancy. Below we explain in more detail the meaning of efficiencies stemming for the systemic treatment of mobile telecommunications, and their relationship to exclusionary practices, and we tie the concept to several recent and contemporary cases that involved some sort of exclusion or discrimination, to show the continuing applicability of the concept in the policy debate.

5.2.1.2.2 Efficiencies Stemming from the Systemic Treatment of Mobile Telecommunications

For various reasons mobile telecommunications were historically not affected by invasive interventions in the structure of the value chain as much as landline communications. In no small part this can be explained on the basis of competition.[578] From the very first generation of mobile telecommunications services the marked was structured as a duopoly and soon after more spectrum was made available to interested entrants.[579] Fewer bottlenecks seemed to characterize the mobile industry especially in the last mile compared to landline communications, and because of the limitations of terminals and of the core network, only a very narrow set of

578 That said the Commission is still hesitant to characterize the mobile broadband market as fully competitive or make any predictions for the future. *See* In the Matter of Preserving the Open Internet Broadband Industry Practices, GN Docket No. 09-191 ¶ 33 (2010) (Report and Order) ("the record does not enable us to make a predictive judgment that the future will be more competitive than the past. Although wireless providers are increasingly offering faster broadband services, we do not know, for example, how end users will value the trade-offs between the benefits of wireless service (e.g., mobility) and the benefits of fixed wireline service (e.g., higher download and upload speeds). We note that the two largest mobile broadband providers also offer wireline or fixed service; this could dampen their incentive to compete aggressively with wireline (or fixed) services.").

579 *See, generally*, Philip Palmer McGuigan et al., *Cellular Mobile Radio Telecommunications: Regulating an Emerging Industry*, 1983 BYU LAW REVIEW 305 (1983).

services was available, which made concerns for exclusion of competing service providers void.[580]

But competition aside, there is another factor that played a major role, namely the technological peculiarities of wireless networks. As the Commission recognized in its 2010 Open Internet Order:

> "mobile broadband presents special considerations that suggest differences in how and when open Internet protections should apply. … [E]xisting mobile networks present operational constraints that fixed broadband networks do not typically encounter. This puts greater pressure on the concept of 'reasonable network management' for mobile providers, and creates additional challenges in applying a broader set of rules to mobile at this time."[581]

Indeed, even after decades of evolution many technical challenges persist. These challenges make wireless networks more sensitive and raise several potential breaking points that are not as common or vexing in fixed networks.[582] Because of these challenges the design of mobile

580 The fact that mobile telecommunications were more competitive did not mean that there were never concerns for exclusionary behavior. It is indicative that, while the Commission had for many years refrained from imposing interconnection requirements between wireless telecommunications carriers, it recently adopted such rules to eliminate the possibility (in case competition and interconnection incentives failed) that some carriers might be disadvantaged by their larger rivals. *Compare*, *e.g.*, Interconnection and Resale Obligations Pertaining to Commercial Mobile Radio Services, 15 FCC Rcd. 13 (2000) (Fourth Report and Order), and In the Matter of Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers Automatic and Manual Roaming Obligations Pertaining to Commercial Mobile Radio Services, WT Docket No. 05-265 (2011) (Second Report and Order).

581 Open Internet Order, supra note 578, ¶ 93, 95.

582 For a succinct summary *see* Christopher S. Yoo, Wireless Networks: Technological Challenges and Policy Implications, University of Pennsylvania Institute for Law and Economics Research Paper No. 13-31 (2013), at 21-27, *available at* http://ssrn.com/abstract=2350777.

networks and their individual components requires the taking into account of more technical considerations. Not only that, but the handling of the technical considerations often requires actions in parts of the network/system other than those where the challenge occurs. This is an important reason for the holistic treatment of telecommunications systems: if system parts are considered separately, then interactions among them and solutions that are more efficient to locate elsewhere in the network, may not be able to emerge.

This reasoning is well reflected in how tightly wireless networks and wireless devices cooperate to achieve efficient and reliable communication. With the risk of oversimplifying, in fixed networks there is little feedback between the network and the attached devices and the devices' behavior is not determined by the network and its conditions of operation. Even in congestion management which requires senders in the network to adjust their behavior based on how loaded the network is, the feedback senders get from the network is indirect in the form of inference from the dropped packets (this is the van Jacobson algorithm implemented in TCP),[583] and not direct information provided by the network itself.[584]

To the contrary, in wireless systems the network and the devices are more tightly coupled, because efficient operation requires each end to do its part. Unlike wireline networks, in wireless networks there is no such thing as a "link" of communication between two devices, there is only a shared medium (the electromagnetic waves), which is affected by the emissions of all sources regardless of destination, as well as by environmental factors. As a consequence, interference caused by such factors as the "near far" problem, multipath propagation, in-phase and out-of-

583 Van Jacobson, *Congestion Avoidance and Control*, 18 COMPUTER AND COMMUNICATIONS REVIEW 314 (1988).

584 A prominent exception is the Explicit Congestion Notification extension (ECN). See RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP (2001).

phase signal propagation etc, is not only a common problem, it also a very significant one.[585] To combat interference and the inherent unreliability of the transmission medium, wireless networks and devices work together as a team: the network can ask devices to adjust their transmission power so that they don't overwhelm the available spectrum, or to hold back a certain type of transmission (e.g. data) in order to prioritize another (e.g. voice), or to switch from one hand-off mechanism (e.g. network-initiated) to another (e.g. device-initiated).[586] In effect, efficient communication between a transmitter and a receiver is not exclusively a matter of receiver or transmitter, but also a matter of how the two ends manage to cooperate to make the most out of the available spectrum.[587]

Another similar example can be drawn from how fixed and wireless network operators have attempted to tackle bandwidth limitations. When the last mile is overloaded, network operators can either tackle the problem where it occurs (i.e. the last mile) by adding more capacity, or elsewhere in the system (i.e. the core) by performing network management to filter heavy traffic from ever reaching the last mile.[588] The logical response would be to try to address the bandwidth limitations where the bottleneck appears, but usually network management is acceptable because regulators and network operators understand that it can be more efficient to filter out some traffic than to overspend in capacity building (hence the term “reasonable network management”).[589] In

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585 ANDREW S. TANENBAUM, COMPUTER NETWORKS ¶ 2.3.1-2.3.3 (4th ed. 2002).

586 *See* Yoo, *supra* note 582, at 21-27.

587 This was early recognized in the Computer Inquiry II order where the Commission opined that “trends in technology enable CPE to function as an enhancement to basic common carrier services and many enhanced service applications involve interaction with sophisticated terminal equipment.” See Computer II Order, 77 FCC 2d 447, ¶ 160.

588 Murat Yuksel et al., *Quantifying Overprovisioning vs. Class-of-Service: Informing the Net Neutrality Debate*, *in* 2010 PROCEEDINGS OF 19TH INTERNATIONAL CONFERENCE ON COMPUTER COMMUNICATIONS AND NETWORKS (ICCCN) (2010).

589 Yaqing Huang & Roch Guerin, *Does Over-Provisioning Become More or Less Efficient as Networks Grow*

wireless networks it is even more imperative to locate the solution in other parts of the network other than the last mile, for several reasons: capacity in wireless networks is significantly more limited, bandwidth in wireless networks cannot be easily added,[590] the available bandwidth is shared among all the devices in a given cell or hotspot radius,[591] and the number of devices that connect to an antenna or hotspot is not static.

As a result not only is capacity expansion more costly (in the broad sense of the word), but the conditions under which it is necessary are more fluid, which in turn increases the risk of it actually being the right solution. To conceive, then, and implement an efficient solution one would have to look in other parts of the network. As mentioned, fixed operators find it more efficient to look at the core of the network, and at the same time this is as far as they can reach. But because mobile network operators' reach extends even farther to the encompass the terminal and applications layer, another possible locus for a solution opens up. If the cause of the problem can be tackled at its source this would be the most efficient thing to do.[592] And to do that one would have to have an overview of the system, of the ripple effects that a problem causes throughout the network, and the ability to intervene in different parts of the network so as to find the best solution.

An illustrative case here is the blocking of FaceTime on AT&T's network. Facetime is a high

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Larger?, *in* PROCEEDINGS OF THE 13TH IEEE INTERNATIONAL CONFERENCE ON NETWORK PROTOCOLS (ICNP) 225 (2005).

590 Putting the cost aside, capacity in the last mile is limited also by the available spectrum.

591 By contrast, capacity expansion in fixed networks is more economical, the last mile connection can be exclusive in some technologies (e.g. DSL, fiber), and even when it is not (e.g. cable), the number of subscribers per neighborhood is known, which provides a better estimate of the demand for network capacity.

592 This principle underlies much of how congestion is managed in the Internet today. TCP, which is executed at the host level, instructs hosts to cut down on their sending rate if congestion is detected in the network (the proxy being packets whose reception has not been acknowledged). The idea is that hosts are responsible for the congestion in the network and therefore it is them that need to take action.

quality video call feature on iPhones. Soon after it was announced, AT&T limited its use over its cellular data network to customers of its MobileShare plans only, whereas customers with "unlimited" data plans would not be able to use FaceTime on AT&T's cellular data network, but only on Wi-Fi.[593] While this sounds like a classic case of vertical exclusion, AT&T did not own a competing videocall service or application and so it had no competing incentives. It also did not block FaceTime completely, but only on the (scarcer) cellular network. The reason for this unfavorable treatment was that FaceTime consumed large amounts of bandwidth, and in fact more than it was necessary based on comparisons with similar applications.[594] In an advisory opinion of the FCC stated: "It is important to note that there is no fundamental reason why FaceTime could not adapt to congestion the same way as other applications, and the way FaceTime behaves in the presence of congestion may easily change in the future."[595]

AT&T had already bad experience with congestion in its data network because of the traffic the iPhone could generate and reasoned that the most efficient thing considering the structure of its network would be to limit the source of traffic instead of expanding capacity.[596] A rule whereby applications and services cannot be blocked (or degraded) would disregard the available solutions in part of the system, and force the solution to take place elsewhere. AT&T and the Commission seemed to agree that tackling the problem at its source was the cheapest, simplest,

593 Cecilia Kang, *AT&T Faces Complaint Over iPhone Facetime Blocking*, WASHINGTON POST, September 18, 2012.

594 AT&T/FaceTime Case Study, Mobile Broadband Working Group, Open Internet Advisory Committee of the FCC (2013), at 3.

595 *Id*.

596 Cecilia Kang, *AT&T lifts FaceTime Restrictions on Apple iPhones*, WASHINGTON POST, November 8, 2012 ("'We decided to take this cautious approach for important reasons,' executive vice president Jim Cicconi said in a blog post. 'To do otherwise might have risked an adverse impact on the services our customers expect — voice quality in particular — if usage of FaceTime exceeded expectations.'").

and quickest solution.[597] It goes without saying that, at the same time, it was the coarsest solution, but considering the many mitigating factors (e.g. the blocking was only temporary and only in the very beginning of FaceTime's introduction, affected only a subset of users, affected only AT&T's 3G and not 4G network, perplexities of bandwidth management in the last mile), AT&T's response might actually have leveraged the possibilities of its network quite well.

In other situations tight integrated control is critical for the success of a system because it ensures that when designing the system all the necessary pieces are identified and fitted together without the distractions, uncertainties or risk factors of an open inclusive system. There is no better illustration of this than the contrasting fates of i-mode in Japan and in Europe. I-mode was an architecture for accessing Internet content in the pre- and early 3G era, that was largely developed and sponsored by NTT DoCoMo, Japan's incumbent and flagship carrier.[598] It consisted of a collection of protocols, interfaces, compatible devices, servers, payment methods, and affiliated content providers, all designed together towards building what was described as a completely new ecosystem. I-mode proved very successful in Japan, but failed to gained traction in other countries and particularly European countries.[599]

Case studies that compared i-mode in Japan and in other countries uniformly agree that the main difference in the implementation was the degree of end-to-end power and control DoCoMo could exercise over the direction of the i-mode ecosystem.[600] In the words of the managing

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597 *Supra* note 594, at 5-6.

598 For an overview *see* Takeshi Natsuno, THE I-MODE WIRELESS ECOSYSTEM 1-5 (2003); Jeffrey L. Funk, *The Mobile Internet Market: Lessons from Japan's i-mode System*, Proceedings of The E-Business Transformation: Sector Developments and Policy Implications, University of California, Berkeley, California, April 2000.

599 *See, e.g.*, MARTIN FRANSMAN, TELECOM IN THE INTERNET AGE: FROM BOOM TO BUST TO? 235 et seq (2003).

600 *See* Richard Tee & Annabelle Gawer, *Industry Architecture as a Determinant of Successful Platform Strategies: A Case Study of the i-mode Mobile Internet Service*, 6 EUROPEAN MANAGEMENT REVIEW 217 (2009); Jeffrey L. Funk, *Standards, Critical Mass, and the Formation of Complex Industries: A Case Study of the Mobile Internet*,

director for i-mode's strategy "[t]he decisive difference is that neither the United States nor Europe has had a telecommunications provider like DoCoMo with the will to grow a new business and service based on a comprehensive view of the ecosystem as a whole."[601] In Japan, the telecommunications industry was structured in a way that accorded a lot of power to the three main operators and especially DoCoMo as the largest operator, as opposed to Europe where power was more evenly divided between operators, device manufacturers and standard setting organizations.[602] The pan-European dominance of the GSM consortium and Nokia, in contrast with the fragmented national markets in which operators were confined, meant that operators lacked the power to direct and control the creation of the necessary standards, interfaces, protocols and devices that were essential to the operation of i-mode.

In contrast to Europe, DoCoMo was well positioned to make several technical decisions about the elements and components that made i-mode work: it excluded WAP from the initial version of i-mode and mandated the use of cHTML (compact HTML) for content creation, it set the specifications for the handsets that would be sold as i-mode compatible (including the interfaces, menus and dedicated i-mode buttons) shutting out manufacturers that did not adhere to the strict requirements, and it developed and mandated the use of a specific micropayment

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28 JOURNAL OF ENGINEERING AND TECHNOLOGY MANAGEMENT 232 (2011); Natsuno, *supra* note 598 at 17-19.

601 Natsuno, *supra* note 598, at 19.

602 *See* Tee & Gawer, *supra* note 600, at 222-224 ("One reason for i-mode's slow adoption, in contrast to Japan, was that procurement of i-mode handsets proved to be more difficult than anticipated. ... [In Europe] by contrast standardization benefited handset and equipment providers more than network operators. ... WAP was part of the first attempt to offer mobile Internet services in GSM markets. ... WAP had not been designed to include any of the features of i-mode such as revenue sharing, micropayments, and initially not even the standard HyperText Markup Language (HTML) language, which would have made a difference for application developers. .. European operators, because of their diminished capabilities, largely lacked the capabilities to knowledge to specify handsets requirements, and to set up the billing or micropayment systems..."); Funk, *supra* note 600, at 237.

system.[603] The result was that the elements that made up i-mode in Japan were much more integrated with each other and provided the much needed compatibility and reliability that both users and service/application/content creators needed in order to adopt it.

To be sure, technological efficiencies were not the only consideration on DoCoMo's agenda nor the only factor that made i-mode successful. Organizational efficiencies stemming from the tight integration, the experience of Japanese phone manufacturers in the interfaces and protocols behind i-mode, the low penetration of fixed Internet in Japan at the time of i-mode's introduction, and the penchant for gadgets have all been suggested as relevant explanations for i-mode's success.[604] The proposition here is not that technological efficiencies take precedence over other factors in firms' decision making process; but that they are still an important parameter co-determining firms' business strategy, and so they can help justify certain business choices and behavior on grounds other than exclusion.

We think this was the case with the introduction of the iPhone exclusively on AT&T's network, for which Apple was sued for monopolization in violation of Section 2 of the Sherman Act.[605] As documented below, the agreement made good economic sense, but it also served important technological efficiencies, which together made an anticompetitive claim harder to defend.

In 2007 in a widely publicized deal, Apple agreed with AT&T (Cingular at the time) to sell the iPhone exclusively on AT&T's network. Consumers had to purchase a data plan with the

603 *See id.*. *See also* Natsuno, *supra* note 598, at 5-6, 11-17, 19-22.

604 *See* Tee & Gawer, supra note 600, at 228. *See also* Natsuno, supra note 598, at 18, where the author anecdotally mentions that one of the reasons for the lack of interest for i-mode phones in Europe was that “such compact mobile phones would be popular only in Japan, because Japanese have dainty hands and can operate tiny keys. Europeans and Americans, with their clumsy big hands, would never go for phones of that size.”

605 In Re Apple & ATTM Antitrust Litigation, No. C 07-05152 JW.

phone. There is no doubt that a powerful incentive for both Apple and AT&T to sign this deal was the mutually beneficial nature of the agreement on financial grounds.[606] AT&T expected that the iPhone would drive data plan adoption on its network up, and Apple managed to extract a significant part of the profits that the iPhone would generate. But, at the same time one of Apple's priorities remained—much like with all of its products—that the end user experience be smooth. To do so, Apple had to ensure that the iPhone's functionality (and especially the pioneering full-featured Internet browser which was data-intensive)[607] would be supported well by the underlying network.[608]

The two major wireless carriers relied on different cellular technologies—AT&T on GSM and Verizon on CDMA. AT&T for various reasons was a better technical match for Apple: "Verizon phones used bigger cell radios than AT&T phones, and there was no additional room in the iPhone case, … Verizon cell radios were well known to be battery hogs … [and] in 2009 [it wasn't clear that] Verizon would be able to handle the iPhone traffic any better."[609] Further,

606 Darrell Etherington, *How Apple Played It Smart with iPhone Exclusivity*, GIGAOM, September 22, 2011.

607 On why the iPhone's full-featured browser was such a crucial component and how it defined technical choices *see* Joel West & Michael Mace, *Browsing as the Killer App: Explaining the Rapid Success of Apple's iPhone*, 34 TELECOMMUNICATIONS POLICY 270, *passim* (2010) ("As Apple CEO Steve Jobs said 3 weeks before the initial iPhone release: They [:Cingular] have spent and are spending a fortune to build these 3G networks, and so far there ain't a lot to do with them. ... [P]eople want the real Internet on their phone. We are going to deliver that." *Id*. at 276 citing external sources); ("A major limitation was that the initial iPhone did not have the 3G support customary in Japanese and European smartphones, but instead used the slower EDGE 2.5G network; Apple claimed this was because GSM-derived 3G was not yet broadly deployed in the US and because existing 3G components would not allow 5 h of battery life. The browser mainly relied on Wi-Fi access, which was common in European phones at the time but was disabled in most phones sold by US network operators; music downloads relied at first on a PC connection and later Wi-Fi." *Id*. At 276).

608 Apple's requirements from the underlying network went beyond what is narrowly understood as services of a wireless cellular operator, but still relevant to their technology and business model. *See, e.g.*, Peter Cohan, *Project Vogue: Inside Apple's iPhone Deal with AT&T*, FORBES, September 10, 2013 ("Jobs said, 'The device would be Wi-Fi enabled, allowing it to connect to the open Internet – a feature not approved by carriers and unavailable on any mobile device at this time.'").

609 Although in retrospect Apple was not satisfied with AT&T's network performance, AT&T remained the best option. *See* FRED VOGELSTEIN, DOGFIGHT: HOW APPLE AND GOOGLE WENT TO WAR AND STARTED A REVOLUTION 139 (2013).

AT&T allowed more technical leeway for Apple to design the device,[610] and because support for both technologies at this early stage of a product's development was deemed to be risky and unwise,[611] Apple had to pick only one technology and optimize the iPhone for it. Tailoring production for only one network gave Apple the chance and the time to launch and test a new product in a way that would both make it reliable and would reveal any weaknesses in terms of how the iPhone cooperated with wireless networks in real-life conditions.[612] A validation of this thinking came de novo a few years later when Apple launched the first 3G-enabled iPad. Again, Apple selected AT&T as the exclusive carrier, one of the reasons being that AT&T had proven "network readiness," while with other carriers it would have to retest and possibly adapt the device to their network peculiarities.[613]

Were the technical considerations the main driving force behind Apple's and AT&T's deal? Perhaps not. And in any case they seemed to have been resolved a few years later when Apple released the iPhone on other carriers as well. However, their documentation in the decision-making process alongside other justifications shows that the initial discrimination against other carriers was based *at a minimum on sound technological reasons*. Even from a secondary role, technological efficiencies can still guide firms' business decisions, and when those business arrangements raise anti-competitive suspicions, technological efficiencies might show that the

610 MG Siegler, *The Long, Complicated Tale Of AT&T's Exclusive (And Elusive) iPhone Agreement*, TECHCRUNCH, May 10, 2010 (" And in some ways, AT&T was taking a risk by giving into Apple's demands to have full control over the software on the phone — something which the carriers previously weren't fond of (just ask Verizon."); Connie Guglielmo, *Life After The iPhone: How AT&T's Bet On Apple Mobilized The Company*, FORBES, January 2, 2013.

611 Yukari Iwatani Kane et al., *New iPhone Could End AT&T's U.S. Monopoly*, WALL STREET JOURNAL, March 30, 2010 ("Apple originally decided against developing a phone for Verizon to keep its development process simple, since the technologies are incompatible.").

612 *See, e.g.*, the frequent problems with dropped calls even on AT&T's highly compatible network in WALTER ISAACSON, STEVE JOBS 520-522 (2011).

613 Elizabeth Woyke, *Why Apple Is Sticking with AT&T*, FORBES, January 27, 2010.

arrangements were necessary to reach a specific result for the successful operation of the product or service.

In that direction this section attempted to demonstrate that technological efficiencies should be a relevant factor to consider, and that while the systemic nature of efficiencies described here may make it hard to discern or describe them, that should not deprive them of a place in the evaluation process. Instead, since systemic efficiencies often underlie certain design choices and business decisions, they should matter in the relevant regulatory review of those decisions.

5.2.2 Exclusionary or Discriminatory Conduct and Industry Coordination on the Cusp of the Next Generation Mobile Communications

In the previous section we described how approaching telecommunications systems as an undivided whole and as the minimum unit of analysis helps discern emerging efficiencies in their operation. Those efficiencies were, in a sense, *internal*, in that they referred to how the various parts of a system interact most efficiently with each other when they remain unobstructed from external interference, whether that means prohibiting or forcing certain interactions.

The system's own good aside, the ability to liaise only with desired partners, allow only certain interactions, and set non-uniform terms and conditions for inter-operation, can also serve the *industry's* efficient operation. Regardless of how a mobile communications network is constructed internally, the very existence of systems that are allowed to diverge from equal treatment and that have the ability to set their own conditions of operation may be useful and

essential, especially at this particular phase of the mobile communications industry's evolution.[614] The argument is that such systems may be necessary to achieve gradual coordination and convergence over those network technologies that will enable them to offer diverse services with the properties that are traditionally associated with mobile communications networks.

One of the key features that is expected from next generation mobile communications networks is the ability to link users and services from different networks and the ability to maintain connectivity when subscribers move across networks.[615] To do so requires that the network nodes along the way from source to destination share common capabilities and can uphold the features and properties of the session between source and destination. As most communications sessions traverse multiple networks, coordination among them becomes crucial, and it should not be taken for granted that all networks share the same capabilities and that coordination is just a matter of simple interconnection among them.

The Internet (as the name suggests) has been at the core of the ability for universal connectivity but not without limitations. While the IP hourglass architecture of the Internet enabled it to serve as a common point for interconnection between different kinds of networks,[616] the fact that each network on the Internet is autonomous and that the IP stack was designed with simplicity in mind (to allow end nodes rather than the network itself to perform most of the

614 *Cf*. the treatment of product differentiation in the economics literature in Kelvin Lancaster, *The Economics of Product Variety: A Survey, 9 Marketing Science 189 (1990); Kelvin Lancaster, Socially Optimal Product Differentiation*, 65 AMERICAN ECONOMIC REVIEW 567 (1975).

615 *See*, *e.g.*, YOUNG KYUN KIM & RAMJEE PRASAD, 4G ROADMAP AND EMERGING COMMUNICATION TECHNOLOGIES 5-6 (2006); SCOTT SNYDER, THE NEW WORLD OF WIRELESS 24 et seq. (2010).

616 Tanenbaum, *supra* note 585, at 56; David D. Clark, *Interoperation, Open Interfaces and Protocol Architecture*, *in* THE UNPREDICTABLE CERTAINTY: WHITE PAPERS INFORMATION INFRASTRUCTURE THROUGH 2000 133, 133-134 (NII 2000 Steering Committee, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council, 1998).

desired functions) translates into reduced end-to-end reliability, security, mobility, and a lack of tools to monetize different aspects of the user experience.[617] To the contrary, while traditional mobile telecommunications networks lag in variety of services and may suffer from potentially slow and monolithic evolution, they excel in ubiquitous coverage, mobility, reliability, quality of service, and powerful authentication, security and charging capabilities.[618]

The vision for the future of mobile telecommunications networks is to complement their traditionally strong points with the kind of generativity that characterizes the Internet.[619] This should not be read as an embracement of any particular technology in that direction, but rather as a statement on the expected materialization of the potentials and expectations of mobile communications.

Ideally, the wedding between the Internet and mobile paradigms would include the best of both worlds. But it may such be the case that at least at this stage of development some combinations are mutually exclusive. To the extent that this is true, one would expect the architect of the system to choose which elements, features or partners to exclude from the development process to save the rest, so to speak.[620] This presupposes the ability to diverge from an egalitarian treatment of industry partners.

In detail, many of the desirable features in communications, like quality of service,

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617 Mark Handley, *Why the Internet Only Just Works*, 24 BT TECHNOLOGY JOURNAL 119, passim (2006); Jon Crowcroft, *Net Neutrality: The Technical Side of the Debate: A White Paper*, COMPUTER COMMUNICATION REVIEW, Jan. 2007, at 49, 50 et seq.

618 *See* Tim Wu, *A Tale of Two Platforms*, at 4-5, *available at* http://ssrn.com/abstract=993288.

619 JYH-CHENG CHEN & TAO ZHANG, IP-BASED NEXT-GENERATION WIRELESS NETWORKS: SYSTEMS, ARCHITECTURES, AND PROTOCOLS 20 (2004); AJAY R. MISHRA, CELLULAR TECHNOLOGIES FOR EMERGING MARKETS 201 et seq. (2010).

620 *See*, e.g., K.C. Wong et al., *Supervisory Control of Distributed Systems: Conflict Resolution*, 10 DISCRETE EVENT DYNAMIC SYSTEMS 131 (2000).

reliability, effective security, and mobility require an end-to-end approach across all layers between terminals. This is because if one of the links along the way drops the required information to support the operation or feature, the connection in that respect is severed irreparably. To achieve this end-to-end approach, an operator would either have to control the entire system/network (from source to destination), or operators from different systems/networks would have to able to coordinate and negotiate agreements based on the capabilities of their networks.

Non-IP communications networks (such as the voice core of current cellular networks) achieve reliable end-to-end service by establishing "flows" of data between terminals, and intermediate network nodes maintain "per flow state," meaning that each node along the way processes data based on the flow (and the related characteristics) it is assigned to.[621] As a result, every hop along the way from source to destination has the ability and necessary information to treat data (and flows) as requested.

To the contrary, IP-based networks normally route packets independently and do not pass enough information from one layer to another to help nodes treat packets in a non-uniform way.[622] Even when mechanisms are implemented to allow additional features to be added (e.g. MPLS, DiffServ, IntServ), these apply only within the autonomous network that installs them.[623] Though there is no technical reason why not all networks along the way from source to destination have not chosen to install such mechanisms, in practice today there is no end-to-end

621 RAY HORAK, TELECOMMUNICATIONS AND DATA COMMUNICATIONS HANDBOOK 240-241 (2007).

622 *See* Ion Stoica & Hui Zhang. *Providing Guaranteed Services Without Per Flow Management.* 29 ACM 81, 81-83 (1999); *See also* Barry M. Leiner et al., *The DARPA Internet Protocol Suite*, IEEE COMMUNICATIONS, Mar. 1985, at 29, 31.

623 Tanenbaum, *supra* note 585, at 409-419.

universally agreed upon mechanism to support the additional features that basic IP networks are lacking.

The combination of the fact that end-to-end connectivity in IP networks requires an additional step in coordination, that mobile communications are transitioning to IP (as well as that IP platforms beyond the Internet are emerging), and that some key features in mobile communications rely on end-to-end coordination, makes the ability to exercise tight control crucial. It is only through partnerships with peers that share common capabilities that industry players can ensure the satisfactory delivery of services that have additional requirements—such as QoS, security, billing arrangements etc—to end users.[624] Control over the network logically includes the ability to choose only those partners that network operators deem suitable and equipped to offer a comparable level of service and features. As networks continue to evolve and agreements between them start to proliferate, the mobile communications industry will smoothly transition to the next generation at the right pace.

There is a problematic parameter here, that of timing. Evidently, new and evolving telecommunications system will not be in a premature state of evolution forever, and the conditions that give rise to the type of efficiencies described here will at some point crystallize. Because the parameter of timing raises broader questions, we discuss it separately infra at 5.2.3. Here, suffice is to say that although the right moment to "declare" a system steady or ready or that efficiencies have been exhausted, is elusive, it is with some certainty that we can say that we are not there yet. The technological reality of the the fourth generation mobile networks is replete

624 *See, e.g.*, how this is reflected in the relationship between MVNOs and MNOs in Rebecca Copeland & Noël Crespi, *Resolving Ten MVNO Issues with EPS Architecture, VoLTE and Advanced Policy Server*, ICIN '11: 15th International Conference on Intelligence in Next Generation Networks: From Bits to Data, from Pipes to Clouds, Berlin, Germany (2011).

with examples of incomplete policies, and differences and incompatibilities among networks, that prevent operators from "simply" connecting.[625] In this environment, case by case negotiation to ensure a confluence of capabilities and technologies may be necessary; this logically implies the ability to strike non-equal agreements, or reject an agreement altogether.

Consider, the following examples. Quality of service in the new EPC core, one of the most crucial features to support diverse services over the fourth generation wireless networks is regulated by a network element called Policy and Charging Control (PCC).[626] Each carrier can set up its PCC function differently, to support various classes of QoS that do not necessarily correspond to the classes of other networks.[627] As a result QoS may not be upheld from one network to another.[628] Until there has been enough experimentation in the market to be certain that the technical specifications of interconnection have been efficiently "standardized," so that refusal to interconnect could be a sign of anticompetitive exclusion, one should examine whether technological realities also explain the refusal to interconnect.

Further, in the EPC core the establishment and termination of a communication session is

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625 *See* the examples in the main text below, but also Jeff Fried & Duane Sword, *Making IMS Work: Current Realities, Challenges and Successes*, BUSINESS COMMUNICATION REVIEW 44, 48 (2006); *See* Igor Radovanovic, *Facilitating Mobile Service Provisioning in IP Multimedia Subsystem (IMS) Using Service Oriented Architecture*, ICSOC '07 Proceedings of the 5th International Conference on Service-Oriented Computing 383, 384-5 (2007); John G. Waclawsky, *IMS: A Critique of the Grand Plan*, BUSINESS COMMUNICATIONS REVIEW, Oct. 2005, at 54, 55.

626 José-Javier Pastor Balbás et al., *Policy and Charging Control in the Evolved Packet System*, 47 IEEE COMMUNICATIONS MAGAZINE 68 (2009).

627 *See* Quality of Service (QoS) and Policy Management in Mobile Data Networks : Validating Service Quality to Ensure Subscriber Quality of Experience (QoE), Ixia White Paper, 915-2731-01 Rev. D, Dec. 2013, at 9, *available at* http://www.ixiacom.com/pdfs/library/white_papers/policy_management.pdf.

628 *See* Peter Mottishaw, Policy Control and Charging for LTE Networks, Analysis Mason White Paper, Oct. 2009, at 13-20, *available at* http://downloads.lightreading.com/wplib/openet/Openet_Policy_control_LTE.pdf (where the author explains the need for gradual transition and constant coordination to avoid faulty or incomplete implementations).

done through the Session Initiation Protocol (SIP).[629] One of the reasons why SIP was selected as the cornerstone protocol for session control was that it is open and versatile.[630] That is to say that, on top of its basic functionality SIP supports additional extensions, such as caller ID, charging and billing functions, tracing, and enhanced media support.[631] However, if not all involved network elements (including user devices) know how to interpret the extensions, the intended functionality will be ignored.[632] To ensure that end-to-end SIP sessions with additional features are successfully set up it is necessary to establish a value chain that supports them at every level and every hop of every network along the way. Similarly, to the extend that IMS (or a comparable architectural framework) will be adopted, it should be noted that IMS equipment, functions and interfaces remain not fully standardized or compatible.[633]

More generally, the separation of the transport and the service layer in next-generation networks means that service level details and interconnection have to be specified separately and can differ from service to service and from operator to operator.[634] This is currently work in

629 *See*, *generally*, TRAVIS RUSSELL, SESSION INITIATION PROTOCOL (SIP): CONTROLLING CONVERGENT NETWORKS (2008); Henning Schulzrinne & Jonathan Rosenberg, *The Session Initiation Protocol: Internet-Centric Signaling*, 38 IEEE COMMUNICATIONS MAGAZINE 134 (2000).

630 *See* Vinton G. Cerf, *foreword*, *in* SIP BEYOND VOIP: THE NEXT STEP IN THE IP COMMUNICATIONS REVOLUTION (Henry Sinnreich et al. 2005) ("It is my honest opinion that we have barely scratched the surface of the various applications to which SIP may be adapted. If we have seen 1% of the applications of SIP so far, then there are still 99% waiting to be invested, developed or deployed. The generality of SIP will make it a major workhorse of the Internet of this century.").

631 Russell, *supra* note 629, at 118-131.

632 *Id*. at 116-117.

633 Kai-Di Chang et al., *Challenges to Next Generation Services in IP Multimedia Subsystem*, 6 JOURNAL OF INFORMATION PROCESSING SYSTEMS 129, 133-143 (2010). *See also* Gonzallo Camarillo et al., *Towards an Innovation Oriented IP Multimedia Subsystem*, 45 IEEE COMMUNICATIONS MAGAZINE 130 (2007) (where the authors describe incompatibility and segmentation problems among different carriers arising from the fact that the SDP is not easily extensible and so new services may run the risk of being rejected from operators whose PCC doesn't know how to deal with them).

634 *See* ITU, General principles and general reference model for Next Generation Networks (Y.2011, 10/2004), at 5-8.

progress. It is indicative that while some wireless operators have already introduced next generation IP services in their networks (e.g. HD voice), they have not made those services available for inter-network connections.[635] Normally, voice service would incur broad interconnection and roaming obligations, but in the case of next-generation voice service it is too early to attribute non-interconnection or non-roaming policies to anti-competitive incentives or results. As operators are still experimenting with these services, it is not unreasonable to let them negotiate among themselves who are the appropriate partners and what are the appropriate specifications, and naturally in the process leave out those peers that are not in the position to keep up with the requirements of the new technologies.

Technical challenges are reflected onto the business propositions of network operators. It would not make much business sense to promise an extensive set of services, applications and features that rely on SIP's and IMS' generativity, if these collapsed once the communication session broke out of the home operator's network. In all of the above cases, we notice that, unlike the old TDM networks or basic Internet connectivity, the offering of diverse services in new IP networks does not simply follow from establishing basic interconnection. Different agreements have to be negotiated between industry players even when they refer to the exact same service or feature, and in certain cases it is entirely possible that some arrangements are technically not feasible at all.

635 *See, e.g.*, AT&T, HD Voice, *available at* http://www.att.com/shop/wireless/services/hd-voice.html#fbid=AHHsJqhqHlg; Verizon, Advanced Calling 1.0, *available at* http://www.verizonwireless.com/support/advanced-calling-faqs/; T-Mobile, HD Voice http://how-to.t-mobile.com/callquality/.

5.2.3 The Parameter of Timing in Evaluating the Importance of Technological Efficiencies

The kind of problems discussed above, and the resulting efficiencies from allowing telecommunications systems to take a systemic and insular approach do not present themselves with the same intensity at all times. It is true that, as a general matter, the engineering and design choices that are put into a new system reflect a selection of components, functions, partners and arrangements that are deemed essential for inclusion or exclusion for the system's efficient operation, and that interference with this selection may well compromise the intended efficiency for the reasons explained supra.[636] Naturally, when a system is built from scratch its parts are designed to fit together to function optimally and in the most efficient way (or at least that is the intended goal).[637] To place rules and restrictions in how the system should be built means departing from that optimal balance.

While this principle applies generally to any type of system, and the more complex and interconnected a system is, the greater the (unintended) consequences of external interference in the system's design and operation, *new or newly upgraded* systems exhibit a more pressing need for tight control over their design and operation, because, until a system has reached its final form, the interdependencies among its parts will not have been resolved, and breaking the coherence and uniformity of the system will affect its operation more drastically.[638] In fact,

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636 *See also* Karl Ulrich, *The Role of Product Architecture in the Manufacturing Firm*, 24 RESEARCH POLICY 419, 434-435 (1995); Charles R. Morris & Charles H. Ferguson, *How Architecture Wins Technology Wars*, HARVARD BUSINESS REVIEW, March 1993, at 86, 94-95.

637 Baldwin & Clark, *supra* note 565, at 64; Carliss Y. Baldwin & Kim B. Clark, *Modularity in the Design of Complex Engineering Systems*, *in* COMPLEX ENGINEERED SYSTEMS: SCIENCE MEETS TECHNOLOGY 175, 199 (Dan Braha et al. eds., 2006).

638 A system's readiness is determined by how well its components and their interactions have been defined. This requires an overview of the system's operation, which is often put into a task structure matrix, which shows the

despite all the engineering effort that is put into a system's construction, there is often not really a moment when a system is *declared* ready and then put into use.[639] This means that a lot of fine tuning, critical to achieving efficient operation, takes place gradually and even after the system has commenced operation. It is often hard to account for all the interdependencies among components before the system is put into use and with the continuous adding of functionality and components constant readjustments must be made.

Until a system has acquired its final form the constituent parts are still in the process of dividing up among them the tasks that the system will perform as well as the necessary information and knowledge to do that.[640] It is only when such division takes places that the interactions between components are clearly defined and understood by the numerous participants in the industry, that the effects of changes to components upon the general system can be predicted, and that the required attributes of components in the system are able to be clearly specified so that transacting actors can effectively communicate their requirements and roles.[641] At this point, a standard "technical grammar" emerges, which boosts efficiency by

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dependencies between tasks and the allocation of tasks to modules and components. *See* Baldwin & Clark, *supra* note 565, at 64. A well designed matrix will include all relevant tasks and components, it will not allow for any conflicts between them and it also reflect any additions, removals and changes in components and tasks. A system built around a well designed matrix will adhere to these rules too. *See* Baldwin & Clark, *supra* note 565, at 246-252. *See also* STEVEN D. EPPINGER TYSON R. BROWNING, DESIGN STRUCTURE MATRIX METHODS AND APPLICATIONS (2012).

639 This characteristic applies predominantly to platform systems, where the platform and its complements are in a ceaseless feedback loop. *See* Thomas R. Eisenmann, *Managing Proprietary and Shared Platforms: A Life-Cycle View*, HBS Working Paper 07-105, at 2 (2007).

640 Lyra Colfer & Carliss Baldwin, The Mirroring Hypothesis: Theory, Evidence and Exceptions, Harvard Business School Finance Working Paper 10-058, at 4 (2010); Eric von Hippel, *Task Partitioning: An Innovation Process Variable*, 19 RESEARCH POLICY 407 (1990).

641 *Id*. *See also* Cabigiosu & Camuffo discuss the possibility that modularity in product design may in fact increase the need for "thick" relationships among components. *See* Anna Cabigiosu & Arnaldo Camuffo, *Beyond the "Mirroring Hypothesis: Product Modularity and Interorganizational Relations in the Airconditioning Industry*, 23 ORGANIZATION SCIENCE 686, 699-700 (2012) (where they conclude: "(a) modularization may not eliminate interdependencies between assemblers and suppliers, and hence the need for thick, collaborative supply relationships persists even in the presence of "perfectly" modular components; (b) modularization may derive

minimizing the necessary interactions between components as each of them has positioned itself and adapted to its surroundings.[642]

Depending on the scope of change or innovation, systems sooner or later reach a more stable state. Then, while external interference can still disturb the system's efficient operation, its effects will at least be more fully understood. The Commission has generally understood and adopted this cautious approach, although one can always argue about when the appropriate time is to enact regulation, and so to some regulatory action may always appear premature or long overdue. An early iteration of this policy was the so called "nascent technologies doctrine."[643] Acknowledging the sensitivity and precariousness of young systems and platforms former Commissioner Abernathy summarized the doctrine in that

> "regulators should exercise restraint when faced with new technologies and

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from the joint efforts of both assemblers and suppliers, which tend to remain engaged in "hand-in-glove" relationships that component modularity may eventually only enhance; and (c) there may be increasing returns to modularity-in-design efforts because of buyer–supplier integration, i.e., they may be complementary or supermodular (Topkis 1998), with modularization nurturing relational quasi rents and buyer–supplier information sharing facilitating modularization"). *See also* Juliana Hsuan, *Impacts of Supplier–buyer Relationships on Modularization in New Product Development*, 5 EUROPEAN JOURNAL OF PURCHASING SUPPLY MANAGEMENT 197 (1999).

642 Nicholas Argyres, *The Impact of Information Technology on Coordination: Evidence from the B-2 "Stealth" Bomber*, 10 ORGANIZATION SCIENCE 162, 164 (1999) (where he discusses how the emergence of "technical grammar" during the development of the B-2 bomber creater a "technical dialog" which served "to reduce the total amount of information that needed to be exchanged between the firms for the project to be completed successfully. In this sense, the costs of information processing were reduced relative to what they would have been without the information system. This in turn enabled designers to make design decisions based on accurate expectations about each other's design plans, allowing convergence to a relatively efficient outcome." Id.). *See also* Michael Jacobides, *Industry Change through Vertical Disintegration: How and Why Markets Emerged in Mortgage Banking*, 48 THE ACADEMY OF MANAGEMENT JOURNAL 465, 480 (2005); David J. Teece, *The Market for Know-How and the Efficient International Transfer of Technology*, *in* ESSAYS IN TECHNOLOGY MANAGEMENT AND POLICY: SELECTED PAPERS OF DAVID J. TEECE 243, 247 (David J. Teece ed., 2003).

643 The Nascent Services Doctrine , Remarks of FCC Commissioner Kathleen Q. Abernathy Before the Federal Communications Bar Association New York Chapter , New York, NY, July 11, 2002, *available at* http://transition.fcc.gov/Speeches/Abernathy/2002/spkqa217.html.

> services. Such restraint should facilitate the development of new products and services without the burden of anachronistic regulations, and in turn promote the goal of enhancing facilities-based competition. Once the new facilities-based competitor has demonstrated its viability, regulators must reexamine the overall regulatory scheme applicable to all providers in the marketplace in light of the new provider to assess whether existing regulations can be modified or repealed."[644]

More recently, the Commission, recognizing the early stage of development of specialized services and their considerably flux state decided to exempt them from the 2010 Open Internet Order.[645] In an even more recent (and as of the time of writing still open) proceeding the Commission is being careful to not haste into regulation of the forthcoming all-IP networks, given that the all-IP architecture presents more of a disruptive rather than incremental evolution.

The current structure has remained by and large stable for the past fifteen years, but what we are seeing now is a trend toward a complete overhaul of the network design. There is something unique about the transformation that the mobile telecommunications industry is currently undergoing. Unlike the incremental evolution of the past fifteen years, the transition to the next generation signifies a paradigm shift.[646] Today's telecommunications networks, including mobile, comprise a legacy TDM core that handles voice (and, in cellular networks, SMS communications), and an IP-based core that handles data transmission (in cellular networks this

644 *Id*. at 1.

645 Open Internet Order, *supra* note 578, at ¶ 93 et seq..

646 *Compare in* Mishra, *supra* note 619, at 5-7, 11;

is the GPRS system and its later versions). What the next generation brings along is a unified IP-based network that handles all types of traffic and that can natively interconnect with other IP networks (as well as with legacy telecommunications networks through gateways).[647] This new model of organization is a major departure from the old system; the grand aspiration is that different access and core technologies will be made interoperable so that developers and end users can develop and access services and applications from any type of network.[648]

If this plan sounds (too) ambitious it is because it is. The unification, at least in some regards, of what has traditionally been disparate networks, technologies and services is no small feat and requires enormous engineering coordination. The temptation and at the same time the risk here is to automatically extend regulatory limitations and mandates to the new system, the reasoning being that the next generation system *simply replaces or supplants* the old one and so the *same* regulatory treatment is warranted.[649] And the counter-argument is that a new system does not always pick up from where the old system was decommissioned, but rather needs time to rise up to the maturity and stability levels of the old system.

For instance, while the transition to full IP is still in the early stages, operators may not possess all the necessary knowledge as to how to structure their network, and—it follows—much less how to structure it in a way that serves others, who wish to interconnect. As a result, when a

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647 Mishra, *supra* note 619, at 164 et seq.

648 ALEX SHNEYDERMAN & ALESSIO CASATI, FIXED MOBILE CONVERGENCE: VOICE OVER WI-FI, IMS, UMA/GAN, FEMTOCELLS, AND OTHER ENABLERS 1-8 (2008); Mishra, *supra* note 619, at 201 et seq.

649 For example, the European Regulators Group (ERG), which was succeeded by BEREC in 2010, was very careful to not give the impression that regulation might not be necessary in the next-generation networks era. In a statement on regulatory principles of IP-IC/NGN core the ERG concluded that "[...] the move to NGNs does not provide an opportunity to roll back regulation on existing services if the competitive conditions have not changed." *See* ERG Consultation Document on Regulatory Principles of IP-IC/NGN Core (ERG (08) 26rev1), *availalbe at* http://berec.europa.eu/doc/publications/consult_erg_ip_ic_ngn_2008/arcor.pdf.

third party operator asks for what is seemingly a simple VoIP interconnection agreement, it is not quite certain that the necessary technical infrastructure is there to support such a request. As AT&T has explained in response to requests for mandatory VoIP interconnection, this "would require [it] to create new functionalities or capabilities that do not currently exist in [its] networks" and it goes on to state that "[w]hile the industry is in the midst of migration to IP technology, that transition is by no means complete."[650] Along the same lines Verizon holds that IP interconnection should not become mandatory until "a comprehensive set of standards" is in place.[651]

One cannot know for sure whether AT&T and Verizon are indeed in no position to accommodate such requests, and if not, when they will be.[652] But this is a matter of drawing the line at the right moment of network maturity; the principle that there is a phase (however short or long) that a system will have commenced operation but at the same time still very fluid and fragile, holds. And it is likely that once the system has passed the nascent phase no intervention will be needed as it will itself incorporate such interactions or features that might have been premature to do so earlier. In the case of FaceTime for example, AT&T was not planning to permanently ban the application from its cellular network.[653] Rather, because it had experienced

650 AT&T, Comments in the Matter of TW Telecom Inc., Petition for Declaratory Ruling Regarding Direct IP-IP Interconnection Pursuant to Section 251(c)(2) of the Communications Act (WC Docket No. 11-119), at 9.

651 Verizon and Verizon Wireless, Comments in the Matter of TW Telecom Inc., Petition for Declaratory Ruling Regarding Direct IP-IP Interconnection Pursuant to Section 251(c)(2) of the Communications Act (WC Docket No. 11-119), at 2, 7.

652 *See, e.g,* Sprint's skepticism *in* Sprint, Reply Comments in the Matter of Petition for Declaratory Ruling Regarding Direct IP-IP Interconnection Pursuant to Section 251(c)(2) of the Communications Act (WC Docket No. 11-119), at 7-15.

653 AT&T/FaceTime Case Study, *supra* note 594, at 5-6 ("As data about FaceTime usage becomes available and as its network evolves, AT&T has indicated that it may further expand the availability of the application. In fact, AT&T has already expanded the availability of the application to users with LTE devices on tiered service plans and on new custom plans for the hearing impaired.").

network outages in the past thanks to the success of the iPhone, AT&T was careful to slowly and gradually introduce the new application in its system.

It is true that the timing parameter comes with inherent uncertainty, but that doesn't mean it should be ignored. Picking the right time to act can be as important as the action itself. We are therefore not arguing here that, because theoretically action can be pushed back indefinitely, the right moment will never come, but that from the viewpoint of efficiencies, authorities should be cognizant that early interventions can interfere with the architecture of a system thusly hampering its ability to gain from efficiencies that would rely on its overall design. And when the highest level of caution is required is when the new system is meant to replace an old one, but with a different technology, such that the conditions are no longer the same, but the purpose is. Under these circumstances it would be unwise to *automatically* extend to new networks the same rules and obligations that apply to old networks, because that would possibly sever their fragile consistency before they can find an efficient modus operandi.

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Technical efficiencies have proven an important and perhaps undervalued parameter in the debate around exclusion. It is true that despite intense technological competition and cooperative incentives, exclusionary practices may arise and may have a considerable impact on the market. However, this is not their net effect. The net effect is calculated after accounting for potential offsetting efficiencies.

Sometimes efficiencies are hard to discern especially in large technical systems, such as

wireless telecommunications systems, because they arise throughout the system and in subtle ways. But precisely because they are systemic and relate to the architecture of the system their benefits can be far reaching and substantial. We suggested that such efficiencies emerge both within and between systems. These should be factored in when regulators consider enacting regulation, because they may conclude that the industry is in a state where new designs and architectures are taking shape and openness mandates would harm the process. They should also be factored in when assessing the effect of exclusion in particular cases to determine whether the net effect is harmful. This, as we suggested in Chapter 2, necessitates flexible rules that allow for a margin of appreciation.

6 . Applications and Limitations

6.1 The Need for a Technology-Driven Analysis of Exclusion: What Did We Learn?

The preceding analysis brought together two key elements of the wireless telecommunications industry: the business practice of exclusion, and the role of technology in informing its regulatory treatment. The contribution of the thesis lied in the exploration of their intersection, which we found alters the perception of the competitive threat exclusion poses in a way that shows that the technological realities of the industry make anticompetitive exclusion less likely to occur.

This, we maintained, both raises the threshold of necessity for regulation that seeks to prevent or limit exclusionary behavior, and to the extent that regulatory measures are indeed necessary, better informs rule- and policy-makers, when applying the measures, on the specific impact of exclusionary practices by taking into account the particular characteristics of the wireless telecommunications industry.

The fact that the wireless telecommunications industry is special because of the prominent role technology plays in the evolution of the industry, the capabilities of industry players, and the relationships among them, creates an imperative need for a technology-informed inquiry. We noticed that an industry analysis that combines both the lessons of antitrust/IO and the technology-intensive nature of the wireless industry was missing, and this served as a primary motivation behind the thesis. Further, the fact that the wireless telecommunications industry is

build around a complex vertical value chain of consecutive layers, which creates multiple loci of potential points of exclusion, makes exclusion a potentially common practice and therefore a potentially common threat. The breadth of the issue and the importance it has for the industry, strengthened our motivation to examine it in its right proportions.

Based on the analysis undertaken here the general trend we observe is that as regards the technology factor in the wireless telecommunications industry, exclusionary behavior becomes less likely to distort competition. To prove this statement this thesis traced the shifts in the structural preconditions of anticompetitive exclusion. As a first step we distilled from industrial organization and antitrust the necessary preconditions: to begin with, exclusionary practices will not occur if they don't make business sense to the excluding firm; in other words the firm must have more to gain from exclusion than from cooperation. Second, the demand and supply conditions in the market must be such that accord firms the ability to foreclose a significant line of commerce. Third, if the previous two conditions are true, there must be no offsetting efficiencies to justify the exclusionary behavior. Lastly, even if all the above conditions are true, the exclusionary practice and its results must be able to persist for a potent amount of time as to justify ex ante rules of general applicability. We then documented how these preconditions are affected when technology is accounted for. In detail, we showed that:

Industry disaggregation and resulting technological interdependencies weaken exclusionary incentives: If industry characteristics make exclusion less of a desirable strategy in the market, it follows that exclusion presents a milder threat for the competitive conditions in the market. To show how this happens we traced the evolution of the wireless industry and demonstrated how it transitioned from a state where the production chain of wireless telecommunications services and

applications was dominated by vertically integrated systems, to a state where the necessary components are decoupled and also available separately. In the former state systems were more self-sufficient and therefore external components were more likely to be seen as competitors and therefore excluded. As the various parts/layers of the value chain modularize (a process that has both a technical and an economical element to it), specialize, become more efficient and more valuable as complements, integrated systems have the option to give up part of the internal production process and turn to the market to procure that component. This turns external components from competitors into complements. We noticed this happening with several parts of the value chain, including services, applications, operating systems, service development and deployment architectures and spectrum. Most of these layers were internalized in vertically integrated systems, yet today they also exist or are starting to exist separately in a modular fashion and in co-opetitive, rather than purely competitive relationships with other components and actors in the market.

Assuming firms have an incentive to exclude, the technology-intensive nature of the industry creates more sources of competition and more ways to bypass bottlenecks, making effective exclusion harder. In industrial organization and antitrust theory, if entry or substitution are possible consumers are likely to be less affected by the exclusionary practice. We found that in the wireless telecommunications market, entry and competitive pressures intensify because of the technological proximity between production stages (i.e. actors in one layer are easier to expand to adjacent layers compared to non technology-dominated industries). The expansion of companies like Google and Palm upstream and downstream from their original markets, creating more options for consumers in those new markets, is an example of how this can happen.

Similarly, as value is being reallocated between complements, firms can lose the ability to effectively exclude. For instance, as the operating system in smartphones becomes a more prominent element of the user experience, compared to the pre-smartphone era, device manufacturers are not as free to discriminate or exclude applications if the operating system manufacturers has an opposing interest. This was a case in the interplay between Google's Android and Samsung devices.

On the demand side, multihoming and interconnection create multiple paths by which service and application developers can reach consumers (and the other way around). As the available paths between nodes in the value chain multiply, bottleneck nodes become less effective because they can be bypassed. For instance if Skype is blocked on the cellular network of a user's operator, it can still be accessible on Wi-Fi or on the user's other mobile devices, like tablets. By no means does this make this hypothetical acceptable, but it does show that parallel paths (in this case, networks connections) limit the effect of exclusion compared to a situation where there are no alternatives.

Assuming that exclusion is both a desirable and an effective strategy, it can nevertheless be welfare enhancing if it engenders offsetting systemic technological efficiencies that subtly but greatly improve the entire ecosystem. Complex technical systems, like wireless telecommunications, develop extensive interdependencies among their constituent parts, and their successful development and operation often requires the careful selection (and by extension exclusion or discrimination) of partners and relationships. We suggested that the ability to manage these interdependencies across the system can give rise to important systemic efficiencies. The difference between the success of the highly integrated and controlled i-mode in

Japan, compared the looser implementation and eventual failure in Europe, is an example of the power of systemic efficiencies. Further, we submitted that technological efficiencies are also important in establishing functional and reliable relationships between different systems (as opposed to within a system). Achieving QoS and service-layer interoperation in fourth generation network provides a good case of this.

In considering the above factors, we also found that they don't engage equally through time and that the evolutionary characteristics of the industry should be taken into account too. On the one hand, the observation of build-up of market power in case the competitive sources we discussed fail to initially contain it, isn't immediately a good indication that regulatory intervention is necessary. This is because theoretical and empirical evidence suggest that the build-up of chronic market power in high technology industries in harder than in non-technical industries. On the other hand, the systemic efficiencies defense is likely to be more relevant during the development or early stages of a system and less so in a mature system. The reason is that in mature systems the interplay among all their components is crystallized and much better understood and so external (regulatory) interventions can be done in a way that can more predictably minimize interference.

In conclusion, technology co-shapes the factors causing the industry's evolution and interrelationship, and regulatory measures should reflect the phase of evolution of the industry relations under scrutiny. The regulation of an industry is by nature a precautionary task in the sense that the rules attempt to prevent bad outcomes under conditions of risk and uncertainty. To mitigate the risk and uncertainty regulators consider a large selection of factors. We suggested that the technological influences on the determinants of anticompetitive exclusion have been

overlooked, and we offered an analysis to fill that gap. Overall, at a macroscopic level, the spirit of this thesis was that the wireless telecommunications market is more resilient to anticompetitive practices than assumed by the current state of regulation. At a more detailed level, the analysis undertaken here provided additional guidance on top of that by industrial economics and antitrust to assess specifically the structural preconditions of exclusion.

6.2 How Can This Framework Be Used: Observations on the Open Internet Proceeding and Beyond

In the course of developing the analytical framework in the previous Chapters several real cases were used to demonstrate the effect of the technological side of the structural preconditions of anticompetitive exclusion. Those cases were chosen to highlight a specific technological determinant of the exclusion analysis. This was necessary to develop each argument separately, but what is also useful to see is how the framework could illuminate various aspects of the same regulatory proceeding, so that it becomes clearer that technological considerations have a bearing on all relevant structural preconditions of exclusion as regulators attempt to strike the right balance. This provides greater assurances that whatever rules are promulgated, they will correspond to a more accurate perception of the competitive conditions and threats in the market.

The Open Internet proceeding is a good case study of how the framework could be applied, considering that to a large extent its purpose is to prevent acts of unfair or anti-competitive blocking and discrimination, and that it applies to a broad scope of relationships and practices in

the industry. The Open Internet proceeding culminated in the 2010 Open Internet Order,[654] which was partly stricken down by the D.C. Circuit Court of Appeals in February 2014.[655] In April 2014 the Commission issued an NPRM to collect comments on how to re-enact a similar set of regulations that can withstand court review and better address the realities of the telecommunications market.[656] The approach taken in the NPRM is a more flexible one, but it still undervalues some aspects of exclusion. Also, by nature, it leaves many issues open to be determined based on the collection of additional comments and market insight.

What follows is an attempt to either suggest answers to the open issues or to demonstrate how some provisional conclusions and directions of the NPRM should change to reflect the technological realities of wireless telecommunications networks.

The NPRM rests on three main pillars with regard to the wireless industry and they will be our focus: (a) along the lines of the 2010 Order it reserves special treatment for wireless operators as opposed to fixed operators (¶105-108, ¶140); (b) it allows differentiated treatment of traffic under a newly introduced "commercially reasonable" standard (¶128); (c) similar to the 2010 Order it limits the applicable rules to the the relationship between broadband providers and end users within the providers' network (¶54-62).

On those topics the analysis of the NPRM through the lens of this thesis would suggest that: (a) whether wireless operators deserve different treatment should not depend on an abstract observation of differences with fixed operators or of "operational constraints," but rather on a

654 In the Matter of Preserving the Open Internet, Broadband Industry Practices, GN Docket No. 09-191 (2010) (Report and Order).

655 Verizon, Inc. v. Federal Communications Commission, 740 F.3d 623 (2014).

656 In the Matter of Protecting and Promoting the Open Internet, GN Docket No 14-28 (2014) (Notice of Proposed Rulemaking).

full and *separate* analysis of the determinants of vertical exclusion in mobile networks as identified in this thesis, (b) that, contrary to the Commission's recommendation, the commercially reasonable standard should not result in a presumption that a broadband provider conduct that forecloses rivals is commercially unreasonable, (c) that artificially limiting the rules to the last mile leaves out bottlenecks that can have a functionally equivalent effect to the exclusionary practices in the last mile.

6.2.1 The Special Treatment of Mobile Broadband

The 2010 Internet Order mandated that wireless operators do not "block consumers from accessing lawful websites, subject to reasonable network management ... [nor] block applications that compete with the provider's voice or video telephony services, subject to reasonable network management."[657] It also didn't require mobile operators to abstain from discriminatory practices.

The exemption of mobile carriers from the non-discrimination rule and the limitation on no-blocking *only* of applications that compete with the provider's voice or video telephony services was meant to strike a balance between an open Internet on mobile, and what the Commission identified as special conditions of the wireless industry. These included the fact that "[m]obile broadband is an earlier-stage platform than fixed broadband, and [that] it is rapidly evolving;"[658] that "most consumers have more choices for mobile broadband than for fixed (particularly fixed

657 Open Internet Order, *supra* note 654, ¶ 99.
658 *Id*. at ¶ 94.

wireline) broadband;"[659] and that "existing mobile networks present operational constraints that fixed broadband networks do not typically encounter."[660] The new NPRM proposes to expand the no- blocking rule to all mobile services, not just those competing with operators' voice or video telephony services, and continue to uphold the exemption for non-discrimination.[661] On top of the previous conditions, which the Commission offers for re-examination, it cites as relevant factors whether a service is marketed to consumers as a substitute for a fixed service, whether an operator is facilities-based or a reseller, and the demographics of users.[662]

While these may be important considerations, they should not detract from the more important and very basic criteria on when exclusion (:blocking and discrimination) bears the characteristics to be threatening to the competitiveness of the industry as identified by industrial organization and antitrust, and as enriched by the analysis in this thesis.. The primary and fundamental question still remains whether mobile operators have the ability and the incentives to exclude or discriminate. As Rosston and Topper highlight "[a]t the heart of the policy debate over wireless Carterfone regulation [:wireless Carterfone is used here as proxy for wireless network neutrality] is an economics question: Do wireless providers have the incentive and ability to profitably favor their own affiliates and discriminate against competing upstream providers, harming competition and ultimately consumers?"[663]

If these conditions are not present, additional criteria are superfluous. And while the

659 *Id*. at ¶ 95.

660 *Id*.

661 NPRM, supra note 656, at ¶ 105-108, and ¶ 140.

662 *Id*.

663 Gregory L. Rosston & Michael D. Topper, A*n Antitrust Analysis of the Case for Wireless Network Neutrality*, 22 INFORMATION ECONOMICS AND POLICY 103, 105 (2010).

considerations included in the 2010 Order are more relevant than those of the NPRM, neither the 2010 Order, nor the NPRM insist on a proper analysis of mobile operators' ability and incentives to exclude or discriminate, contrary to the recommendations of this thesis. For instance the Commission notes that the mobile industry is more competitive than fixed communications, but it grounds that conclusion only on the finding of a greater number of mobile operators than fixed operators.[664] By focusing just on that metric, it completely misses potential sources of competitive pressure from other parts of the value chain, other than direct competitors, as we discussed in Chapter 3.

The danger here is that if, for example, the four national operators merged in three (as proposed in the AT&T/T-Mobile merger) the Commission might have departed from its conclusions, even though the remaining and unaccounted for competitive sources maintained overall competitiveness at high levels. The Commission also did not discuss incentives or efficiencies in mobile networks. The end outcome of the regulatory process might have not been different if the Commission had taken into account the factors we deemed important in this thesis. However, the Commission, at a minimum as a matter of withstanding judicial review, has an obligation to base its decisions on substantial evidence, and arguments across the spectrum.[665] This necessitates both the taking into account of the determinants of the behavior in question for regulation (including technological determinants since they are crucial in technology-intensive industries), and a separate analysis as opposed to simply a comparative examination vis-a-vis fixed broadband.

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664 Open Internet Order, *supra* note 654, ¶ 95 (citing the National Broadband Plan and the Wireless Competition Report, both of which measure competition base competition on the number of mobile operators).

665 *See* STUART M. BENJAMIN, TELECOMMUNICATIONS LAW AND POLICY 61-62 (2nd ed. 2006).

In detail, the Commission should have attempted to reach an independent finding on whether the multiplication of competitive sources and the increase in competitive pressure in the wireless telecommunications value chain is such that diminishes players' ability to engage in the kind of exclusion that could distort competition. In Chapter 3 we showed that in the wireless industry technological proximity and transferability of functionality facilitate entry and mobility along the value chain with the effect of intensifying competition. At the same time, even if no entry occurs, technological interdependencies and the fact that the value chain is built upon successive platforms makes it easier for value and market power to shift from one layer to another, and harder for players to accumulate and maintain market power.

Moreover, the Commission should take note of the seismic changes in the disaggregation of the wireless value chain. In Chapter 4 we proposed that disaggregation moves the industry from a state of systems competition to a state of components competition, turning in the process some competitors into complements and limiting exclusionary incentives. Taking these developments in to account, can change regulators' perception as to whether market actors actually find it profitable to exclude complements, which through technological progress are increasingly becoming more specialized, efficient and ultimately valuable, and can thusly supplement or replace market actors' own functionalities. Even if the Commission in the end decided that the co-opetitive incentives created by disintegration are not strong enough to counter exclusionary incentives, it would at least have reached that conclusion after taking into account the very special transformation the wireless industry is going through, thereby providing greater assurances of future-proof and effective policy-making.

6.2.2 The Commercially Reasonable Standard

The rules contained in the 2010 Order were inflexible in that their application did not depend at all on the circumstances of a particular case. Wireless operators could not block applications and services that competed with their own, save for reasonable network management, while discriminatory treatment was allowed, although it was unclear whether that could mean preferential treatment. The rules did not explicitly reference other qualifications.

The problem with this method—both unconditionally prohibiting certain types of conduct and in unconditionally allowing others—is that it can be over-inclusive and under-inclusive because it overlooks the nuances of individualized cases. We discussed this issue in Chapter 2 and concluded that flexible rules that allow for a margin of appreciation to account for the specific circumstances as discussed in this thesis, is superior to black-and-white rules that tend to treat dissimilar situations the same.

The NPRM corrected this black-and-white approach by introducing the commercially reasonable standard against which discriminatory practices would be assessed to determine whether they had the potential to harm competition. In particular the proposed rule

> "would prohibit *as commercially unreasonable* those broadband providers' practices that, based on the *totality of the circumstances*, threaten to harm Internet openness and all that it protects. At the same time, it could permit broadband providers to serve customers and carry traffic on an individually negotiated basis, 'without having to hold themselves out to serve all comers indiscriminately on the same or standardized terms,' so long as such conduct is commercially reasonable"

(emphasis added).[666]

The critical element here is the interpretation of the "totality of circumstances" criterion. Bearing in mind the conclusions drawn from this thesis we submit that the Commission has only partly gotten it right. First, the NPRM exempted mobile broadband from the "commercially reasonable" rule. But for the reasons suggested above in 6.2.1, whether mobiles should be treated any differently is a question that should be answered after undertaking the same analysis as for fixed networks based on the economic and technological realities of the industry. Under this rationale, there was no reason to leave mobile broadband out of the "commercially reasonable" standard.

Second (assuming that mobile broadband would be covered under the "commercially reasonable" standard), while a "catch all" factor as suggested in the NPRM, is indeed the right approach, the Commission seems to overlook the role nuances play in a flexible case by case analysis, and proposes presumptions of commercial unreasonableness under certain conditions. These however are not supported by the framework presented in this thesis or the broader industrial organization and antitrust lessons this framework is based on.

To begin with, the Commission rightly points out that the catch all factor should encompass, among others, the impact on present and future competition, and the technical characteristics of broadband providers.[667] With regard to the former the Commission gravitates towards a list of indications that reflect the degree of competition in the market, but fails to point to the direction of vertical competition and vertical entry that is more prominent in high technology platform

666 NPRM, supra note 656, at ¶ 116.

667 *Id*. at ¶ 123 et seq.

industries such as wireless telecommunications, or to heightened complexity of the demand side due to more intricate interconnection options and multihoming. Hence, the kind of competition analysis the Commission invites on foreclosure is one that is not tailored to the technological realities of the wireless industry as it doesn't seem to acknowledge that in this industry competitive pressures can come from what competition law traditionally treats merely as inputs, rather than as potential entrants.

At the same time, regarding the technical characteristics of broadband providers, the Commission does not indicate that a systemic approach to networks should be among the technical characteristics that it will consider. While this does not conclusively mean that the Commission can still not take systemic efficiencies into account, a relevant reference in the NPRM would increase the changes that the Commission would get better guidance on the matter, as we discussed in Chapter 5, especially considering the ongoing transition to 4G and next-generation technologies. As we explained, the early stages of a new system's development are critical for its success and for the attainment of efficiencies. It would therefore be appropriate for the Commission to point out that this is a relevant consideration.

What is even more problematic is that the Commission appears to be proposing that "broadband provider conduct that forecloses rivals (of the provider or its affiliates) from the competing marketplace" could be considered presumptively unreasonable.[668] Such presumptions collide head-on with the analysis here and its underpinnings from industrial organization and antitrust. Similar to per se illegality in antitrust law, a presumption of unreasonableness should be reserved only for those cases that anti-competitiveness is so likely, that the burden of proof

668 NPRM, supra note 656, at ¶ 128.

shifts and a higher standard of proof is required from the party engaging in the exclusionary conduct, so that regulators and the market save resources from analyzing the case.[669] However, not only isn't this the case in mainstream industrial organization and antitrust analysis, but the link between exclusion of competitors and potentially anticompetitive effect on the market becomes even weaker considering the technological characteristics of the industry as presented in this thesis. The spirit of this thesis was to show that if one considers the true dimensions of technological competition, exclusionary conduct is *even less likely* to present a threat to the institutional function of competition. If presumptions were not justified based on a pure economic analysis, their foundations are even feebler when the technological side is also accounted for. To conclude, presumptions against exclusionary conduct, unless very carefully and narrowly carved, are likely to prove overzealous regulatory measures.

6.2.3 Scope of the Rules

One of the underlying working assumptions of the analytical framework presented in this thesis was that the factors deemed relevant for the assessment of exclusionary practices can be used to analyze such cases anywhere on the value chain. Indeed, the numerous examples used to illustrate the arguments were drawn from all layers of the value chain. The explanation for this is

669 *Cf.* Continental T.V. Inc. v. Gte Sylvania, 433 U.S. 36, 49-50 (1977) ("Per se rules of illegality are appropriate only when they relate to conduct that is manifestly anti-competitive."). *See also* Northern Pacific Rail Co. v. United States, 356 U.S. 1, 5 (1958) ("there are certain agreements or practices which because of their pernicious effect on competition and lack of any redeeming virtue are conclusively presumed to be unreasonable and therefore illegal without elaborate inquiry as to the precise harm they have caused or the business excuse for their use.").

that the technology-centric analysis undertaken here was mapped on the analytical framework used in antitrust, which in turn incorporates lessons from industrial organization, and both apply to all the segments of an industry.

If one is to be consistent as to the value of this framework, then policy-making based on the triptych of ability, incentives, and efficiency would logically prohibit exclusion if the triptych showed that exclusion can have an anticompetitive effect. This implies, similar to the analysis followed in industrial organization and antitrust law, that ability, incentives and efficiencies are *sufficient* conditions to determine the competitive threat exclusion poses, and therefore that policy-making can rely on them. The framework does not preclude additional qualifications or limitations, but it doesn't require them either.

The 2010 Order and the NPRM do indeed operate on the basis of an additional qualification: a topological limitation as to the part of the network exclusion occurs. The 2010 Order limits the applicability of the anti-exclusion rules (no blocking, and in the NPRM no discrimination too) to the last mile of broadband connectivity, that is the relationship between broadband providers and end users, leaving out the relationship between broadband providers and services/applications/ content providers and all other intermediaries.[670] The NPRM tentatively concluded that this is the proper scope of application for the new rules as well.[671]

The weakness of the limited scope of these rules is that it sometimes leaves out practices that have an equivalent effect to that which the rules aim to prevent. This was illustrated in the 2014 Netflix/Comcast dispute, where allegedly Netflix traffic was slowed down due to congestion that was created at the interconnection point where Netflix traffic was handed off to

670 Open Internet Order, *supra* note 654, at ¶ 44, 50.

671 NPRM, *supra* note 656, at ¶ 54-62

Comcast's network.[672] Comcast typically did not violate the 2010 Order, and yet the end result was the same to what Comcast would have achieved if it actively throttled Netflix traffic within its network. Indeed the reason why the Commission did not intervene was that it lacked jurisdiction to do so, since the Netflix/Comcast dispute was more of an Internet interconnection issue, which has traditionally been left unregulated, and less of a network neutrality issue.[673]

The Commission had good reasons to limit the 2010 Order and NPRM to the last mile only. For one thing, the 2010 Order flowed directly from the Internet Policy Statement the Commission had adopted in 2005, which served as a limiting factor in terms of scope.[674] Further, the 2010 Order contains considerations and rules that go beyond the narrow issue of identifying anticompetitive exclusion, which is the focus of the framework. For instance the transparency requirement as well as the "reasonable network management" exception that permeates much of the 2010 Order and NPRM are both tailored to the economic, market, and technological realities of *last mile* broadband providers. Moreover, the impetus behind the adoption of the Order was foreclosure concerns in the last mile by ISPs as evidenced by sporadic cases of VoIP blocking and the infamous Comcast/Bittorrent dispute, which were documented by the Commission.[675]

This is why we refrain from conclusively suggesting that the scope of the new Open Internet Order should change, but we do note that this is not an unsupportable view.[676] An alternative way

672 Zachary M. Seward, *The Inside Story of How Netflix Came to Pay Comcast for Internet Traffic*, QUARTZ, August 27, 2014.

673 *See* Jacob Kastrenakes, *FCC Scrutizing Netflix Speed Issues on Comcast and Verizon*, THE VERGE, June 13, 2014 (quoting Tom Wheeler “this issue regards the 'exchange of traffic between ISPs and other networks and services,' rather than between internet providers and consumers, which net neutrality rules largely govern.”). *See also* Marguerite Reardon, *Comcast vs. Netflix: Is this really about Net neutrality?*, CNET, May 15, 2014.

674 Open Internet Order, *supra* note 654, at ¶ 5.

675 Open Internet Order, supra note 654, at ¶ 35 et seq.

676 *See, e.g.*, David D. Clark et al., Comments In the Matter of Protecting and Promoting the Open Internet Framework for Broadband Internet Services, GN Docket 14-28 (where the authors argue that interconnection

to structure the Open Internet Order and solely for the purposes of identifying and regulating anticompetitive exclusion (which is a narrower goal than that of the Order), would be to make conduct the defining element around which the analysis would revolve (by applying the framework), without conditioning applicability to where in the value chain it occurs, as long as the conduct falls under the authority of the Commission.[677] This has the benefit of consistent application of rules, while at the same time avoiding unnecessary expansion of the Commission's regulatory scope. For instance, the Commission has authority over data roaming and spectrum interoperability, two cases whose subject matter is currently excluded from the 2010 Order and the NPRM, but which can be the focal point of exclusionary practices, and could well be analyzed through the lens of the framework used in this thesis.

Both data roaming and interoperability arose as potential candidates for regulation partly because exclusion was (and remains) a concern. The Commission adopted the Data Roaming Order to prevent carriers, especially rural ones, from being foreclosed from the rest of the national market.[678] This was only the last step in a long line of findings that refusal to allow

raises the same issues as throttling within ISPs' networks and therefore should be monitored and potentially regulated by the Commission); Mozilla Foundation, Comments In the Matter of Protecting and Promoting the Open Internet Framework for Broadband Internet Services, GN Docket 14-28, at 9-12 (where Mozilla urges the Commission to codify and regulate the relationship between broadband providers and edge providers); Netflix, Comments In the Matter of Protecting and Promoting the Open Internet Framework for Broadband Internet Services, GN Docket 14-28, at 11 ("Open Internet protections that guard only against pay-for-play and pay-for-priority on the last mile can be easily circumvented by moving the discrimination upstream. As such, for any open Internet protection to be complete, it should address the points of interconnection to terminating ISPs' networks."); Comptel, Comments In the Matter of Protecting and Promoting the Open Internet Framework for Broadband Internet Services, GN Docket 14-28

677 *See, e.g.* Rosston & Topper, *supra* note 663, *passim* (where the authors analyze wireless network neutrality in upstream (equipment, applications) and downstream markets (subscribers) through a competition law lens); Robert W. Hahn et al., *The Economics of "Wireless Net Neutrality,"* AEI-Brookings Joint Center Related Publication 07-10 (2007) (where the authors apply an antitrust framework to foreclosure in content, applications, and equipment in the wireless market).

678 Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers and Other Providers of Mobile Data Services, FCC Rcd 5411, ¶ 15, ¶ 26 (Second Report and Order).

roaming can effectively foreclose operators from the market.[679] The Commission has also asserted its authority to regulate data roaming even though it hasn't formally characterized it as a telecommunications or informations service.[680] In fact, the Commission tailored the roaming obligation to each particular case by requiring that roaming to be provided under "commercially reasonable terms and conditions." This approach is not too far from a flexible standard advocated by the triptych here, and in fact the NPRM cites the Data Roaming Order as potential source of inspiration.[681] Theoretically, if the Data Roaming and the Open Internet Order standards were to be constructed the same, and solely for the purposes of identifying and regulating exclusion, *a single unified* rule and approach could serve both situations.

The Commission has faced similar issues with spectrum bands interoperability. When in 2009, 3GPP defined four discrete frequency blocks in the 700MHz band, there were fears that AT&T and Verizon would get different bands than smaller players, which—small players feared—would result in their inability to access AT&T's and Verizon's networks for roaming purposes, and to sell to their users the same high-end devices that AT&T and Verizon could.[682] Effectively, small players were concerned that they would be foreclosed from the market. Although the issue remains as of now unresolved, the proposition is that this issue can be resolved by applying the same analysis as for every other case of exclusion in the wireless value chain, including network neutrality in the last mile and roaming obligations.

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679 *See* similar previous steps in Interconnection and Resale Obligations Pertaining to Commercial Mobile Radio Service Providers, CC Docket No. 94-54, 11 FCC Rcd. 9462 (1996) (Second Report and Order and Third Notice of Proposed Rulemaking); Reexamination of Roaming Obligations of Commercial Mobile Radio Service Providers, WT Docket No. 05-265 (2007).

680 Data Roaming Order, *supra* note 678, ¶ 61 et seq.

681 NPRM, *supra* note 656, ¶ 114-115.

682 For a summary discussion *see* JONATHAN NUECHTERLEIN & PHILIP WEISER, DIGITAL CROSSROADS 146-152 (2nd ed. 2014).

6.3 Limitations and Criticism

It goes without saying that this analytical framework is not devoid of limitations and weaknesses. If up till now we presented what this framework is good for, we now turn to what this framework cannot do. This will hopefully address any residual unanswered questions on the scope, applicability and purpose of the claims contained herein.

To begin with, we acknowledge that the parameters presented in this framework do not make it a self-sufficient tool for regulatory analysis. Its focus is on the technological determinants of exclusion and therefore it is meant to complement, not replace, mainstream economics analysis of the industry. By highlighting how the technical complexity of the wireless industry affects the relevant parameters in assessing the competitive harm presented by exclusion, this framework enhances the policymaking process, but still relies on—indeed extends—existing analytical frameworks.

Second, we don't seek to present technology as a purely benevolent force. Admittedly, the spirit of this thesis has been favorable towards the role of technology in the mobile market. We showed how it makes anticompetitive exclusion harder to occur in the market by facilitating competition, causing exclusionary incentives to attenuate, and giving rise to important efficiencies. Despite the overall positive evaluation of technology, we were careful to discuss exceptions, limitations and opposing views while presenting the relevant arguments. Here, we also offer the general observation that technology can create opportunities for anticompetitive conduct in a manner similar to that by which it creates competition, although we still maintain

that the positive effect dominates.

In particular, although, as we showed in Chapter 3, technology can increase vertical pressure and facilitate entry, which was seen as a positive effect because it intensified competition, it can for the same reason assist a player in one layer to more easily expand power in other layers thus potentially distorting competition. For instance, taking advantage of the mechanism we described in Chapter 3, a firm can enter different layers of the value chain and then tie its products and services together.[683] Google, for example, aided by technological proximity and synergies between the layers of the value chain, expanded from the services layer to the operating system and device layers, and tied them together in a way that both creates much wanted competition, but also facilitates tying, which under certain circumstances can be anticompetitive.[684]

One should be careful here not to overstate the dangers. First, while expansion in neighboring parts of the value chain is a precondition for tying, actually proving that tying is anticompetitive is still required. Second, and most importantly, while expansion of market power is a risk, it is a necessary side effect of the argument that the technology-intensive nature of the industry enhances mobility along the value chain, which causes greater competitive friction. Fostering entry and vertical interactions can theoretically result in *too much* competition,[685] or

683 On the dangers of technological tying *see* M. Sean Royall, *Coping with the Antitrust Risks of Technological Integration*, 68 ANTITRUST LAW JOURNAL 1023 (2001) (discussing at length the Microsoft case); Timothy Derdenger, *Technological Tying and the Intensity of Competition: An Empirical Analysis of the Video Game Industry*, CMU Research Paper 5-2011, *available at* http://repository.cmu.edu/cgi/viewcontent.cgi?article=2418&context=tepper&sei-redir=1 (where the author discusses the incentives and implications of entering adjacent markets and tying hardware and software in the gaming industry).

684 Benjamin G. Edelman, *Leveraging Market Power Through Tying and Bundling: Does Google Behave Anti-competitively?*, Harvard Business School NOM Unit Working Paper 14-112 (2014). See also Thomas H. Au, *Anticompetitive Tying and Bundling Arrangements in the Smartphone Industry*, 16 STANFORD TECHNOLOGY LAW REVIEW 188 (2012).

685 *See* for example the literature of compatibility, which concludes that while compatibility increases entry and participation is also intensifies competition and this can even serve as a disincentive for further entry. *See* Jeffrey R. Church and Neil Gandal, *Platform Competition in Telecommunications*, *in* HANDBOOK OF

expansion of market power from one layer to another, but this consideration logically comes only *after* the conditions that facilitate entry and vertical interactions have been established. And such conditions are generally welcome by regulators. In principle, one should acknowledge as a positive development that technology has a facilitating effect on the creation of competitive conditions and entry.

Lastly, a more general point of criticism relates to the value of studying the role of technology in exclusion, and assigning, as we do here, a distinct role to it in the theory of exclusion. In other words are technological determinants in reality so important as to justify deviation from existing policy? One could reasonably argue that in the final analysis, everything translates into economic interests, that it is economic considerations that drive the behavior of firms in the market, and that therefore economic analysis is sufficient to explain market behavior and the need for regulation. Even if that is true, economic interests and firm capabilities are composed of a multitude of factors. In high technology industries, the technical infrastructure determines to a large extent what is possible, what is desirable and what is profitable. It also determines the limits of regulation in terms of available expertise, implementability of measures, feasibility of monitoring, and even estimation of the cost of regulation. We are not denying that at least some of the aspects of the interface between technology and policy-making have been discussed in the literature and even incorporated in policy measures (or lack thereof); but, as

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TELECOMMUNICATIONS 119 (Martin Cave et al., eds 2005). Also, innovation studies have shown that while competition and innovation are correlated, their relationship is not monotonic. It rather forms an inverted U curve, which means that there is such thing as too fierce competition to foster innovation. *See* Philipe Aghion et al., *Competition and Innovation: an Inverted-U Relationship*, 120 QUARTERLY JOURNAL OF ECONOMICS 701 (2005). *See also* Geoffrey Parker & Marshall Van Alstyne, *Innovation, Openness and Platform Control*, PROCEEDINGS OF THE 11TH ACM CONFERENCE ON ELECTRONIC COMMERCE, at 95 (2010) ("Holding other factors constant, more intense developer competition reduces the Nash bargaining surplus available to the platform sponsor. This surplus goes instead to platform users, reducing the sponsor's incentive to open the platform.").

mentioned in the Introduction, we still feel that, possibly due to the under-assessment of the effect of technology, certain policies were misguided, and that perhaps a systematic and comprehensive examination will help rectify that.

6.4 WHERE TO GO FROM HERE

The identification of the analysis' weaknesses and limitations right above points to preliminary directions from this point on. The central point is to attempt to merge the economic and technology-centered analyses into one unified analytical tool. As pointed out already, while important, technology is but one factor that determines business behavior and market organization. This means that regulatory analysis is expected to benefit from integrating the points and conclusions raised here, while keeping in place many of the existing tools. The next step from here would be to examine how this integration might take place.

This task is more complicated than it may seem. It is not simply about putting economic and technological considerations together. It implies a (partial) transition from rigid rules that statically attempt to describe impermissible behavior, to rules that are triggered only when the scrutinized behavior is linked to conditions that, assessed on a case by case basis, indicate possible anticompetitive effect. The “commercially reasonable” standard is a step in that direction. A flexible scope of application is another.

Moreover, we pointed out that while technology as an initial matter facilitates competition, it has the potential to also facilitate business practices that might harm it. This observation is a step further down the purpose of this thesis. It would be useful to identify as many such cases a

possible, and then use them to more fully document the effect of technology on the structural elements of competition and exclusion in the market. Balancing the positive effect of technology on the competitive conditions in the market with the potential dangers it brings along at a subsequent stage would complete the picture.

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