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Wi-Fi Helps Define the Relevant Market for Wireless Services

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The Federal Communications Commission (FCC) has recognized that Wi-Fi plays an increasingly important role as a competitor to the services offered by the mobile wireless industry, including when evaluating the state of competition in the mobile wireless marketplace.[1] When reviewing proposed mergers, however, the FCC relies on a product market definition—"mobile telephony/broadband services"[2]—that has been unchanged for approximately a decade and that does not account for the changing role of Wi-Fi in the competitive marketplace during that time. Notably, the FCC continues to rely on this market definition without undertaking any particular analysis and without the support of any empirical evidence. Since the FCC adopted its market definition: (1) the choice of Wi-Fi has become a clear reflection of how U.S. consumers use wireless devices; (2) market conditions for wireless services have changed rapidly; (3) more data has migrated to Wi-Fi offload—transmitting wireless data to a Wi-Fi network—than has remained on the cellular networks, and most wireless services are used in both nomadic and fixed environments; (4) Wi-Fi capabilities in wireless devices have evolved and become ubiquitous; (5) new technologies have not appeared to lessen demand for Wi-Fi; (6) cable providers are challenging wireless carriers with Wi-Fi offload and wireless services; and (7) consumers have become sensitive to price and quality in choosing between cellular services and Wi-Fi. When the use of Wi-Fi for consumer data offload is examined, a hypothetical

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[1] *See, e.g.*, WTB Seeks Comment on CMRS Market Competition, Public Notice, WT Dkt. No. 07-71, 22 FCC Rcd. 6810, 6811 (2007) (inquiring into the extent to which WLAN-based data services, such as Wi-Fi, are considered substitutes for the data and voice services offered over CMRS networks).

[2] I will discuss this definition in more detail in Part I.B.3 below.

monopolist might reveal that "mobile telephony/broadband services" are not a separate market.

The FCC first adopted this market definition in 2008, when 3G technologies were first being deployed and 4G was only on the planning boards. Today, the technologies of 2008 and the associated market definitions are outdated. Instead, new 5G technologies are being deployed. In this context, the FCC's reliance on an outdated market definition results in an inaccurate understanding of competition in the market. Before conducting competitive analyses of the mobile marketplace, the FCC should carefully examine consumer choices of communications services and develop market definitions that reflect current technologies and consumer practices. Wi-Fi and the businesses that provide it likely discipline prices of wireless services and are part of the same economic market.

I. Introduction

Market definitions are critical. If a market is not appropriately defined, regulators cannot accurately analyze the market, and regulatory actions could easily go awry.

Markets do not remain constant, impervious to real-world developments. Market definitions follow markets. They evolve and keep pace with technology and the actual behavior exhibited by consumers and businesses. The pace of technological change in the communications industry has been unrelenting. Consumers and businesses have both responded in rational ways.

The FCC has used a market definition of "mobile telephony/broadband services" for many years—at least since 2008. A review of developments since then suggests that mobile services are not necessarily a separate market from other communications services. An understanding of Wi-Fi offload is critical to this analysis.

A. Wi-Fi

When a wireless user—effectively, everyone—goes for the first time to an office, home, school, restaurant, or any other public place in the United States, one of the first questions the user asks is: "What is the Wi-Fi password?"

Once in possession of the coveted code, the wireless user enters the password into the relevant wireless phone, tablet, or other device. The wireless device will then choose the relevant Wi-Fi network and bypass the wireless carrier's network. Even if we do not use—or even know—the term, "Wi-Fi offload" is an integral part of the day-to-day life of practically every U.S. consumer. Most of us simply call it "Wi-Fi." I will use that term as well.

Although in this scenario the wireless user could decide to pay to use additional cellular network data, the user instead chooses to switch to the Wi-Fi system because doing so is usually incrementally free of charge, and because Wi-Fi more often than not offers a faster speed than does the cellular network.[3] The wireless user then asks for the Wi-Fi password not out of indifference to the price and quality of communications services, but precisely out of sensitivity to price and quality of service.

Price sensitivity is important for defining economic markets. Economists have well-developed techniques to determine whether two services are substitutes or complements based on the cross-price elasticity of demand—that is, how much demand for Wi-Fi services changes in response to changes in the price and quality of cellular services while holding the price and quality of Wi-Fi services constant. If the price of cellular network services were to increase or if the quality of cellular network services were to decrease, a user would be *more likely* to ask for the Wi-Fi password. To such users, cellular network services and Wi-Fi offload are *substitutes*. This observation has implications for the assessment of competition in the market for mobile wireless or cellular services.

B. FCC Reports

Federal agencies sometimes define market boundaries to examine competitive conditions in those markets. Every year, the FCC conducts many analyses of economic competition for various services under its jurisdiction. These analyses, which include annual or biennial reports to Congress on competition for wireless services[4] and the deployment of broadband services,[5] involve an assessment of the current state of the dynamic wireless marketplace. In this context, the FCC has taken into account the role of Wi-Fi. In fact, on different occasions, the FCC has asked the public to what extent they considered wireless local access network (WLAN)-based data and Voice over Internet Protocol (VoIP) services to be complements to, or substitutes for, the mobile voice and data services offered over mobile wireless networks.[6]

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[3] For example, Cisco reported that average Wi-Fi speeds in 2016 in North America were twice the average mobile network speed: 27.4 Mbps compared to 13.7 Mbps. Cisco Systems, Inc., The Zettabyte Era: Trends and Analysis tbls.6 & 7 (2017), https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/vni-hyperconnectivity-wp.pdf.

[4] *See Mobile Wireless Competition Reports*, Fed. Comms. Commission, https://www.fcc.gov/wireless/bureau-divisions/competition-infrastructure-policy-division/mobile-wireless-competition.

[5] *See 2018 Broadband Deployment Report*, Fed. Comms. Commission, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report. For prior reports, see *Archive of Released Broadband Deployment Reports and Notices of Inquiry*, Fed. Comms. Commission, https://www.fcc.gov/general/archive-released-broadband-progress-notices-inquiry.

[6] *See supra* note 1.

The FCC has also accounted for the competitive pressures exerted by hybrid Wi-Fi/cellular services.[7]

The FCC also routinely reviews transfers of licenses and permits that often involve the merger of two firms.[8] When engaging in this exercise, however, the FCC has relied on the same market definition it adopted in 2008, "mobile telephony/broadband services,"[9] which ignores the reality of the wireless marketplace today including, significantly, the role of Wi-Fi offload. This inconsistency results in an obsolete understanding of competition in the communications marketplace and can lead to agency determinations that run counter to the public interest.

1. FCC Reports on Competition for Wireless Services

Until 2018, the FCC was statutorily required to prepare an annual Mobile Wireless Competition Report.[10] Specifically, the FCC was required to

> review competitive market conditions with respect to commercial mobile services and . . . include in its annual report an analysis of those conditions. Such analysis shall include an identification of the number of competitors in various commercial mobile services, an analysis of whether or not there is effective competition, an analysis of whether any of such competitors have a dominant share of the market for such services, and a statement of whether additional providers or classes of providers in those services would be likely to enhance competition.[11]

Some of the wireless competition reports specifically included discussions of Wi-Fi. The 2009 competition report, for example, found Wi-Fi and WLANs to be "playing an increasingly important role as [] competitor[s] and supplement[s]" to commercial mobile services.[12] In 2011, however, Wi-Fi and WLANs were briefly discussed, not as competitors, but rather

[7] *See, e.g.*, Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Twentieth Report, WT Dkt. No. 17-69, 32 FCC Rcd. 8968, 8976–77 ¶ 16 (2017) [hereinafter Twentieth Mobile Wireless Competition Report].

[8] *See Mergers and Acquisitions*, Fed. Comms. Commission, https://www.fcc.gov/proceedings-actions/mergers-and-acquisitions#block-menu-block-4.

[9] I will discuss this definition in more detail in Part I.B.3 below. Although its records are not public, the Department of Justice's (DOJ's) Antitrust Division might have used a similar market definition in evaluating proposed mergers between wireless carriers. The complaint in the proposed AT&T and T-Mobile merger used a "mobile wireless telecommunications services" market definition. *See* Complaint, United States v. AT&T Inc., No. 1:11-cv-01560, 2011 WL 3823252 (D.D.C. Aug. 31, 2011). This definition would exclude all forms of Wi-Fi that are neither "mobile" nor a "service." The DOJ reached its market definition without econometric evidence.

[10] *Mobile Wireless Competition Reports*, Fed. Comms. Commission, *supra* note 4.

[11] 47 U.S.C. § 332(c)(1)(C).

[12] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, Thirteenth Report, WT Dkt. No. 08-27, 24 FCC Rcd. 6185, 6296 ¶ 233 (2009).

as "complements" to mobile networks.[13] In 2017, Wi-Fi was only briefly discussed in the wireless competition report.[14]

On March 23, 2018, President Trump signed into law the Consolidated Appropriations Act of 2018, which included the Repack Airwaves Yielding Better Access for Users of Modern Services Act of 2018 (RAY BAUM'S Act). The RAY BAUM's Act revised the Communications Act of 1934 by eliminating the two sentences requiring the FCC to prepare an annual "Mobile Wireless Competition Report." As a result, the Communications Act now requires that the FCC publish a "Communications Marketplace Report" in the last quarter of every even-numbered year that, among other things, "assess[es] the state of competition in the communications marketplace," including providers of commercial mobile service.[15] This exercise will result in a report that will include information from what was the now-defunct Mobile Wireless Competition Report and will also look more broadly at competition across all forms of communications, both wireline and wireless, including Wi-Fi.

Two points are worth noting. First, as of 2018, Congress no longer seeks a report on the "commercial mobile services" market but on a much broader "communications marketplace." Second, the fact that Congress previously required an annual, and now biennial, report reflects the expectation that market conditions will not necessarily be the same year in and year out. Yet, despite having reassessed the state of the market every year for many years, the FCC continues to rely on the same market definition from a decade ago, and does not engage in any empirical analysis to determine the boundaries of the markets in which mobile service providers compete, or what factors discipline prices for those providers in the context of merger reviews.

2. FCC Broadband Deployment Reports

The FCC, in its broadband deployment reports, has stated that wireline broadband and cellular broadband are not technologically "full substitutes" because they have different characteristics and capabilities.[16] The fact that wireline and wireless services are not *technological* substitutes because cellular network services remain less capable than wireline network services does not answer the question of whether wireline and cellular broadband are *economic*

[13] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Fifteenth Report, WT Dkt. No. 10-133, 26 FCC Rcd. 9664, 9872–73 ¶¶ 370–72 (2011).

[14] Twentieth Mobile Wireless Competition Report, *supra* note 7.

[15] 47 U.S.C. § 163.

[16] *See, e.g.*, Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, 2018 Broadband Deployment Report, GN Dkt. No. 17-199, 33 FCC Rcd. 1660, 1666–67 ¶ 18 (2018).

substitutes—an analysis that the FCC does not undertake. The FCC does not address economic market definitions in its broadband deployment reports.

Wireless consumers find their way to better broadband services at lower prices and better quality through Wi-Fi, not because cellular network services and Wi-Fi are technologically equivalent, but precisely because they are not. The FCC broadband deployment reports do not address Wi-Fi offload, much less provide an economic analysis of whether Wi-Fi is an economic substitute for cellular broadband services.

Some commenters have suggested to the FCC that wireline broadband and cellular broadband are substitutes, a position the FCC has rejected.[17] In fact, the FCC has set different standards for the definition of broadband services for wireline services[18] and for cellular broadband services.[19] This distinction indicates that the FCC expects cellular networks to have lower data speeds and capabilities than do wireline networks.

3. FCC License Transfers and Merger Reviews

Historically, the FCC has not considered the effect of Wi-Fi offload in its review of license transfers. The unchanging nature of the FCC's approach to market definitions can be seen in reviews of major license transfers, including the most recently granted major license transfer, the AT&T and Leap Wireless transaction, which was approved by the Acting Chief of the Wireless Telecommunications Bureau.[20] There, the Bureau stated:

> We continue to use the product market definition that the Commission has applied in recent transactions: a combined "mobile telephony/broadband services" product market that is comprised of mobile voice and data services, including mobile voice and data services provided over advanced broadband cellular networks (mobile broadband services). As set out in prior transaction proceedings, the product market we define encompasses differentiated services (*e.g.*, voice-centric or data-centric), devices (*e.g.*, feature phone, smartphone, tablet, etc.), and contract features (*e.g.*, prepaid vs. postpaid), which are distinctions that wireless providers often recognize in their internal analyses of the marketplace.[21]

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[17] *Id.* at 1666 n.37.

[18] The standard for wireline broadband is 25 Mbps download/3 Mbps upload. *See id.* at 1667–68 ¶ 21.

[19] The FCC evaluated two standards for wireless services: 10 Mbps/3 Mbps and 5 Mbps/1 Mbps. The FCC repeatedly stated that it was not concluding that the latter represented a "mobile advanced telecommunications capability benchmark." *Id.* at 1670–74 ¶¶ 27–34.

[20] Applications of Cricket License Company, LLC, et al., Leap Wireless International, Inc., and AT&T Inc. for Consent to Transfer Control of Authorizations, Memorandum Opinion and Order, WT Dkt. No. 13-193, 29 FCC Rcd. 2735 (2014).

[21] *Id.* at 2747–48 ¶ 26.

The discussion of market definition in the AT&T-Leap Wireless merger was not based on empirical evidence or any particular analysis. It was simply based on precedent from prior merger analyses, including GCI-Alaska Wireless,[22] SoftBank-Sprint,[23] Verizon-SpectrumCo,[24] AT&T-WCS,[25] T-Mobile-MetroPCS,[26] and AT&T-T-Mobile.[27] These orders in turn cite earlier orders, such as AT&T-Qualcomm,[28] AT&T-Verizon,[29] AT&T-Centennial,[30] and Nextel-Sprint-Clearwire.[31] In all of these proceedings, the relevant product market was found to be "mobile telephony/broadband services." In most of the proceedings, no parties objected to the market definition of "mobile telephony/broadband services," a definition that does not include Wi-Fi offload.[32] In one proceeding, the FCC declined to adopt a narrower market definition, such as "value wireless services."[33]

[22] Applications of GCI Communication Corp., ACS Wireless License Sub, Inc., ACS of Anchorage License Sub, Inc., and Unicom, Inc. for Consent to Assign Licenses to the Alaska Wireless Network, LLC, Memorandum Opinion and Order and Declaratory Ruling, WT Dkt. No. 12-187, 28 FCC Rcd. 10,433, 10,447 ¶ 35 (2013) [hereinafter GCI-Alaska Wireless Memorandum Opinion].

[23] Applications of SoftBank Corp., Starburst II, Inc., Sprint Nextel Corporation, and Clearwire Corporation for Consent to Transfer Control of Licenses and Authorizations, Memorandum Opinion and Order, Declaratory Ruling, and Order on Reconsideration, IB Dkt. No. 12-343, 28 FCC Rcd. 9642, 9656 ¶ 37 (2013) [hereinafter SoftBank-Sprint Memorandum Opinion].

[24] Applications of Cellco Partnership d/b/a Verizon Wireless and SpectrumCo LLC and Cox TMI, LLC for Consent to Assign AWS-1 Licenses, Memorandum Opinion and Order and Declaratory Ruling, WT Dkt. No. 12-4, 27 FCC Rcd. 10,698, 10,717 ¶ 53 (2012) [hereinafter Verizon-SpectrumCo Memorandum Opinion].

[25] Applications of AT&T Mobility Spectrum LLC, New Cingular Wireless PCS, LLC, Comcast Corporation, Horizon Wi-Com, LLC, NextWave Wireless, Inc., and San Diego Gas & Electric Company for Consent to Assign and Transfer Licenses, Memorandum Opinion and Order, WT Dkt. No. 12-240, 27 FCC Rcd. 16,459, 16,468 ¶ 24 (2012).

[26] Applications of Deutsche Telekom AG, T-Mobile USA, Inc., and MetroPCS Communications, Inc. for Consent to Transfer of Control of Licenses and Authorizations, Memorandum Opinion and Order and Declaratory Ruling, WT Dkt. No. 12-301, 28 FCC Rcd. 2322, 2332 ¶ 28 (2013) [hereinafter T-Mobile-MetroPCS Memorandum Opinion].

[27] Applications of AT&T Inc. and Deutsche Telekom AG for Consent to Assign or Transfer Control of Licenses and Authorizations, Order, WT Dkt. No. 11-65, 26 FCC Rcd. 16,184, 16,186 (2011) (dismissing without prejudice AT&T's application to acquire T-Mobile for $39 billion); *see also* Staff Analysis and Findings, WT Dkt. No. 11-65, 26 FCC Rcd. 16,188 (2011) [hereinafter AT&T-T-Mobile Staff Analysis and Findings].

[28] *See* Application of AT&T Inc. and Qualcomm Incorporated for Consent to Assign Licenses and Authorizations, Order, WT Dkt. No. 11-18, 26 FCC Rcd. 17,589, 17,602–03 ¶¶ 32–33 (2011).

[29] Applications of AT&T Inc. and Cellco Partnership d/b/a Verizon Wireless for Consent to Assign or Transfer Control of Licenses and Authorizations and Modify a Spectrum Leasing Arrangement, Memorandum Opinion and Order, WT Dkt. No. 09-104, 25 FCC Rcd. 8704, 8721 ¶ 35 (2010).

[30] Applications of AT&T and Centennial Communications Corp. for Consent to Transfer Control of Licenses, Authorizations, and Spectrum Leasing Arrangements, Memorandum Opinion and Order, WT Dkt. No. 08-246, 24 FCC Rcd. 13,915, 13,932 ¶ 37 (2009) [hereinafter AT&T-Centennial Memorandum Opinion].

[31] Sprint Nextel Corporation and Clearwire Corporation, Applications for Consent to Transfer Control of Licenses, Leases, and Authorizations, Memorandum Opinion and Order, WT Dkt. No. 08-94, 23 FCC Rcd. 17,570, 17,585–90 ¶¶ 33–49 (2008) [hereinafter Nextel-Sprint-Clearwire Memorandum Opinion].

[32] *See, e.g.*, GCI-Alaska Wireless Memorandum Opinion, *supra* note 22; SoftBank-Sprint Memorandum Opinion, *supra* note 23; Verizon-SpectrumCo Memorandum Opinion, *supra* note 24.

[33] *See* T-Mobile-MetroPCS Memorandum Opinion, *supra* note 26, at 2332 ¶ 28.

The earliest of these decisions to adopt "mobile telephony/broadband services" as a product market for FCC evaluation was Nextel-Sprint-Clearwire in 2008. The FCC stated:

> Specifically, we delineate the scope of a combined market for mobile telephony/broadband services broadly to include mobile voice and data services provided over wireless broadband networks (mobile broadband services), as well as mobile voice and data services provided over less advanced, earlier generation (e.g., 2G, 2.5G) legacy wireless networks. In addition, the market includes a wide array of mobile data services, ranging from handset-based mobile data services marketed primarily as an add-on to mobile voice services to standalone mobile Internet access services for laptop users.[34]

The discussion is quaintly dated from 2008, a time when 3G technology was novel and 4G merely a future concept. In 2008, mobile services were primarily voice, and Wi-Fi was not fully integrated into mobile technology. Today, voice is a declining share of mobile, and, as will be discussed in more detail below, Wi-Fi handles most data originating on mobile devices.

The FCC found that analyzing the various older voice and data services as well as the emerging mobile broadband product markets under this combined market would ensure a reasonable assessment of any potential competitive harm resulting from the proposed transaction under review, and noted that "there are risks associated with defining product markets too narrowly in the context of rapidly evolving markets and services such as those for mobile broadband services."[35] The risks of evaluating too narrow a market are no less today than they were in 2008. Indeed, they are likely greater.

The FCC's market definition of "mobile telephony/broadband services" was not derived from econometric studies or detailed analyses of market information. The FCC did not rely upon measurements of demand elasticities, either own-price or cross-price elasticities of demand. To the contrary, the FCC's definition was based more on anecdotal discussions and comments from parties in proceedings. Although the FCC has since acknowledged that its inquiries into competition in the mobile wireless ecosystem "suggest[] the possibility that . . . future analysis of the competitive effects of proposed transactions may change,"[36] since the FCC adopted the "mobile telephony/broadband services"[37] market definition, it has been reluctant to change it.

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[34] Nextel-Sprint-Clearwire Memorandum Opinion, *supra* note 31, at 17,586–87 ¶ 39.
[35] *Id.* at 17,586 ¶ 37.
[36] AT&T-Centennial Memorandum Opinion, *supra* note 30, at 13,932 ¶ 35.
[37] *Id.* at 13,932 ¶ 36.

C. Market Changes

Although the FCC's product market definition might have been perfectly adequate when it was originally adopted in 2008, it is not appropriate in 2018. In many other markets, little has changed in the past decade or so. But in the markets in which wireless carriers compete, little has stayed the same.[38] Let us imagine that a consumer wanted to purchase today a wireless handset and wireless service that were available in 2008. This would be impossible: wireless handsets have a shelf life of a year or two, so one cannot purchase a 2008 wireless handset in a store. They are obsolete. So too are the wireless services that those products enabled through the wireless carriers of the last decade. In many markets, it is perfectly possible to purchase products or services that were available ten years ago, but imagining doing so with a mobile phone and cell service seems absurd. The very fact that this thought experiment seems so anachronistic with wireless products is instructive of the speed with which this market changes.

Over the past decade, wireless carriers have faced increased competition from many sources, including outside of traditional wireless services. This competition is intensified by new technologies that allow customers to bypass traditional wireless services. Indeed, this is the public stance taken by AT&T,[39] Verizon,[40] Sprint,[41] and T-Mobile.[42]

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[38] *See* Part II.A below.

[39] AT&T Inc., Annual Report for the Fiscal Year Ended December 31, 2017 (SEC Form 10-K), at 38 (Feb. 20, 2018) ("We have multiple wireless competitors in each of our service areas and compete for customers based principally on service/device offerings, price, network quality, coverage area and customer service. In addition, we are facing growing competition from providers offering services using advanced wireless technologies and IP-based networks as well as traditional wireline networks.").

[40] Verizon Communications Inc., Annual Report for the Fiscal Year Ended December 31, 2017 (SEC Form 10-K), at 7 (Feb. 23, 2018) ("Microsoft, Google, Apple and others are offering alternative means for making wireless voice calls that, in certain cases, can be used in lieu of the wireless provider's voice service, as well as alternative means of accessing video content.").

[41] Sprint Corp., Annual Report for the Fiscal Year Ended March 31, 2017 (SEC Form 10-K), at 16 (May 26, 2017) ("The wireless industry also faces competition from other communications, cable, and technology companies seeking to increase their brand recognition and capture customer revenue with respect to the provision of wireless products and services, in addition to non-traditional offerings in mobile data. Further, some of our current competitors now provide content services in addition to voice and broadband services, and consumers are increasingly accessing video content from alternative sources via Internet-based providers and applications, all of which create increased competition in this area. . . . [T]echnological advances have caused long distance, local, wireless, video, and Internet services to become more integrated, which has contributed to increased competition, new competitors, new products, and the expansion of services offered by our competitors in each of these markets.").

[42] T-Mobile US, Inc., Annual Report for the Fiscal Year Ended December 31, 2017 (SEC Form 10-K), at 9–10 (Feb. 8, 2018) ("We face intense and increasing competition from other service providers as industry sectors converge, such as cable, telecom services and content, satellite, and other service providers. Companies like Comcast and AT&T (and AT&T's proposed acquisition of Time Warner, Inc.) will have the scale and assets to aggressively compete in a converging industry. Verizon, through the acquisitions of AOL, Inc. and Yahoo! Inc. is also a significant competitor focusing on premium content offerings to diversify outside of core wireless. Further, some of our competitors now provide content services in addition to voice and broadband services, and consumers are increasingly accessing video content from Internet-based providers and applications, all of which create increased competition in this area. These factors, together with the effects of the increasing aggregate penetration of wireless services in all met-

The most important of these non-traditional competitive sources is Wi-Fi. In 2018, consumers are likely to switch between cellular service and Wi-Fi offload seamlessly, multiple times per day, as they expect practically ubiquitous access to broadband networks and fast Internet connections from their mobile devices, primarily over Wi-Fi networks.

There is another factor that directly affects the reasonableness of the FCC's "mobile telephony/broadband services" product market definition. Nearly ten years ago, wireless consumers primarily used wireless devices connected to cellular networks so that the services were either mobile or functionally equivalent to mobile. Today, and for the past few years, wireless consumers primarily use mobile devices for nomadic or even fixed purposes directly connected to wireline networks through Wi-Fi, not cellular networks.

Indeed, consumers today use their wireless devices to connect to wireline networks primarily through Wi-Fi. To most consumers, wireless cellular service and Wi-Fi offload are choices made daily, with Wi-Fi being the default choice where available. Consumers use the same wireless device that provides mobile services through a carrier's cellular network for fixed Wi-Fi offload services in their homes, schools, workplaces, and practically everywhere consumers go.

Wi-Fi offload allows consumers to bypass costlier and often slower cellular networks and to connect directly with lower-cost, faster landline networks. The Nextel-Sprint-Clearwire order might not have discussed Wi-Fi offload largely because it was not common in 2008. In 2010, the first year for which I can find credible data, only 21 percent of wireless data from mobile devices passed through Wi-Fi. Today, 60 percent or more of wireless data from mobile devices passes through Wi-Fi.[43] Today Wi-Fi offload is the norm, rather than the exception.

In 2008, consumers primarily relied on their cellular networks when using mobile devices, which rendered the adjective "mobile" in the market definition of "mobile telephony/broadband services" reasonable. In 2018, the default use of wireless devices is more often through Wi-Fi offload and landline networks. This current usage renders the term "mobile" in the market definition of "mobile telephony/broadband services" dated at best, and quite likely inappropriate for most wireless devices. The application of

ropolitan areas and the ability of our larger competitors to use resources to build out their networks and to quickly deploy advanced technologies, could make it more difficult for us to continue to attract and retain customers, and may adversely affect our competitive position and ability to grow, which would have a material adverse effect on our business, financial condition and operating results.").

[43] *See infra* Table 6. The Wi-Fi offload presented here is from mobile devices only. A substantially greater amount of wireless data is transmitted over Wi-Fi from Wi-Fi-only devices such as laptops and tablets. *See* Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016–2021, at 18–19 (2017) [hereinafter Cisco Global Mobile Data Traffic Forecast Update, 2016–2021], https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.pdf.

this definition by the FCC has excluded discussion, much less inclusion, of Wi-Fi.[44]

There are at least two limitations to the FCC's market definition. First, "mobile" communications services are constantly in competition with both fixed and nomadic communications services. No one offers a purely "mobile" service that cannot be operated in a fixed location. Once in that fixed location, the competition with fixed services, such as Wi-Fi, ensues.

Second, even if Wi-Fi were considered to be "mobile," Wi-Fi often has the characteristic of either (1) being free to the public for practical purposes,[45] or (2) being private and not available to the general public. In either case, Wi-Fi might not qualify as a "telecommunications service,"[46] which is often considered available to the public for a fee (but economic market definitions are based on demand conditions, and are not limited to legal definitions).

Wi-Fi offload is then a substitute for cellular networks. Where Wi-Fi is available, the choice is to substitute faster and less costly Wi-Fi for the slower and costlier cellular network. If Wi-Fi offload were not a substitute, consumers would not bother to switch to Wi-Fi whenever convenient.

At least five factors have made the substitution of Wi-Fi for cellular network services more common today for mobile devices than it was when the FCC originally adopted its market definition.

1. Growth in Online Demand for Data

As I will discuss in more detail below, demand for broadband access has grown substantially since 2008.[47]

2. Improvements in Wi-Fi Technology

Wi-Fi has been available for decades, and new versions of 802.11 Wi-Fi technology have constantly been updated.[48] Data speeds and data capacity have

[44] Whether Wi-Fi is a mobile service, and whether a Wi-Fi device a mobile or a fixed station, are semantic questions. *See* 47 U.S.C. § 153 (definitions). In particular, see *id.* § 153(34) ("The term 'mobile station' means a radio-communication station capable of being moved and which ordinarily does move."). A Wi-Fi router or hotspot, while technically portable, is usually not moved and is usually considered a fixed device. Its broadband access is usually to a fixed landline network. Thus, even if transmissions between a mobile device and a Wi-Fi hotspot are mobile, the transmissions between the Wi-Fi hotspot and the Internet likely are not.

[45] Wi-Fi is being integrated into many fee-for-service offerings such as Boingo and Google's Project Fi. But in many instances, Wi-Fi is not part of a fee-based service.

[46] *See* 47 U.S.C. § 153(53) ("The term 'telecommunications service' means the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used.").

[47] *See infra* Part II.A & Table 1.

[48] *See infra* Part II.E; *see also Official 802.11 Working Group Project Timelines*, Inst. Electrical & Electronic Engineers, http://grouper.ieee.org/groups/802/11/Reports/802.11_Timelines.htm.

increased substantially over the past decade. New standards for 802.11ac include speeds of up to nearly 7 Gbps.[49]

3. Growing Ubiquity of Wi-Fi in the Home

Wi-Fi is the norm rather than the exception in U.S. homes with broadband. NCTA reports that nine out of ten broadband homes use Wi-Fi.[50]

4. Growth of Public Wi-Fi Hotspots

Public Wi-Fi hotspots have long been available in coffee shops, airports, and municipal parks. All of these have grown over time. In recent years, cable operators have also organized proprietary Wi-Fi networks. NCTA reported in 2016 that public cable-related Wi-Fi hotspots have increased from 50,000 in 2012, to 200,000 in 2013, to 500,000 in 2016.[51]

5. Growth of the Wi-Fi-Supported Internet of Things

Part of the growth in Wi-Fi is also attributable to the Internet of Things (IoT). In 2009, 5 billion devices were connected to the IoT; today, more than 34 billion devices are connected, largely through Wi-Fi, and the number is growing rapidly.[52]

II. Wi-Fi Ought to be Considered by Federal Agencies as Part of the Economic Market for Wireless Services in Which Mobile Wireless Carriers Compete

In Part II, I examine whether Wi-Fi is—and ought to be—considered by federal agencies, including the FCC and the DOJ, as part of the economic market for wireless services in which mobile wireless carriers compete. At the very least, federal agencies should update market definitions first introduced in 2008. As discussed below, (1) market conditions for wireless services have changed rapidly since the FCC adopted its product market definition; (2) over the past decade, more data has migrated to Wi-Fi offload than has remained on the cellular networks, and most wireless services are used in both nomadic and fixed environments; (3) Wi-Fi capabilities in wireless devices have likewise evolved and become ubiquitous; (4) new technologies

[49] *See, e.g.*, *IEEE 802.11ac Gigabit Wi-Fi*, Electronics Notes, https://www.electronics-notes.com/articles/connectivity/wifi-ieee-802-11/802-11ac.php; *see also 802.11ac Wave 2 FAQ*, Cisco, https://www.cisco.com/c/en/us/solutions/collateral/enterprise-networks/802-11ac-solution/q-and-a-c67-734152.html.

[50] *How Wi-Fi Has Changed America*, NCTA (June 19, 2018), https://www.ncta.com/whats-new/how-wi-fi-has-changed-america.

[51] *Public Wi-Fi Hotspots Hit 500,000*, NCTA (July 20, 2016), https://www.ncta.com/whats-new/public-wi-fi-hotspots-hit-500000.

[52] *See, e.g.*, *Broadband by the Numbers*, NCTA, https://www.ncta.com/broadband-by-the-numbers.

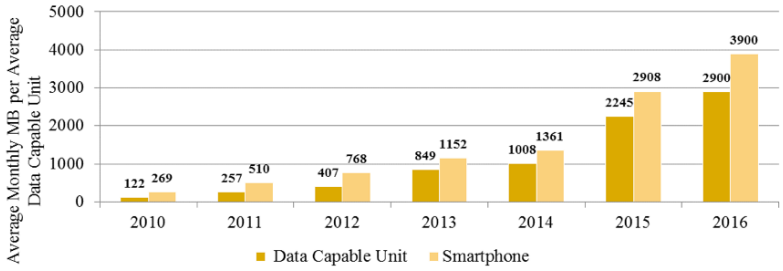
do not appear to lessen demand for Wi-Fi offload; (5) cable providers are challenging wireless carriers with Wi-Fi offload and other wireless services; and (6) consumers are sensitive to price and quality in choosing between cellular services or Wi-Fi offload. Despite all these factors, the FCC has not updated the market definition of "mobile telephony/broadband services" in the past decade.

A. Market Conditions for Wireless Services Have Changed Rapidly Since the FCC Adopted Its Product Market

Markets for communications services have changed substantially since the FCC adopted its product market definition of "mobile telephony/broadband services." Indeed, the market has changed substantially even since 2014, when the FCC last considered a merger of wireless communications carriers using the market definition of "mobile telephony/broadband services."

Wireless data demand in the United States has exploded. As shown in Figure 1, the FCC first reported mobile data usage in 2010. Between 2010 and 2016, the average data usage per customer increased more than 23 times for data-capable units and more than 14 times for smartphones. There is no reason to believe that the growth of average data use has slowed since 2016.

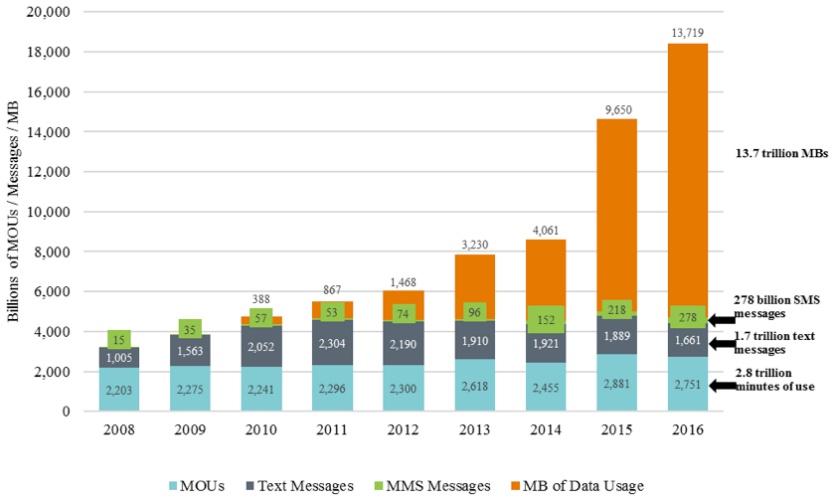
Figure 1. Mobile Data Usage per Subscriber from CTI Data



Source: Twentieth Mobile Wireless Competition Report, *supra* note 7, at 9029 App. I, Chart 2.

Voice minutes for many wireline services have declined, and this is reflected in the slow growth of wireless voice minutes as well. Rather than speak through traditional phone services, many users prefer to use VoIP applications, or social media messenger applications, none of which are recorded as traditional voice minutes of use. As shown in Figure 2, the growth of voice minutes and text minutes on mobile networks has been modest relative to the growth of data services.

Figure 2. Annual Wireless Traffic



Source: Twentieth Mobile Wireless Competition Report, *supra* note 7, at 9029 App. I, Chart 1.

Although Wi-Fi can be used for voice and texts,[53] its primary use today is for data. Most of the growth in U.S. wireless services between 2010 and 2016 was for cellular data services, not voice or texts.[54] U.S. cellular data traffic increased from 388 petabytes in 2010 to 13,719 petabytes in 2016, a growth of 3436 percent between 2010 and 2016, and a growth of 42 percent between 2015 and 2016.[55]

In Table 1, I present both cellular and wireline data growth in petabytes from 2010 to 2016.[56] As the table shows, cellular data accounted for only 0.5 percent of total broadband data in 2010, climbing to 3.6 percent by 2016. USTelecom projects that this share will grow to 7 percent by 2021, still a very small share. Data carried over cellular networks are the exception rather than the rule. Non-cellular data accounted for the remainder. Still, the rapidly growing share of data carried over cellular networks indicates that cellular data has been growing more rapidly has than non-cellular data. Cisco made

53 T-Mobile even advertises the use of Wi-Fi offload for voice calls. *See Wi-Fi Calling and Wi-Fi Extenders*, T-Mobile, https://www.t-mobile.com/offers/wifi-calling-wifi-extenders.

54 CTIA, Annual Year-End 2016 Top-Line Survey Results (2017), https://api.ctia.org/docs/default-source/default-document-library/annual-year-end-2016-top-line-survey-results-final.pdf.

55 *Id.*; *see also supra* Figure 2.

56 The underlying cellular data from CTIA is variously labeled "wireless" and "mobile." *See* Robert F. Roche & Kathryn Malarkey, CTIA's Wireless Industry Indices Report: Year-End 2016 Results, Chart 31 (2017). I assume that what is captured is actually data on the cellular network rather than "all wireless" or "just mobile." That interpretation is consistent with data presented in USTelecom. *See* Patrick Brogan, *U.S. Internet Usage Continues to Expand*, USTelecom (Nov. 27, 2017), https://www.ustelecom.org/blog/us-internet-usage-continues-expand.

a similar finding.[57] It found that, in 2015, 6 percent of total global IP traffic (both wireline and wireless) was carried by cellular networks.[58]

Increased wireless data carriage has not necessarily resulted in increased wireless revenue. As shown in Table 2, based on CTIA estimates, between 2010 and 2016 service revenue in the U.S. wireless industry increased slowly, from approximately $160 billion in 2010 to $188 billion in 2016, or a little more than 2 percent annually.[59] The wireless industry has simply provided more and more service for effectively the same revenue. Other government data, however, reveal more revenue growth for the wireless industry.[60] According to the U.S. Census Bureau, revenue for wireless services has grown by more than 4 percent annually between 2010 and 2016. For cellular data, annual revenue growth was more than 12 percent between 2012 and 2016. Both of these revenue growth values are substantially less than the growth in data transmitted. However, the U.S. Census Bureau only began collecting cellular data revenue in 2012.

Table 1. Distribution of Data Traffic in the United States Between Cellular and Non-Cellular (Petabytes of Data per Month)

	2010	2011	2012	2013	2014	2015	2016
Total	6314	9351	12,400	15,162	18,127	23,443	31,352
Cellular	32	72	122	269	338	803	1143
Percentage of Total	*0.5%*	*0.8%*	*1.0%*	*1.8%*	*1.9%*	*3.4%*	*3.6%*
Implied Non-Cellular	6282	9279	12,278	14,893	17,789	22,640	30,209
Percentage of Total	*99.5%*	*99.2%*	*99.0%*	*98.2%*	*98.1%*	*96.6%*	*96.4%*

Sources: Patrick Brogan, USTelecom, U.S. Internet Usage and Global Leadership Are Expanding 4 Chart 3 (2017), https://www.ustelecom.org/sites/default/files/USTelecom%20Research%20Brief%2011.27.17%20FINAL%20revised.pdf; Roche & Malarkey, *supra* note 56, Chart 31.

[57] Cisco Global Mobile Data Traffic Forecast Update, 2016–2021, *supra* note 43.
[58] *Id.* at 22 fig.23.
[59] CTIA, Annual Year-End 2016 Top-Line Survey Results, *supra* note 54.
[60] *See* U.S. Census Bureau, Service Annual Survey Latest Data (NAICS-Basis): 2016 tbl.4 (2017), https://census.gov/data/tables/2016/econ/services/sas-naics.html. Following FCC practice, I will place more reliance on the CTIA data.

Table 2. Various Measures of U.S. Wireless Industry Revenue (Billions USD)

	Total Service Revenue (CTIA)	Total Service Revenue (Census)	Data Service Revenue (Census)
2010	159.9	199.2	–
2011	169.8	214.4	–
2012	185.0	225.4	62.9
2013	189.2	233.1	66.3
2014	187.8	251.8	77.4
2015	191.9	254.4	87.3
2016	188.5	262.7	99.0

Sources: Roche & Malarkey, *supra* note 56, Chart 16; U.S. Census Bureau, Service Annual Survey Latest Data (NAICS-Basis): 2016, *supra* note 60, tbl.4; U.S. Census Bureau, Service Annual Survey Historical Data tbl.4 (2012).

B. Measures of Wireless Revenue per Unit of Data Have Fallen Precipitously

In Table 3, I present various measures of wireless revenue per megabyte by dividing annual revenue values from Table 2 by measures of monthly cellular data traffic from Table 1 and dividing by 12. The market conditions for wireless services have changed dramatically since the FCC first adopted the "mobile telephony/broadband services" market definition. While average revenue per wireless subscriber declined by approximately 20 percent from 2008 and 2016,[61] average revenue per megabyte declined by more than a factor of 10 between 2010 and 2016. Both the number of subscribers and the average megabytes per subscriber increased during this period.

[61] *See* Twentieth Mobile Wireless Competition Report, *supra* note 7, at 9009 Chart III.A.3.

Table 3. Various Measures of U.S. Wireless Industry Revenue per Megabyte (USD)

	Total Service Revenue (CTIA)	Total Service Revenue (Census)	Data Service Revenue (Census)
2010	0.41	0.51	–
2011	0.20	0.25	–
2012	0.13	0.15	0.04
2013	0.06	0.07	0.02
2014	0.05	0.06	0.02
2015	0.02	0.03	0.01
2016	0.01	0.02	0.01

Sources: Roche & Malarkey, *supra* note 56, Chart 16; U.S. Census Bureau, Service Annual Survey Latest Data (NAICS-Basis): 2016, *supra* note 60, tbl.4; U.S. Census Bureau, Service Annual Survey Historical Data, *supra* sources to Table 2, tbl.4.

Average prices for a megabyte of mobile data fell more than 70 percent from 2009 to 2011.[62] Average mobile revenues per megabyte of data fell further between 2012 and 2016: average total revenue per megabyte fell by more than 80 percent, and average data revenue per megabyte fell by more than 60 percent.[63] Although the data sources used by the FCC in different wireless competition reports are not necessarily exactly comparable, they indicate a substantial decline in mobile data prices from 2009 to 2016 that has almost certainly continued in the last two years. Stated differently, as prices for wireless data have fallen dramatically and the quality of wireless data has improved dramatically, revenue has increased modestly.

In addition, wireline revenue has not kept pace with increased data usage, which can be explained by consumer reliance on Wi-Fi offload. Increased wireline data carriage has not necessarily resulted in increased wireline revenue. As shown in Table 4, between 2010 and 2016, total wireline service revenue from the Census Bureau grew modestly by more than 2 percent. Wireline data service revenue from the Census Bureau grew by nearly 9 percent annually during the same time period. Both of these revenue growth values are substantially less than the growth in data transmitted.

[62] *See* Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Sixteenth Report, WT Dkt. No. 11-186, 28 FCC Rcd. 3700, 3881 Chart 30 (2013).

[63] Twentieth Mobile Wireless Competition Report, *supra* note 7, at 9010 Chart III.A.4.

Table 4. Various Measures of U.S. Wireline Industry Revenue (Billions USD)

	Total Service Revenue (Census)	Data Service Revenue (Census)	Total Broadband Service Revenue (Statista)
2010	281.1	51.6	–
2011	284.8	57.2	43.2
2012	285.7	63.1	46.5
2013	288.6	70.1	49.6
2014	296.8	73.0	52.4
2015	306.4	77.5	54.7
2016	325.6	86.3	56.4

Sources: U.S. Census Bureau, Service Annual Survey Latest Data (NAICS-Basis): 2016, *supra* note 60, tbl.4; U.S. Census Bureau, Service Annual Survey Historical Data, *supra* sources to Table 2, tbl.4; *Fixed Broadband Access Revenues in the United States from 2011 to 2021 (in Million U.S. Dollars)*, Statista, https://www.statista.com/statistics/280435/fixed-broadband-access-revenues-in-the-united-states/.

A comparison of U.S. Census Bureau data in Table 2 and Table 4 reveals that wireless and wireline services generated similar revenue, at least the same order of magnitude (in the tens of billions of dollars). But, as shown in Table 1, wireline data services accounted for the vast majority of data transmitted. On a dollar per megabyte basis, wireline data services are far more efficient than wireless data services.

In Table 5, I present various measures of wireline revenue per megabyte by dividing annual revenue from Table 4 by monthly non-cellular data traffic in Table 1 and dividing by 12. Revenue per megabyte of data has been consistently declining from 2010 to 2016. Wireline revenue per megabyte in Table 5 is one or two orders of magnitude smaller than the wireless revenue per megabyte reported in Table 3.

Table 5. Various Measures of U.S. Wireline Industry Revenue per Megabyte (USD)

	Total Service Revenue (Census)	Data Service Revenue (Census)	Total Broadband Service Revenue (Statista)
2010	0.0037	0.0007	–
2011	0.0026	0.0005	0.0004
2012	0.0019	0.0004	0.0003
2013	0.0016	0.0004	0.0003
2014	0.0014	0.0003	0.0002
2015	0.0011	0.0003	0.0002
2016	0.0009	0.0002	0.0002

Sources: U.S. Census Bureau, Service Annual Survey Latest Data (NAICS-Basis): 2016, *supra* note 60, tbl.4; U.S. Census Bureau, Service Annual Survey Historical Data, *supra* sources to Table 2, tbl.4; *Fixed Broadband Access Revenues in the United States from 2011 to 2021 (in Million U.S. Dollars)*, Statista, *supra* sources to Table 4.

Some care should be taken in interpreting the average revenue per megabyte information in Table 3 and Table 5. These values are average values across all consumers and across all service providers. Individual consumers generate varying average revenues per megabyte depending on many different factors, including carrier, choice of plan, and usage patterns. But it is a reasonable interpretation that, for the vast majority of consumers, average revenue per megabyte has been declining over time, and average revenue per megabyte for wireline tends to be much lower than for wireless.

Another point to consider is that these are *average* values, not *marginal* or *incremental* values that consumers might face in deciding whether to offload to Wi-Fi or use a cellular network. Although the average revenue per megabyte for wireline is less than 10 percent of the average revenue for wireless, the observed incremental price that many consumers actually face in the decision for Wi-Fi is zero. Of course, there are nuisance and transactional costs, as well as security concerns, in asking for a Wi-Fi password, entering it in one's wireless device, and then searching for the Wi-Fi signal. To many consumers, this transaction cost, usually measured in time, not money, is small relative to the wireless incremental price per megabyte. It is possible if not likely that the owner of the premises, say a coffee shop, increases the cost of every cup of coffee by a dime to pay for the Wi-Fi access. But most premises owners distribute the costs of Wi-Fi across all customers rather than target Wi-Fi users. Similarly, if a consumer purchases wireline broadband services at

home, he incurs a large monthly charge, but incremental gigabytes of data are usually free. Offices similarly incur large monthly fees but have unlimited Wi-Fi access. In each instance—coffee shop, home, or office—there might be a fixed, often non-monetary cost for the consumer to gain access to the Wi-Fi system, but incremental monetary costs of access are almost always zero.[64]

On the other hand, wireless plans, even "unlimited" plans,[65] often have caps above which either costs increase, quality decreases, or both. Below the cap, incremental data usage might have zero incremental cost. Above the cap, incremental costs can be quite high—certainly greater than the average revenue per megabyte values reflected in Table 3. Ordinary consumers might not closely monitor their data usage, but instead might use Wi-Fi offload both to preserve wireless usage for mobile applications later in the month and to avail themselves of the higher speeds available with Wi-Fi offload.

C. Over the Past Decade, More Mobile Data Are Transmitted over Wi-Fi than Have Remained on the Cellular Networks, and Most Wireless Services Are Used in a Nomadic or Fixed Environment

As discussed above, asking for a Wi-Fi password is a common and unremarkable occurrence these days. Many estimates find that 60 percent or more of mobile wireless device data usage is *offloaded* or transferred to Wi-Fi, where a wireline provider ultimately carries the data traffic.[66] As wireless traffic has become predominantly data, this means that most wireless services are offloaded in response to consumer perception of price and quality of service. Of course, when driving down a highway or walking along a road, Wi-Fi is usually not available. But the majority of use of wireless services is in a nomadic or sedentary environment; one estimate places 80 percent of wireless use indoors.[67] In homes, offices, and most public buildings—places where most individuals spend most of their time with their portable nomadic cell phones and tablets—Wi-Fi is available.

Wi-Fi offloading has been around since the advent of mobile data. In 2016 Wi-Fi offload accounted for 60 percent of mobile wireless device traffic *globally*, according to Cisco. It is unclear whether U.S. Wi-Fi offload is above

[64] Of course, the coffee shop owner, the homeowner, and the office owner pay for the fixed cost of Wi-Fi access. Comcast Business Internet has different tiers of service that it recommends depending on the number of users. *See, e.g.*, *Business Internet*, Comcast, https://business.comcast.com/internet/business-internet.

[65] Patrick Holland, *Verizon, AT&T, T-Mobile, and Sprint Unlimited Plans Compared*, CNET (Sept. 4, 2018), https://www.cnet.com/news/verizon-att-t-mobile-sprint-unlimited-data-plan-comparison/.

[66] The data discussed here are only from mobile wireless devices capable of being connected to a cellular network. Additional data from laptops, tablets, and other wireless devices without cellular network capability are transmitted over Wi-Fi.

[67] Letter from Colleen King, Vice President, Regulatory Affairs, Charter Commc'ns Inc., to Marlene H. Dortch, Secretary, Fed. Commc'ns Comm'n 2 (Oct. 18, 2017) [hereinafter Charter *Ex Parte* Letter], https://ecfsapi.fcc.gov/file/10182288220292/Charter%203.5%20GHz%20Ex%20Parte%20(10-18-17).pdf.

or below the global average. Some estimates place future Wi-Fi offload at 80 percent.[68] According to Charter Communications, 80 percent of wireless traffic is generated indoors, presumably not in a mobile environment.[69]

Based on various Cisco documents, in the first row of Table 6, I present the percentage of global wireless traffic that was offloaded to Wi-Fi between 2010 and 2016. As with all of the Cisco data, these figures represent data from devices that have access to cellular networks and exclude laptops and other devices that can communicate wirelessly with Wi-Fi networks but not cellular networks. As shown below, Wi-Fi offload grew from 21 percent of wireless traffic in 2010 to 60 percent of wireless traffic in 2016.

Table 6. Percent of Global Wireless Traffic Offloaded and Implied Volume of Offloaded Data (Petabytes)

	2010	2011	2012	2013	2014	2015	2016
Percent of Wireless Data Traffic Offloaded	21%	33%	33%	45%	45%	51%	60%
Implied Wi-Fi Offloaded in the United States	9	36	60	220	277	836	1715

Sources: Cisco Global Mobile Data Traffic Forecast Update, 2016–2021, *supra* note 43, at 19 fig.19; Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020, at 1 (2016), https://www.cisco.com/c/dam/m/en_in/innovation/enterprise/assets/mobile-white-paper-c11-520862.pdf (based on global handsets and tablets); Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014–2019, at 21–22 (2015), http://www.fastdas.com/uploads/3/4/7/6/34761169/cisco_white_paper_c11-520862.pdf (based on global handsets and tablets); Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013–2018, at 18 (2014), https://blog.acens.com/wp-content/images/cisco-global-mobile-data-2013%E2%80%932018-blog-acens.pdf (based on global handsets and tablets); Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017, at 11–12 (2013), http://boletines.prisadigital.com/Cisco_Visual_Networking.pdf (based on global handsets and tablets); Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011–2016, at 13 (2012), http://tmfassociates.com/blog/wp-content/uploads/2013/02/Cisco-mobile-VNI-Feb-2012.pdf (based on global handsets and tablets); Cisco Systems, Inc., Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015, at 11 tbl.7 (2011), http://tmfassociates.com/blog/wp-content/uploads/2013/02/Cisco-mobile-VNI-Feb-2011.pdf (based on U.S. smartphones); *see* sources cited in *supra* Table 1.

It is possible that the CTIA and Cisco data underestimate Wi-Fi offload. For example, based on 2010 data, Kyunghan Lee, Injong Rhee, Joohyun Lee,

[68] *See, e.g.*, Affirmed Networks, Inc., How, When and Wi-Fi: Weaving Wi-Fi into Your Network Experience Through Virtualization 1 (2017), https://affirmednetworks.com/wp-content/uploads/2017/12/Affirmed-Wifi-Solution-Brief.pdf.

[69] Charter *Ex Parte* Letter, *supra* note 67, at 2.

Song Chong, and Yung Yi estimate that more than 60 percent of mobile data were offloaded in that year, not the 21 percent found by Cisco.[70]

Assuming that the U.S. Wi-Fi offload rate is the same as the global rate, in the second row of Table 6, I present estimates of monthly Wi-Fi offload in the United States in petabytes. Wi-Fi offload grew from 9 petabytes in 2010 to 1715 petabytes in 2016.

The Wireless Broadband Alliance reached a similar conclusion. It reported that, as Juniper Research estimated, more than 60 percent of mobile data traffic globally would be offloaded onto Wi-Fi in 2017.[71] Cisco had a similar finding.[72] I found that, in 2015, 6 percent of total IP traffic globally (both wireline and wireless) was carried by cellular networks, 8 percent was carried on Wi-Fi systems from mobile offload, and 34 percent was carried on Wi-Fi from fixed offload.[73] Cisco predicts that almost half of all IP traffic globally, both wired and wireless, will be carried on Wi-Fi by 2020, far more than will be carried on cellular networks.[74] Most of this traffic will come from mobile devices such as smartphones. Cisco predicts that growth of data carriage on Wi-Fi will exceed growth of data on cellular networks.[75]

Based in part on the Cisco Visual Networking Index study, USTelecom projected that in 2016 only 4 percent of IP traffic in the United States was based on mobile wireless traffic, and that share was projected to grow to 7 percent by 2021.[76] Wi-Fi carriage of IP traffic in the United States, both from fixed and mobile sources, was projected to grow from 35 percent to 43 percent.[77]

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[70] Kyunghan Lee, Injong Rhee, Joohyun Lee, Song Chong & Yung Yi, *Mobile Data Offloading: How Much Can WiFi Deliver?*, 21 IEEE/ACM Transactions on Networking 536, 536 (2013).

[71] Press Release, Wireless Broadband Alliance, More than 60% of Global Mobile Data Traffic Will Be Offloaded onto WiFi Networks This Year (Apr. 4, 2017), https://www.wballiance.com/more-than-60-of-global-mobile-data-traffic-will-be-offloaded-onto-WiFi-networks-this-year/.

[72] Cisco Global Mobile Data Traffic Forecast Update, 2016–2021, *supra* note 43, at 19.

[73] *Id.* at 22 fig.23. The Cisco data are for global IP data, and are different from the U.S. data cited in Table 8.

[74] *Id.*

[75] *Id.*

[76] Brogan, *U.S. Internet Usage Continues to Expand*, *supra* note 56.

[77] *Id.*

Table 7. Average Monthly Data Usage by Plan Type, 2Q2018 from Strategy Analytics (Android Users) (Megabytes)

	No Data Plan or Pay as You Go	Data Plan with Monthly Allowance	Unlimited Data Plan
Cellular	887	1785	6493
	(8%)	(12%)	(31%)
Wi-Fi	10,004	13,499	14,310
	(92%)	(88%)	(69%)
Total	10,891	15,284	20,803

Source: Mike Dano, *How Much Data We're Using by Network, Operator and Service Plan*, FierceWireless (July 24, 2018), https://www.fiercewireless.com/wireless/how-much-data-we-re-using-by-network-operator-and-service-plan.

Strategy Analytics reports similar findings for Android users in the United States. In Table 7, I present the results of a Strategy Analytics survey of several thousand Android users in the United States in the second quarter of 2018. The results show that, for users with a pay-as-you-go or no data plan, 92 percent of data traffic was over Wi-Fi. For users with a monthly data allowance, 88 percent of data traffic was over Wi-Fi. For unlimited plan users, 69 percent of data traffic was over Wi-Fi.

Table 8. Distribution of IP Traffic in the United States in 2016

	Petabytes per Month	Percentage of Total
Cellular	1143	4%
Wireless Offload to Wi-Fi	1715	5%
Other Wi-Fi	4779	15%
Fixed Network	23,715	76%
Total	31,352	100%

Sources: Brogan, *supra* Table 1, at 4 Chart 3; *see* sources cited in *supra* Table 6; sources cited in *supra* table 1.

Comparing the results of Table 1 and Table 6, the data suggest that consumers prefer to offload data to Wi-Fi rather than use cellular data. But as shown in Table 8, in 2016, Wi-Fi offload was small relative to other forms of Wi-Fi data, which in turn was small relative to data on purely fixed networks. Table 8 also shows that all forms of Wi-Fi, both fixed and wireless offload, carried approximately 5 times as much data as cellular. This value is roughly

consistent with Nielsen findings that Android consumers use three times as much Wi-Fi as cellular data.[78]

Table 9. Distribution of Wireless Traffic in the United States in a Competitive Market Environment in 2016 (Petabytes per Month)

	Wi-Fi	Wireless Traffic Routed Through Cellular Network	Environment of Wireless Traffic
	[A]	[B]	[C] = [A] + [B]
Mobile	0	572	572
	(0%)	(100%)	(20%)
Fixed	1715	572	2286
	(75%)	(25%)	80%
Total	1715	1143	2858

Sources: *See* sources cited in *supra* Table 6; *see also* Charter *Ex Parte* Letter, *supra* note 67.
Note: Table 9 assumes Cisco's global Wi-Fi offload rate of 60 percent and information from Charter that 80 percent of wireless traffic is indoors.

If the Cisco figures in Table 6 are accurate, and if the Charter estimate that 80 percent of traffic is indoors, we have the results shown in Table 9 for the distribution in 2016 of the 2858 petabytes per month of wireless data in the United States in a competitive environment.[79] Eighty percent of wireless data, or 2286 petabytes per month, is represented as being indoors or in a fixed location and the remaining 572 petabytes per month of data is in a mobile environment. None of the wireless data in the mobile environment is offloaded. But 75 percent of the wireless data in a fixed environment is offloaded, accounting for the 60 percent of the total data figure represented in Table 6. Of the indoor data, 25 percent remains on a cellular network, for a total of 20 percent of wireless data traffic.

Table 9 also illustrates that, in 2016, 50 percent (572 petabytes per month) of cellular network traffic was carried in a mobile environment and 50 percent was in a fixed environment.

[78] *What Drives Data Usage?*, Nielsen (Nov. 22, 2016), http://www.nielsen.com/us/en/insights/news/2016/what-drives-data-usage.html.

[79] As with all of the Cisco data, these figures represent data from devices that access cellular networks and exclude laptops and other devices that can communicate wirelessly with Wi-Fi networks but not cellular networks.

C. Wi-Fi Capabilities in Wireless Devices Have Likewise Evolved and Become Ubiquitous

Wireless technology has changed substantially since the FCC adopted its product market definition, and it will continue to change. Each generation of wireless cellular technology is labeled with a number: 1G through 5G. The first cellular technologies capable of Internet access were 3G wireless technologies. The 4G technologies, which are widely deployed today and have been deployed for several years, have much faster speeds and greater data capacity than have prior 3G wireless technologies. Indeed, 4G technology today is largely associated with mobile data services. The 3G technologies were more commonly used in the period from 2008 to 2014 when the FCC most recently reviewed mergers involving wireless carriers.

Reporting in 2010 based on 2009 data, the FCC described the "plans" that various wireless carriers had for 4G rollout.[80] Within a few years, those plans had largely been implemented, and the vast majority of U.S. consumers had many choices for mobile data services.[81] Thus, the "mobile telephony/broadband" services definition was adopted ten years ago when 4G was not available. Wi-Fi capabilities in wireless devices have likewise evolved and have become ubiquitous.

The advances in cellular technologies from 3G to 4G and 5G might have suggested that wireless data would migrate from Wi-Fi offload to cellular networks. The opposite happened.

Wireless mobile technologies have advanced, as have Wi-Fi technologies under the broad 802.11 standards. New Wi-Fi technologies over the past decade have substantially increased both the speed and capacity of Wi-Fi services, making Wi-Fi offload more attractive relative to cellular services.[82] Cisco reported that average Wi-Fi speeds in 2016 in North America were twice the average mobile network speeds—27.4 Mbps compared with 13.7 Mbps.[83] New standards for 802.11ac include speeds of up to nearly 7 Gbps.[84]

In 2018, the focus of governmental attention for the wireless industry is on 5G. Every major carrier has plans for the deployment of 5G. The FCC's website has a separate area for 5G labeled "The FCC's 5G FAST Plan."[85] New wireless technologies—for example, 5G, LTE License Assisted Access

[80] *See* Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Fourteenth Report, WT Dkt. No. 09-66, 25 FCC Rcd. 11,407, 11,411–29 ¶ 4 (2010).

[81] *See* Twentieth Mobile Wireless Competition Report, *supra* note 7, at 9022 Chart III.D.4.

[82] *See, e.g.*, *802.11 Working Group Project Timelines*, Inst. Electrical & Electronic Engineers, *supra* note 48.

[83] Cisco Systems, Inc., The Zettabyte Era: Trends and Analysis, *supra* note 3.

[84] *See, e.g.*, *IEEE 802.11ac Gigabit Wi-Fi*, Electronics Notes, *supra* note 49; *see also 802.11ac Wave 2 FAQ*, Cisco, *supra* note 49.

[85] *The FCC's 5G FAST Plan*, Fed. Comms. Commission, https://www.fcc.gov/5G.

(LTE-LAA), and LTE Unlicensed (LTE-U)—increasingly combine the use of a wireless carrier's licensed spectrum with unlicensed spectrum.[86] Although in the future these new technologies will further improve a customer's wireless experience, consumers will still offload traffic onto Wi-Fi networks.

Equipment manufacturers are well aware that consumers are sensitive to price and quality of service in choosing between cellular networks and Wi-Fi offload. The vast majority of mobile communications devices—that is, handsets—are both cellular and Wi-Fi-capable. Many devices automatically search for Wi-Fi signals and notify the user which Wi-Fi signals are available. Switching from cellular networks to Wi-Fi, and vice versa, is easy.

D. New Technologies Do Not Appear to Lessen Demand for Wi-Fi Offload

New technologies do not appear to lessen the demand for Wi-Fi offload. Cisco sees 5G technology as requiring as much, if not more, offload than have prior wireless technology generations.[87] As Cisco reported in a blog post, "[c]ellular capacity constraints ensure the ongoing need for Wi-Fi."[88] Other new technological developments, such as cloud computing, IoT, satellite services, and autonomous vehicles, do not appear to lead to a reduction in demand for Wi-Fi offload. If anything, increasing demand for communications services will likely lead to greater demand for services such as Wi-Fi offload.

E. Cable Providers Are Challenging Wireless Carriers with Wi-Fi Offload and Other Wireless Services

Many firms have attempted to enter the wireless industry. For the past two decades, those entrants have included resellers, small regional operators, and municipal governments. Potential entrants in these three groups are still available, but the most serious form of entry in the past year has been by cable companies, which have been labeled as hybrid mobile network operators. Two such companies are already offering wireless services focused on Wi-Fi offload, and several others announced plans to offer such services soon.

Comcast began offering wireless services through Xfinity Mobile in 2017. The service network is based on using Wi-Fi hotspots in Comcast's service territory combined with resale of Verizon's mobile services. Xfinity Mobile,

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[86] *See* discussion below.

[87] Cisco Global Mobile Data Traffic Forecast Update, 2016–2021, *supra* note 43, at 20 fig.20.

[88] Arielle Sumits, *Top 5 Surprises from the 2017 Mobile VNI Study*, Cisco Blog (Feb. 7, 2017), https://blogs.cisco.com/sp/top-5-surprises-from-the-2017-mobile-vni-study.

which reported net line additions of 204,000 in the second quarter of 2018, ended the quarter with 781,000 total lines.[89]

Charter recently launched a similar plan called Spectrum Mobile.[90] Altice is planning a wireless service as well.[91] Google also offers wireless services to consumers.[92] Some observers suggest that other major corporations such as Amazon and Facebook might soon offer wireless services as well.[93]

Cable entry is not limited to consumer retail services. For example, Comcast also has an IoT offering that competes with IoT offerings from traditional wireless carriers.[94]

F. Consumers Are Sensitive to Price and Quality in Choosing Between Cellular Services or Wi-Fi Offload

Consumers are sensitive to price and quality of wireless services. As noted above, the ubiquity of the question about Wi-Fi passwords indicates that, when Wi-Fi is available, many consumers prefer Wi-Fi offload to the use of cellular networks.

Consumers can purchase wireless plans with less data and lower prices, or those whose more cellular service can purchase plans with more data capability or unlimited plans. As the relative price and quality of cellular and Wi-Fi services change, consumers rationally shift how they route their wireless data. When cellular prices fall and cellular quality increases, consumers shift to cellular network services. When Wi-Fi costs fall or Wi-Fi quality improves, consumers shift to Wi-Fi services. Over the past decade (and likely for years to come), consumers have benefitted from substantial improvements in both cellular and Wi-Fi services. During that time, consumers have shifted from predominantly using cellular network services to predominantly using Wi-Fi offload for their mobile wireless device traffic. The competition between Wi-Fi and cellular services offers choices to consumers.

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[89] *See* Mike Dano, *Comcast's Xfinity Mobile to Grow to 3.3M Customers by 2020, Analyst Predicts*, FierceWireless (Aug. 14, 2018), https://www.fiercewireless.com/wireless/comcast-s-xfinity-mobile-to-grow-to-3-3m-customers-by-2020-analyst-predicts.

[90] Ryan Hollander, *Charter Launches Spectrum Mobile*, Bus. Insider (July 6, 2018), https://www.businessinsider.com/charter-spectrum-mobile-mvno-service-2018-7.

[91] Chris Mills, *Sprint and Altice Are Teaming Up to Launch a New Wireless Carrier*, BGR (Nov. 6, 2017), http://bgr.com/2017/11/06/sprint-prepaid-plans-mvno-altice-cheap-wireless-carrier/.

[92] *Project Fi, A Phone Plan from Google*, Google, https://store.google.com/us/magazine/project_fi?hl=en-US.

[93] Jeff Kagan, *The Wireless Industry's Two Horse Race*, E-Commerce Times (May 30, 2018), https://www.ecommercetimes.com/story/85364.html.

[94] Press Release, Comcast Corp. & Neptune Technology Group Inc., Comcast's MachineQ and Neptune Collaborate on IoT Solution Designed to Accelerate Smart City Efforts (June 11, 2018), https://www.businesswire.com/news/home/20180611005652/en/Comcast's-machineQ-Neptune-Collaborate-IoT-Solution-Designed.

Wireless carriers in the United States offer unlimited data plans at higher prices than limited data plans.[95] Consumers on unlimited data plans are likely to respond by using cellular network services more than they would on a data-limited plan; a recent study reported by NPD Group finds that unlimited plan users consume 67 percent more data than limited plan users.[96] The NPD Group results are similar to those for Strategy Analytics presented in Table 7. Unlimited plan customers use cellular networks substantially more than customers on capped plans or pay-as-you go plans. As shown in Table 7, the unlimited plan consumers, on average, use more wireless data overall than other consumers.

The tradeoff between the costlier cellular network usage and Wi-Fi usage is well known and closely monitored. Not surprisingly, consumers who choose the lowest-price option, the pay-as-you-go services, use the high-cost cellular networks the least. Consumers who choose the highest-price option, unlimited plans, use cellular networks the most, and proportionately rely the least on Wi-Fi, although they frequently use Wi-Fi as well. All of this information indicates that consumers are economically rational and will substitute Wi-Fi for cellular service based on their respective costs (both monetary and otherwise) to the consumer.

III. A Hypothetical Monopolist Might Reveal that "Mobile Telephony/Broadband Services" Are Not a Separate Market

In this part, I discuss how an antitrust agency should examine whether "mobile telephony/broadband services" are a separate economic market or part of a larger market.

A. Academic Research

The primary publicly available empirical research on consumer demand cited in the proposed merger of AT&T and T-Mobile in 2011 was based on data from 2000 to 2001.[97] Economic analyses from as early as 2013 found that wireline

[95] Chris Holmes, *Best Unlimited Data Plans Around: Stop Paying Too Much*, WhistleOut (Nov. 1, 2018), https://www.whistleout.com/CellPhones/Guides/The-Best-Unlimited-Data-Plans-Around.

[96] Press Release, NPD Group, Unlimited Data Plan Users Consume 67 Percent More Cellular Data than Users on Limited Plans Consume (Dec. 27, 2017), https://www.npd.com/wps/portal/npd/us/news/press-releases/2017/unlimited-data-plan-users-consume-67-percent-more-cellular-data-than-users-on-limited-plans-consume/.

[97] AT&T-T-Mobile Staff Analysis and Findings, *supra* note 27, at 16,323 App. C n.24 (reporting an own-price elasticity of –0.36 and –0.51). These estimates are based on Mark J. Rodini, Glenn A. Woroch & Michael R. Ward, *Going Mobile: Substitutability Between Fixed and Mobile Access*, 27 Telecommunications Pol'y 457 (2003), which was based on data from 2000 to 2001.

and wireless services should be considered in the same market.[98] More recent developments with Wi-Fi offload strengthen the conclusion that wireless services are not a meaningful separate economic market but instead are part of the broader market for broadband services.

Academic economists have examined the price sensitivity of consumers of wireless services and have found consumers to be price sensitive. For example, Carlee Joe-Wong, Sangtae Ha, Soumya Sen, and Mung Chiang find that demand for wireless services is sensitive to prices.[99] Some academic economic studies have also examined whether fixed and mobile broadband are in the same market. For example, Lukasz Grzybowski, Rainer Nitsche, Frank Verboven, and Lars Wiethaus found that, in Slovakia, "[f]or a reasonable range of profit margins, this estimate [that is, an econometric estimate of own-price elasticity of demand] implies that mobile broadband should be included in the relevant antitrust market of fixed broadband."[100]

There have been remarkably few recent academic empirical studies of the market boundaries for wireless services, particularly between cellular network services and Wi-Fi offload. The detailed price and demand data necessary for a study of cellular services are not publicly available. Another reason, as discussed above, is that the actual prices consumers face in the decision of choosing Wi-Fi versus a cellular network are not visible.

B. Antitrust Analyses and Market Definitions

The FCC often looks to federal antitrust agencies for guidance on conducting market analyses. The federal antitrust agencies, the Federal Trade Commission and the DOJ, examine the concept of "relevant market" for antitrust analyses.[101] The concept of "relevant market" is dependent on consumer demand, and the firms that compete within a "relevant market" depend on available technologies. The Horizontal Merger Guidelines describe a hypothetical monopolist test to determine a relevant product market.[102] A hypothetical monopolist in a candidate product market "likely

[98] For a review and analysis, see Harold Furchtgott-Roth & Jeffrey Li, *Defining Relevant Markets for Mergers and Acquisitions Involving Communications Services* (Hudson Inst. Working Paper, 2013), https://www.hudson.org/content/researchattachments/attachment/1209/m121413.pdf.

[99] Carlee Joe-Wong, Sangtae Ha, Soumya Sen & Mung Chiang, *Do Mobile Data Plans Affect Usage? Results from a Pricing Trial with ISP Customers*, 16TH INT'L CONF. ON PASSIVE & ACTIVE NETWORK MGMT. 96 (2015); *see also* Soumya Sen, Carlee Joe-Wong, Sangtae Ha & Mung Chiang, *Time-Dependent Pricing of Mobile Data: Model, Systems, and Field Trials*, 42 ACM SIGCOMM COMPUTER COMM. REV. 247 (2012); Soumya Sen, Carlee Joe-Wong, Sangtae Ha & Mung Chiang, *Smart Data Pricing: Using Economics to Manage Network Congestion*, 58 COMM. ACM 86 (2015).

[100] Lukasz Grzybowski, Rainer Nitsche, Frank Verboven & Lars Wiethaus, *Market Definition for Broadband Internet in Slovakia—Are Fixed and Mobile Technologies in the Same Market?*, 28 INFO. ECON. & POL'Y 39 (2014).

[101] U.S. DEPARTMENT OF JUSTICE & FEDERAL TRADE COMMISSION, HORIZONTAL MERGER GUIDELINES 7–12 (2010), https://www.justice.gov/atr/file/810276/download.

[102] *Id.*

would impose at least a small but significant and non-transitory increase in price ('SSNIP') on at least one product in the market, including at least one product sold by one of the merging firms."[103]

If a hypothetical monopolist of a candidate market were to raise prices by a small amount for a non-transitory period and if that price change were profitable, the candidate market is plausibly a product market. If the hypothetical price change were not profitable (for example, if a significant number of customers would respond to the price increase by switching to another substitute product), the candidate market is not plausibly a product market. The application of the hypothetical monopolist test depends on at least (1) the incremental costs of the various firms in the candidate market, and (2) customer reactions to hypothetical increased prices. These customer reactions include reductions in demand for products in the candidate product market as well as increases in demand for products outside the candidate market. Information on incremental costs and the magnitude of consumer switching to other communications services are not publicly available. Below, I examine, to the extent possible based on recent public data, whether mobile services as used by the FCC are plausibly a separate antitrust market.

If a hypothetical monopolist of "mobile telephony/broadband services" were to raise prices, customers would have the following alternatives: (1) continue with the current pattern of demand and pay the higher price; (2) continue with the current provider but reduce demand for services by shifting to a less costly plan; (3) reduce demand for wireless data altogether; (4) switch to one of the new entrant carriers such as Xfinity Mobile or Spectrum Mobile; or (5) shift some or all mobile demand to a fixed or nomadic environment where the consumer would further have the following options: (1) switch to a landline carrier; (2) substitute more Wi-Fi for wireless services in the nomadic environment; or (3) switch all wireless data to Wi-Fi.

As cellular providers cannot effectively price discriminate between users in a mobile environment and those in a fixed environment, a price increase by a hypothetical monopolist would apply equally to customers in a mobile environment and those in a fixed environment. But consumer reaction to prices increases by a hypothetical monopolist need not be the same in a mobile environment as they are in a fixed environment. For the 80 percent (a percentage that could easily increase under a hypothetical monopolist) of wireless data demand in a fixed or nomadic environment, competing prices—often free for Wi-Fi—would remain unchanged. To the extent that Wi-Fi is a substitute for nomadic cellular data, as it almost certainly is, increasing the price of cellular data would increase demand for Wi-Fi and reduce demand for cellular data in a nomadic environment. In today's competitive

[103] *Id.* at 9.

market, the fixed environment represents approximately 50 percent of the demand on mobile wireless networks, a share that would almost certainly decrease under a hypothetical monopolist's efforts to raise prices. For much the same reason that a competitive carrier cannot profitably increase prices in a nomadic environment—it is difficult to compete with free—it would be unprofitable for a monopolist cellular carrier to increase prices in a nomadic or fixed environment.

In a mobile environment, representing roughly 20 percent of total wireless demand but 50 percent of cellular demand, as shown in Table 9, consumers facing a hypothetical monopolist would still have all five options listed above for responding to a price increase. Some demand for mobile services would certainly remain, and the issue ultimately is whether the profitability of a hypothetical monopolist raising cellular prices in a mobile environment could offset likely losses in a nomadic or fixed environment.

If the antitrust market included both cellular services and Wi-Fi services, and the hypothetical monopolist of both cellular and Wi-Fi services were to raise prices, wireless consumers would have no place to turn to escape the higher prices. That would be a plausible antitrust market. But if the antitrust market is limited to cellular services—"mobile telephony/broadband services," in the words of the FCC—consumers could avoid much of the effect on an increase in mobile services alone of a price increase by switching to Wi-Fi.

As shown in Table 7, consumers self-select whether to purchase a pay-as-you-go cellular plan or an unlimited cellular data plan or something in between. Not surprisingly, and as noted above, the consumers who purchase more costly plans use more cellular data than do other consumers, and the percentage of reliance on Wi-Fi declines with more costly plans. Consumers with all types of plans use Wi-Fi far more than cellular services, but the ratio is greatest for those consumers on the lowest-cost plans. Consumers are substituting Wi-Fi usage for cellular usage.

Consumer reaction to a hypothetical monopolist of cellular services raising prices could be a combination of responses. For example, if all cellular prices increased by 5 percent, a consumer on a $50 monthly plan today that was raised by 5 percent to $52.50 might switch to today's $40 plan that increased to $42. The lower-priced plan would likely have less cellular data capability and minutes, and the consumer would likely switch at least some wireless data to Wi-Fi. Thus, the response to the price increase of a hypothetical monopolist of cellular services would involve both a potential reduction in cellular data service usage and a potential increase in Wi-Fi usage.

Over the past decade, U.S. consumers have been switching wireless data demand from cellular services to Wi-Fi during a period when cellular service prices have been *falling* rapidly by almost any measure. How much more substitution would there be in the face of a price increase from a hypothetical

monopolist. One scenario where consumers would not be more inclined than they are at present to switch to Wi-Fi in the face of a price increase for cellular data services would be if the price of Wi-Fi services increased in the same manner as did the prices for cellular services.

Conclusion

The FCC should reconsider its use of a product market definition that does not account for the role of Wi-Fi in the market and that has been unchanged since 2008 when performing competitive analyses. The FCC's current definition is not based on any particular analysis, nor is it supported by empirical evidence. This product market definition is further inconsistent with the FCC's treatment and analysis of the mobile wireless marketplace in other contexts. This results in an obsolete understanding of competition in the market. Before conducting competitive analyses, the FCC should carefully examine relevant market definitions that include wireless carriers and ensure that they reflect the current practices and technologies. Wi-Fi offload and the businesses that provide it likely discipline prices of wireless services and should be considered part of the same economic market.