WiFi Helps Define the Relevant Market for Wireless Services

Harold Furchtgott-Roth • September 2018
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The Federal Communications Commission ("FCC") has recognized that WiFi 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. When reviewing proposed mergers, however, the FCC relies on a product market definition, "mobile telephony/broadband services," that has been unchanged for approximately a decade and does not account for the changed role of WiFi in the competitive marketplace. 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 WiFi has become a clear reflection of how Americans use wireless devices; (2) market conditions for wireless services have changed rapidly; (3) more data has migrated to WiFi—transmitting wireless data to a WiFi network—than has remained on the cellular networks, and most wireless services are used in both nomadic and fixed environments; (4) WiFi capabilities in wireless devices have evolved and become ubiquitous; (5) new technologies have not appeared to lessen demand for WiFi; (6) cable providers are challenging wireless carriers with WiFi and wireless services; and (7) consumers have become sensitive to price and quality in choosing between cellular services or WiFi. When the use of WiFi for consumer data offload is examined, a hypothetical monopolist test may reveal that "mobile telephony/broadband services" are not a separate market.

The FCC’s market definition was first adopted 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 Today, the technologies of 2008 and the associated market definitions are outdated, and new 5G technologies are being deployed. In this context, the FCC’s reliance on an outdated market definition results in an inaccurate understanding of competition in the market.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. WiFi, and the businesses that provide it, likely discipline prices of wireless services and are part of the same economic market.

This report has been underwritten by T-Mobile. The opinions expressed in this report are those of the author alone.
A. CONTEXT

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. Market definitions should therefore 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 Federal Communications Commission ("FCC") has used the same 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 WiFi is critical to this analysis.
B. WIFI

When a wireless user—effectively, everyone—goes for the first time to an office, home, school, restaurant, or any other public place in America, one of the first questions the user asks is: “What is the WiFi 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 WiFi network and bypass the wireless carrier’s network. Even if we don’t use—or even know—the term, “WiFi offload” is integral part of the day-to-day life of practically every American. Most of us simply call it “WiFi.” 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 WiFi system because doing so is usually incrementally free of charge, and more often than not offers a faster speed than the cellular network. The wireless user, then, asks for the WiFi password not out of indifference to the price and quality of communications services, but precisely out of sensitivity to price and to quality of service.

Price sensitivity is important in 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, i.e., how much demand for WiFi services changes in response to changes in the price and quality of cellular services while holding the price and quality of WiFi 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 WiFi password. To such users, cellular network services and WiFi are substitutes. This observation has implications when assessing competition in the market for mobile wireless or cellular services.
C. FCC REPORTS

Federal agencies sometimes define market boundaries to examine competitive conditions in those markets.

Each 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 and the deployment of broadband services, involve an assessment of the current reality of the dynamic wireless marketplace. In this context, the FCC has taken into account the role of WiFi. In fact, on different occasions, the FCC has asked the public to what extent wireless local access network (“WLAN”)-based data and VoIP services were considered to be complements to, or substitutes for, the mobile voice and data services offered over mobile wireless networks. It has also accounted for the competitive pressures exerted by hybrid WiFi/cellular services.

The FCC also routinely reviews transfers of licenses and permits, which often involve the merger of two firms. When engaging in this exercise, however, the FCC has relied on the same market definition it adopted in 2008, “mobile telephony/broadband services,” which ignores the reality of the wireless marketplace today, including, significantly, the role of WiFi. 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 Service

Up until this year, the FCC was statutorily required to prepare an annual Mobile Wireless Competition Report. 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.]
Some of the wireless competition reports specifically included discussions of WiFi. The 2009 competition report, for example, found WiFi and WLANs to be “playing an increasingly important role as a competitor and supplement” to commercial mobile services. By 2011, however, WiFi and WLANs are briefly discussed, not as competitors, but rather only as “complements” to mobile networks. Even in 2017, WiFi is only briefly discussed in the wireless competition report.

On March 23, 2018, the President 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, as amended (the “Act”), by eliminating the two sentences requiring the FCC to prepare an annual Mobile Wireless Competition Report. As a result, the Act now requires that the Commission 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. This exercise will result in a report that includes information from 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 WiFi.

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 requires regular (previously annual, now biennial) reports suggests an expectation that market conditions would not necessarily be the same, year-in and year-out. Yet, despite reassessing 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 engages in no empirical analysis to determine the boundaries of 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. 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 substitutes, an analysis that the Commission 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 WiFi, not because cellular network services and WiFi are technologically equivalent, but precisely because they are not. The FCC broadband deployment reports do not address WiFi, much less provide an economic analysis of whether WiFi is an economic substitute for cellular broadband services.
Some commenters have suggested to the FCC that wireline broadband and cellular broadband were substitutes, a position the FCC rejected. In fact, the FCC has set different standards for the definition of broadband service, for wireline services, and for cellular broadband services. This distinction indicates that the FCC expects cellular networks to have lower data speeds and capabilities than wireline networks.

3. FCC License Transfers and Merger Reviews

Historically, the FCC has not considered the effect of WiFi 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. 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.

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, SoftBank-Sprint, Verizon-SpectrumCo, AT&T-WCS, T-Mobile-MetroPCS, and AT&T-T-Mobile.
These orders, in turn, cite earlier orders such as AT&T-Qualcomm, AT&T-Verizon, AT&T-Centennial, and Nextel-Sprint-Clearwire. 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 WiFi.

In one proceeding, the Commission declined to adopt a narrower market definition, such as “value wireless services.”

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

In 2008, 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.” The risks of evaluating too narrow a market are no less today than they were in 2008. Indeed, they are likely greater.

The Commission’s market definition of “mobile telephony/broadband services” was not derived from econometric studies or detailed analyses of market information. The Commission did not rely upon measurements of demand elasticities, either own-price or cross-price elasticities of demand. To the contrary, the Commission’s definition was based 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,” once the Commission had adopted the “mobile telephony/broadband services” market definition, it has been reluctant to change it.

4. 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 today. 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. Let’s imagine that one wanted to pay today for a wireless handset and wireless service that were available in 2008. This would be impossible: wireless handsets have a shelf life of a few years, so one cannot purchase a 2008 wireless handset in a store. They are obsolete. So, too, are the wireless services they enabled through the wireless carriers of the last decade. In many markets, it is perfectly possible to purchase products or services that were available that many years before, 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, Verizon, Sprint, and T-Mobile.
There is another factor that directly affects the reasonableness of the “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 either were 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 WiFi, not cellular networks.

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

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

Ten years ago, 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. Today, the default use of wireless devices is more often through WiFi 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 this definition by the FCC has excluded discussion, much less inclusion, of WiFi.\textsuperscript{41}

There are at least two limitations to the Commission’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 WiFi, ensues.

Second, even if WiFi were considered to be “mobile,” WiFi often has the characteristic of either: (a) being free to the public for practical purposes;\textsuperscript{42} or (b) being private and not available to the general public. In either case, WiFi might not qualify as a “telecommunications service,”\textsuperscript{43} which is often considered available to the public for a fee, but economic market definitions are based on demand conditions, not limited to legal definitions.

WiFi is then a substitute to cellular networks. Where WiFi is available, the choice is to substitute faster and less costly WiFi for the slower and more costly cellular network. If WiFi were not a substitute, consumers would not bother to switch to WiFi whenever convenient. The fact that the two are substitutes can also be observed when, for example, parents choose to give their children a WiFi-only tablet to place voice calls and text family, instead of a device with a cellular connection for that same purpose.

At least five factors have made the substitution of WiFi for cellular network services more common today for mobile devices than when the FCC originally adopted its market definition. These factors are summarized in the graphic below and discussed in the next section.

---

**a) Growth in online demand for data**

Demand for broadband access has grown substantially since 2008.\textsuperscript{44}

**b) Improvements in WiFi technology**

WiFi has been available for decades, with new versions of 802.11 WiFi technology constantly updated.\textsuperscript{45} Data speeds and data capacity have increased substantially over the past decade. New standards for 802.11ac include speeds up to nearly 7 Gbps.\textsuperscript{46}

**c) Growing ubiquity of WiFi in the home**

WiFi is the norm, rather than the exception, in American homes with broadband. NCTA reports that nine out of ten broadband homes use WiFi.\textsuperscript{47}

**d) Growth of public WiFi hotspots**

Public WiFi 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 WiFi networks. For example, NCTA reported in 2016 that Cable WiFi Alliance hotspots increased from 50,000 in 2012, to 200,000 in 2013, to 500,000 in 2016.\textsuperscript{48}

**e) Growth of the WiFi-supported Internet of Things (“IoT”)**

The IoT is at least partially responsible for the growth of WiFi. In 2009, five billion devices were connected to the IoT; today, more than thirty-four billion devices are connected, largely through WiFi, and the number is growing rapidly.\textsuperscript{49}
In this section, I examine whether WiFi 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:

- Market conditions for wireless services have changed rapidly since the FCC adopted its product market definition;
- Over the past decade, more data has migrated to WiFi than has remained on the cellular networks, and most wireless services are used in both nomadic and fixed environment;
- WiFi capabilities in wireless devices have likewise evolved and become ubiquitous;
- New technologies do not appear to lessen demand for WiFi;
- Cable providers are challenging wireless carriers with WiFi and other wireless services; and
- Consumers are sensitive to price and quality in choosing between cellular services or WiFi.

Despite all these factors, the FCC has not updated the market definition of “mobile telephony/broadband services” in the past decade. Further, a hypothetical monopolist test may reveal that the “mobile telephony/broadband services” are not a separate market.
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 Commission 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 twenty-three times for data-capable units and more than fourteen times for smartphones. There is no reason to believe that the growth of average data use since 2016 has slowed.

Figure 1: Mobile Data Usage per Subscriber 2010-2016

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 Minutes, Messages, and Megabytes of Wireless Traffic

Although WiFi can be used for voice and messaging, the primary use today is for data. Most of the growth in wireless services in the United States between 2010 and 2016 was for cellular data services, not voice or texts. U.S. cellular data traffic increased from 388 petabytes in 2010 to 13,719 petabytes in 2016, a growth of thirty-five times between 2010 and 2016, and a growth of 42% between 2015 and 2016.
In Table 1, I present both cellular and wireline data growth in petabytes from 2010-2016. As the table shows, cellular data accounted for only 0.5% of total broadband data in 2010, climbing to 3.6% by 2016. USTelecom projects that this share will grow to 7% 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 than non-cellular data.

### Table 1


<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Cellular</th>
<th>Percentage of Total</th>
<th>Implied Non-Cellular</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>6,314</td>
<td>32</td>
<td>0.5%</td>
<td>6,282</td>
<td>99.5%</td>
</tr>
<tr>
<td>2011</td>
<td>9,351</td>
<td>72</td>
<td>0.8%</td>
<td>9,279</td>
<td>99.2%</td>
</tr>
<tr>
<td>2012</td>
<td>12,400</td>
<td>122</td>
<td>1.0%</td>
<td>12,278</td>
<td>99.0%</td>
</tr>
<tr>
<td>2013</td>
<td>15,162</td>
<td>269</td>
<td>1.8%</td>
<td>14,893</td>
<td>98.2%</td>
</tr>
<tr>
<td>2014</td>
<td>18,162</td>
<td>338</td>
<td>1.9%</td>
<td>17,824</td>
<td>98.1%</td>
</tr>
<tr>
<td>2015</td>
<td>23,443</td>
<td>803</td>
<td>3.4%</td>
<td>22,640</td>
<td>96.6%</td>
</tr>
<tr>
<td>2016</td>
<td>31,352</td>
<td>1,143</td>
<td>3.6%</td>
<td>30,209</td>
<td>96.4%</td>
</tr>
</tbody>
</table>

Cisco made a similar finding. Cisco found that, globally in 2015, 6% of total IP traffic (both wireline and wireless) was carried by cellular networks.

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, increasing by little more than 2% annually from approximately $160 billion in 2010 to $188 billion in 2016.

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.

### Table 2


<table>
<thead>
<tr>
<th>Year</th>
<th>a. Total Service Revenue (CTIA)</th>
<th>b. Total Service Revenue (Census)</th>
<th>b. Data Service Revenue (Census)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>159.9</td>
<td>199.2</td>
<td>x</td>
</tr>
<tr>
<td>2011</td>
<td>169.8</td>
<td>214.4</td>
<td>x</td>
</tr>
<tr>
<td>2012</td>
<td>185.0</td>
<td>225.4</td>
<td>62.9</td>
</tr>
<tr>
<td>2013</td>
<td>189.2</td>
<td>233.1</td>
<td>66.3</td>
</tr>
<tr>
<td>2014</td>
<td>187.8</td>
<td>251.8</td>
<td>77.4</td>
</tr>
<tr>
<td>2015</td>
<td>191.9</td>
<td>254.8</td>
<td>87.3</td>
</tr>
<tr>
<td>2016</td>
<td>188.5</td>
<td>262.7</td>
<td>99.0</td>
</tr>
</tbody>
</table>

According to the Census Bureau, revenue for wireless services has grown more than 4% annually between 2010 and 2016. For cellular data, annual revenue growth was more than 12% between 2012 and 2016. Both of these revenue growth values are substantially less than the growth in data transmitted. The Census Bureau, however, only began collecting cellular data revenue in 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 twelve. 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 approximately 20% from 2008 and 2016, average revenue per megabyte declined by more than a factor of ten between 2010 and 2016. Both the number of subscribers and the average megabytes per subscriber were increasing during this time period.

In addition, wireline revenue has not kept pace with increased data usage, which can be explained by consumer reliance on WiFi. 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%. Wireline data service revenue from the Census Bureau grew by nearly 9% annually during the same time period. Both of these revenue growth values are substantially less than the growth in data transmitted.

A comparison of Census Bureau data in Tables 2 and 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.

### Table 3.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Service Revenue (CTIA)</th>
<th>Total Service Revenue (Census)</th>
<th>Data Service Revenue (Census)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.41</td>
<td>0.51</td>
<td>x</td>
</tr>
<tr>
<td>2011</td>
<td>0.20</td>
<td>0.25</td>
<td>x</td>
</tr>
<tr>
<td>2012</td>
<td>0.13</td>
<td>0.15</td>
<td>0.04</td>
</tr>
<tr>
<td>2013</td>
<td>0.06</td>
<td>0.07</td>
<td>0.02</td>
</tr>
<tr>
<td>2014</td>
<td>0.05</td>
<td>0.06</td>
<td>0.02</td>
</tr>
<tr>
<td>2015</td>
<td>0.02</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>2016</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Source:
- b. Census Bureau, Service Annual Survey, 2012, Table 4, for 2012; Service Annual Survey, 2016, Table 4 for 2013-2016.
- x. Not collected.

Average prices for a megabyte (MB) of mobile data fell more than 70% from 2009-2011. 58 Average mobile revenues per MB of data fell further between 2012 and 2016: average total revenue per MB fell by more than 80%; average data revenue per MB fell by more than 60%. 59 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 2009-2016 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 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 twelve. Revenue per megabyte of data has been consistently declining from 2010-2016. Wireline revenue per megabyte in Table 5 is one or two orders of magnitude smaller than wireless revenue per megabyte in Table 3.

Some care should be taken in interpreting the average revenue per megabyte information in Tables 3 and 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 may face in deciding whether to offload to WiFi or to use a cellular network. Although the average revenue per megabyte for wireline is less than 10% of the average revenue of wireless, the observed incremental price that many consumers actually face in the decision for WiFi is zero. Of course, there are nuisance and transactional costs, as well as security concerns, in asking for the password, entering it in one’s wireless device, and then searching for the WiFi signal. To many consumers, this transaction cost, usually measured in time not currency, 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 WiFi access. But most premises owners distribute the costs of WiFi across all customers rather than targeting WiFi users. Similarly, if one purchases wireline broadband services at home, one incurs a large monthly charge, but incremental gigabytes of data are usually free. Offices similarly incur large monthly fees but have unlimited access. In all instances—coffee shop, home, or office—there may be a fixed, often non-monetary cost of gaining access for the consumer to the WiFi system, but incremental monetary costs of access are almost always zero. 60

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Service Revenue (Census)</th>
<th>Data Service Revenue (Census)</th>
<th>Total Broadband Service Revenue (Statista)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.0037</td>
<td>0.0007</td>
<td>x</td>
</tr>
<tr>
<td>2011</td>
<td>0.0026</td>
<td>0.0005</td>
<td>0.0004</td>
</tr>
<tr>
<td>2012</td>
<td>0.0019</td>
<td>0.0004</td>
<td>0.0003</td>
</tr>
<tr>
<td>2013</td>
<td>0.0016</td>
<td>0.0004</td>
<td>0.0003</td>
</tr>
<tr>
<td>2014</td>
<td>0.0014</td>
<td>0.0003</td>
<td>0.0002</td>
</tr>
<tr>
<td>2015</td>
<td>0.0011</td>
<td>0.0003</td>
<td>0.0002</td>
</tr>
<tr>
<td>2016</td>
<td>0.0009</td>
<td>0.0002</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

60
On the other hand, wireless plans, even “unlimited” plans, often have caps above which either costs increase, quality decreases, or both. If one is below the cap, incremental data usage may 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 may not monitor closely their data usage but instead use WiFi both to preserve wireless usage for mobile applications later in the month and to avail themselves of the higher speeds available with WiFi.

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

As discussed above, asking for the WiFi password is a common and unremarkable occurrence these days. Many estimates find that 60% or more of mobile wireless device data usage is offloaded or transferred to WiFi where a wireline provider ultimately carries the data traffic. 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, WiFi is usually not available. But the majority of use of wireless services is in a nomadic or sedentary environment; one estimate places 80% of wireless use indoors. In homes, offices, and most public buildings—places where most individuals spend most of their time with their portable nomadic cell phones and tablets—WiFi is available.

WiFi has been around since the advent of mobile data. In 2016, WiFi accounted for 60% of mobile wireless device traffic globally according to Cisco. It is unclear whether American WiFi traffic is above or below the global average. Some estimates place future WiFi traffic at 80%. According to Charter Communications, 80% of wireless traffic is generated indoors, presumably not in a mobile environment.

Based on various Cisco documents, in the first row of Table 6, I present the percentage of global wireless traffic that was offloaded to WiFi between 2010 and 2016.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>21%</td>
<td>33%</td>
<td>33%</td>
<td>45%</td>
<td>45%</td>
<td>51%</td>
<td>60%</td>
</tr>
<tr>
<td>2011</td>
<td>36</td>
<td>60</td>
<td>220</td>
<td>277</td>
<td>836</td>
<td>1,715</td>
<td></td>
</tr>
</tbody>
</table>

g. Based on global handsets and tablets, Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016-2021, February 7, 2017, Figure 19.
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 WiFi networks but not cellular networks. As can be seen, WiFi grew from 21% of wireless traffic in 2010 to 60% of wireless traffic in 2016.

It is possible that the CTIA and Cisco data underestimate WiFi. For example, based on 2010 data, K. Lee et al. estimate that more than 60% of mobile data were offloaded in that year, not the 21% found by Cisco.66

Assuming that the American WiFi rate is the same as the global rate, in the second row of Table 6, I present estimates of monthly WiFi in the United States in petabytes. WiFi grew from nine petabytes in 2010 to 1,715 petabytes in 2016.

The Wireless Broadband Alliance reaches a similar conclusion. It reports that Juniper Research estimated that, globally, more than 60% of mobile data traffic would be offloaded onto WiFi in 2017.67 Cisco had a similar finding.68 Cisco found that, globally in 2015, 6% of total IP traffic (both wireline and wireless) was carried by cellular networks, 8% was carried on WiFi systems from mobile offload, and 34% on WiFi from fixed offload.69 Cisco predicts that globally almost half of all IP traffic, both wired and wireless, will be carried on WiFi by 2020, far more than will be carried on cellular networks.70 Most of this traffic will come from mobile devices such as smartphones. Cisco predicts that growth of data carriage on WiFi will exceed that of growth of data on cellular networks.71

Based in part on the Cisco VNI study, USTelecom projected that in 2016 only 4% of IP traffic in the United States was based on mobile wireless traffic, and that share was projected to grow to 7% by 2021.72 WiFi carriage of IP traffic in the United States, both from fixed and mobile sources, was projected to grow from 35% to 43% over the same period.73

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% of data traffic was over WiFi. For users with a monthly data allowance, 88% of data traffic was over WiFi. For unlimited plan users, 69% of data traffic was over WiFi.

<table>
<thead>
<tr>
<th>Plan Type</th>
<th>No data plan or Pay as You Go</th>
<th>Data plan with monthly allowance</th>
<th>Unlimited data plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CELLULAR</strong></td>
<td>887</td>
<td>1,785</td>
<td>6,493</td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td>12%</td>
<td>31%</td>
</tr>
<tr>
<td><strong>WIFI</strong></td>
<td>10,004</td>
<td>13,499</td>
<td>14,310</td>
</tr>
<tr>
<td></td>
<td>92%</td>
<td>88%</td>
<td>69%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>10,891</td>
<td>15,284</td>
<td>20,803</td>
</tr>
</tbody>
</table>

Comparing the results of Tables 1 and 6, the data suggests that consumers prefer to offload data to WiFi rather than use cellular data. But as shown in Table 8, in 2016, WiFi was small relative to other forms of WiFi data, which in turn was small, relative to data on purely fixed networks. Table 8 also shows that all forms of WiFi, both fixed and wireless offload, carried approximately five times as much data as cellular. This value is roughly consistent with Nielsen findings that Android consumers use three times as much WiFi as cellular data.74
If the Cisco figures in Table 6 are accurate, and the Charter estimate that 80% of traffic is indoors is likewise correct, we have the results shown in Table 9 for the distribution in 2016 of the 2,858 petabytes per month of wireless data in the United States in a competitive environment. Eighty percent of wireless data, or 2,286 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% of the wireless data in a fixed environment is offloaded, accounting for the 60% of the total data figure represented in Table 6. Of the indoor data, 25% remains on a cellular network, for a total of 20% of wireless data traffic.

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

D. WiFi 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- 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 prior 3G wireless technologies. Indeed, 4G technology today is largely associated with mobile data services. The 3G technologies were more commonly used in the 2008-2014 period 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. Within a few years, those plans had been largely implemented, and the vast majority of Americans had many choices for mobile data services.
Thus the “mobile telephony/broadband” services definition was adopted ten years ago when 4G was not available. WiFi capabilities in wireless devices have likewise evolved and become ubiquitous.

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

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

The focus of governmental attention today for the wireless industry is on 5G. Every major carrier has plans for the deployment of 5G. The Commission’s website has a separate area for 5G labeled “Leading the World Towards a 5G Future.” New wireless technologies—e.g., 5G, LTE License Assisted Access (“LTE-LAA”) and LTE Unlicensed (“LTE-U”)—increasingly combine use of a wireless carrier’s licensed spectrum with unlicensed spectrum. While these new technologies will, in the future, further improve a customer’s wireless experience, consumers will still offload traffic onto WiFi networks.

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

E. New Technologies Do Not Appear to Lessen Demand for WiFi

New technologies do not appear to lessen the demand for WiFi. Cisco sees 5G technology as requiring as much, if not more, offload than prior wireless technology generations. As Cisco reported in a blog post, “[c]ellular capacity constraints ensure ongoing need for WiFi.” 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 WiFi. If anything, increasing demand for communications services generally will likely lead to greater demand for services such as WiFi.
F. Cable Providers Are Challenging Wireless Carriers With WiFi and Other Wireless Services

Many firms have attempted to enter the wireless industry. For the past two decades, those entrants included resellers, small regional operators, and municipal governments. Potential entrants from 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 “hybrid mobile network operators.” Two such companies are already offering wireless services focused on WiFi, and several others announced plans to offer such service soon.

Comcast began offering wireless services through Xfinity Mobile in 2017. The service network is based on using WiFi hotspots in Comcast’s service territory combined with resale of Verizon’s mobile services. Xfinity Mobile, which reported net line additions of 204,000 in the second quarter of 2018, ended the quarter with 781,000 total lines. Charter recently launched a similar plan called Spectrum Mobile. Altice is planning a wireless service as well. Google also offers wireless services to consumers. Some observers suggest that other major corporations, such as Amazon and Facebook, may soon offer wireless services as well.

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.

G. Consumers Are Sensitive to Price and Quality in Choosing Between Cellular Services or WiFi

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

Consumers can purchase wireless plans with less data for lower prices. Those who desire more cellular service can purchase plans with more data capability or unlimited plans. As the relative price and quality of cellular and WiFi 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 WiFi costs fall or WiFi quality improves, consumers shift to WiFi services. Over the past decade and likely for years to come, consumers have benefitted from substantial improvements in both cellular and WiFi services.
During that time, consumers have shifted from predominantly using cellular network services to predominantly using WiFi for their mobile wireless device traffic. The competition between WiFi and cellular services offers choices to consumers.

Wireless carriers in the United States offer unlimited data plans at higher prices than limited data plans. 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 at NPD.com finds that unlimited plan users consume 67% more data than limited plan users. The NPD.com 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 more costly cellular network usage and WiFi 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 (one exception would be prepaid customers who consume more cellular data because they lack a broadband connection at home and rely exclusively on their mobile broadband service to access the Internet). Consumers who choose the highest-price option, unlimited plans, use cellular networks the most, and rely proportionately the least on WiFi, although they frequently use WiFi as well. All of this information indicates that consumers are economically rational and will substitute WiFi for cellular service based on their respective costs (both monetary and otherwise) to the consumer.
In this section, 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 2000-2001 data. Economic analyses from as early as 2013 found that wireline and wireless services should be considered in the same market. More recent developments with WiFi 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 for wireless services and have found consumers to be price sensitive. For example, Joe-Wong et al. find demand for wireless services is sensitive to prices. There have been remarkably few recent academic empirical studies of the market boundaries for wireless services, particularly between cellular network services and WiFi.
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 WiFi 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. 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. A hypothetical monopolist in a candidate product market “likely 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.”

If a hypothetical monopolist of a candidate market were to raise prices by a small amount for a non-transitory period and that price change would be profitable, the candidate market is plausibly a product market. If the hypothetical price change would not be profitable (e.g., 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 the following: (1) 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 telephony/broadband 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 have the following further options: (a) switch to a landline carrier; (b) substitute more WiFi for wireless services in the nomadic environment; or (c) switch all wireless data to WiFi.

As cellular providers cannot effectively price discriminate between those users in a mobile 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 in a fixed environment. For the 80% (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 WiFi—would remain unchanged. To the extent WiFi is a substitute for nomadic cellular data, as it almost certainly is, increasing the price of cellular data would increase demand for WiFi and reduce demand for cellular data in a nomadic environment. In a competitive market today, the fixed environment represents approximately 50% 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% of total wireless demand but 50% of cellular demand in Table 9, consumers facing a hypothetical monopolist would still have all five options listed above to respond to a price increase. Some demand for mobile services would certainly remain, and the issue ultimately is whether the possible 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 WiFi services, and the hypothetical monopolist of both cellular and WiFi 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 WiFi.

As seen in Table 7, consumers self-select whether to purchase a pay-as-you go cellular plan, an unlimited cellular data plan, or something in between.

<table>
<thead>
<tr>
<th>Environment of Wireless Traffic (in petabytes per month)</th>
<th>Wi Fi</th>
<th>Wireless Traffic Routed Through Cellular Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td>572</td>
<td>0</td>
</tr>
<tr>
<td>Fixed</td>
<td>2,286</td>
<td>1,715</td>
</tr>
<tr>
<td>Total</td>
<td>2,858</td>
<td>1,715</td>
</tr>
</tbody>
</table>

Not surprisingly, and as noted above, the consumers who purchase more costly plans use more cellular data than other consumers, and the percentage of reliance on WiFi declines with more costly plans. Consumers with all types of plans use far more WiFi than cellular services, but the ratio is greatest for those consumers on the lowest-cost plans. Consumers are substituting WiFi 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%, a consumer on a $50 monthly plan today that got raised by 5% to $52.50 might switch to today’s $40 plan that went to $42. The lower priced plan likely would have less cellular data capability and minutes, and the consumer would likely switch at least some wireless data to WiFi. 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 WiFi usage.
When performing competitive analyses, the FCC should reconsider its use of a product market definition that does not account for the role of WiFi in the market and which has been unchanged since 2008. The FCC’s current definition is not based on particular analysis or 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. WiFi, and the businesses that provide it, likely discipline prices of wireless services and should be considered part of the same economic market.
Harold Furchtgott-Roth founded Furchtgott-Roth Economic Enterprises in 2003. He frequently comments on issues related to the communications sector of the economy. From 2001-2003, Mr. Furchtgott-Roth was a visiting fellow at the American Enterprise Institute where he completed the writing of A Tough Act to Follow, a book about the difficulties implementing the Telecommunications Act of 1996.

From 1997 through 2001, Mr. Furchtgott-Roth served as a commissioner of the Federal Communications Commission. In that capacity, he served on the Joint Board on Universal Service. He is one of the few economists to have served as a federal regulatory commissioner, and the only one to have served on the Federal Communications Commission.

Before his appointment to the FCC, he was chief economist for the House Committee on Commerce and a principal staff member on the Telecommunications Act of 1996. Earlier in his career, he was a senior economist with Economists Incorporated and a research analyst with the Center for Naval Analyses.

Mr. Furchtgott-Roth is a member of the Washington Legal Foundation’s Legal Policy Advisory Board. He is the coauthor of three books: Cable TV: Regulation or Competition, with R.W. Crandall, The Brookings Institution, 1996; Economics of A Disaster: The Exxon Valdez Oil Spill, with B.M. Owen et al., Quorum Books, 1995; and International Trade in Computer Software, with S.E. Siwek, Quorum Books, 1993.
would exclude all forms of WiFi which are neither
22 Applications of Celico Partnership dba
Verizon Wireless and SpectrumCo LLC and
Cox TMI, LLC For Consent To Assign AWS-1
Licenses, Memorandum Opinion and Order
23 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, 27 FCC Rcd
24 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, 28 FCC Rcd 2322 ¶ 28 (2013)
(“T-Mobile-MetroPCS”).
25 Applications of AT&T Inc. and Deutsche
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of Licenses and Authorizations, Order, 26
FCC Rcd 16184 (2011) (“AT&T-T-Mobile”); see
also Applications of AT&T Inc. and Deutsche
Telekom AG For Consent To Assign or Control
of Licenses and Authorizations, Staff Analysis
and Findings, 26 FCC Rcd 16184 (2011) (“Staff Analysis
and Findings”).
26 See Application of AT&T Inc. and Qualcomm
Incorporated For Consent To Assign Licenses
and Authorizations, Order, 26 FCC Rcd 17589 ¶¶
27 Applications of AT&T Inc. and Cellco
Partnership dba Verizon Wireless,
Memorandum Opinion and Order, 25 FCC Rcd
28 Applications of AT&T and Centennial
Communications Corp. For Consent to Transfer
Control of Licenses, Authorizations and
Spectrum Leasing Arrangements, Memorandum
Opinion and Order, 24 FCC Rcd 13915 ¶ 37
See, e.g., GCI-Alaska Wireless, SoftBank-Sprint, Verizon-SpectrumCo. See T-Mobile-MetroPCS. Subsequent FCC documents often cite AT&T-Centennial as the first use of the “mobile telephony/broadband” market definition, apparently because the Nextel-Sprint-Clearwire review also included a second separate market definition of fixed broadband. See, e.g., GCI-Alaska Wireless ¶ 35 n.110, SoftBank-Sprint ¶ 37 n.114. Nextel-Sprint-Clearwire ¶ 39. Id. See Section II.A below. AT&T Inc., Annual Report (Form 10-K) (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.”). Verizon Communications Inc., Annual Report (Form 10-K) (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.”). Sprint Corp., Annual Report (Form 10-K) (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…” and “technological 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.”). T-Mobile US, Inc., Annual Report (Form 10-K) (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 metropolitan 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.”). See Table 6 below. The WiFi analyzed here is from mobile devices only. A substantially greater amount of wireless data is transmitted over WiFi from WiFi-only devices such as laptops and tablets. See Cisco, Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016-2021, 18-19 (2017), https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.pdf (“Global Mobile Data Traffic Forecast Update”). Whether WiFi is a mobile service, and whether a WiFi device is a mobile or a fixed station, are semantic questions. See 47 U.S.C. § 153 (definitions). In particular, “The term ‘mobile station’ means a radio-communication station capable of being moved and which ordinarily does move.” Id. A WiFi 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 WiFi hotspot are mobile, the transmissions between the WiFi hotspot and the Internet likely are not. WiFi is being integrated into many fee-for-service offerings, such as Boingo and Google’s Project Fi. But in many instances, WiFi is not part of a fee-based service. 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”). See Section II.E below. See also Official 802.11 Working Group Project Timelines, IEEE, http://grouper.ieee.org/groups/802/11/Reports/802.11_Timelines.htm (last updated July 17, 2018) (“Working Group Project Timelines”). See, e.g., 80211.ac Gigabit WiFi, Electronic Notes, https://www.electronics-notes.com/articles/connectivity/wifi-ieee-802-11/802-11ac.php (last visited July 11, 2018) (“80211.ac Gigabit WiFi”). See also 80211ac Wave 2 FAQ, Cisco, https://www.cisco.com/c/en/us/solutions/collateral/enterprise-networks/802-11ac-solution/q-and-a-c67-734152.html (last updated June 20, 2018) (“802.11ac Wave 2 FAQ”). How Wi-Fi Has Changed America, NCTA (June 19, 2018), https://www.ncta.com/whats-new/how-wi-fi-has-changed-america. Public Wi-Fi Hotspots Hit 500,000, NCTA (July 20, 2016), https://www.ncta.com/Whats-new/public-wi-fi-hotspots-hit-500000. See, e.g., Broadband by the Numbers, NCTA, https://www.ncta.com/broadband-by-the-numbers (last visited Aug. 20, 2018). T-Mobile even advertises the use of WiFi offload for voice calls. See Wi-Fi Calling and Wi-Fi Extenders, T-Mobile, https://www.t-mobile.com/offers/wi-fi-calling-wi-fi-extenders (last visited Aug. 20, 2018).

Global Mobile Data Traffic Forecast Update.

Id., Figure 23.

Top-Line Survey Results.


Twentieth Report, Chart III.A.4.

Of course, the coffee shop owner, the homeowner, or the office owner pays for the fixed cost of the WiFi access. Comcast Business internet has different tiers of service that they recommend, depending on the number of users. See, e.g., Business Internet, Comcast, https://business.comcast.com/internet/business-internet (last visited Aug. 20, 2018).


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 WiFi.


Charter Letter.


Press Release, Wireless Broadband Alliance, More than 60% of mobile data traffic will be offloaded onto WiFi networks this year (Apr. 4, 2017), https://www.wblliance.com/>more-than-60-of-global-mobile-data-traffic-will-be-offloaded-onto-WiFi-networks-this-year/.

Global Mobile Data Traffic Forecast Update at 19.

Id., Figure 23. The Cisco data are for global IP data, and are different from the U.S. data cited in Table 8.

Id.

Id.

U.S. Internet Usage Continues to Expand.

Id.


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 WiFi networks but not cellular networks.


See Twentieth Report, Chart III.D.4.

94 For a review and analysis, see Harold Furchtgott-Roth & Jeffrey Li, Defining relevant markets for mergers and acquisitions involving communications services (Hudson Institute Working Paper Nov. 2013), https://www.hudson.org/content/researchattachments/attachment/1209/m121413.pdf.


97 Id.

98 Id. at 9.