



# The Evolution of Consumer Welfare in the Mobile Wireless Service Industry

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## I. Introduction

Economic performance does not happen in a policy vacuum. Whether by design or unintentional consequence, economic policies act to enhance or retard economic welfare in industries across the U.S. economy. The wireless telecommunications industry provides a prime example. From the outset of the mobile wireless industry in 1983, the Federal Communications Commission (FCC) has consistently embraced regulatory policies designed to encourage industry growth, innovation, and competition. In response to the FCC's so-called "light-touch regulation," the industry has flourished, and the quality of millions of consumers' personal and professional lives have been substantially enhanced. This *prima facie* success story notwithstanding, the FCC is currently considering the imposition of a more stringent regulatory regime, under a banner of "net neutrality." The merits of the proposed regulatory changes depend in considerable measure on the success or failure of the existing regulatory framework to produce consumer welfare gains.

Accordingly, the purpose of this paper is to engage in a more systematic assessment of the evolution of consumer welfare in the mobile wireless telecommunications industry in a "light-touch" regulatory environment. The analysis incorporates both traditional economic indicators of consumer welfare such as price levels and quality (Section II), but also extends this simple assessment by examining two more subtle, but vitally important, features of this industry that can profoundly impact consumer welfare. In particular, it examines (Section III) the evolution of service features offered by wireless carriers as they seek to satisfy the diverse preferences and demands of consumers of wireless services. This analysis finds that service options and features have expanded dramatically over time in this industry and that this expansion provides a multitude of new avenues for consumers to find value from purchasing wireless services. Next (Section IV), the paper examines the evolution of price structure: has the policy environment acted to restrain or expand the pricing options by which consumers can best satisfy their diverse needs? This analysis finds that in the wireless industry, pricing options available to consumers have substantially expanded over time, with consumers facing multiple pricing pathways by which they can match specific pricing plans to their individual needs. Collectively, the impact of the current policy environment on price levels, quality, the proliferation of service features, and expanded pricing options drive economic indicators of aggregate consumer welfare in the wireless industry.

Section V evaluates the cumulative effects that these industry features have produced on both current consumers and those of tomorrow. The results indicate that within the FCC's "light-touch" regulatory approach, today's wireless consumers are the beneficiaries of substantial consumer welfare gains. These gains are most directly manifest in the saturation of mobile service across virtually all consumers in the United States. Moreover, the interplay between the investments in the wireless industry's core network infrastructure and competition-driven price reductions, quality enhancements, proliferating service features, and pricing options has created a self-reinforcing cycle of increasing consumer benefits and technological improvements that assure further gains to consumer welfare on an ongoing basis. Finally, with the factual assessment of on-the-ground conditions in the mobile wireless service industry in hand, Section VI concludes with a brief reflection on the policy take-aways from this analysis.

## II. The Evolution of Quality and Price

A key input into the consumer welfare associated with consuming a product or service stems from the quality of the service being consumed. In some industries the evolution of quality is incremental, in others more dramatic. In the wireless industry, quality changes have been pronounced. Quality changes have occurred across both simply-observed and more subtle dimensions of the services offered by carriers. While subtle quality features such as expanding service features and pricing options are discussed in Sections III and IV below, available data reveal a clear picture of consumer welfare-enhancing quality change in the wireless industry.

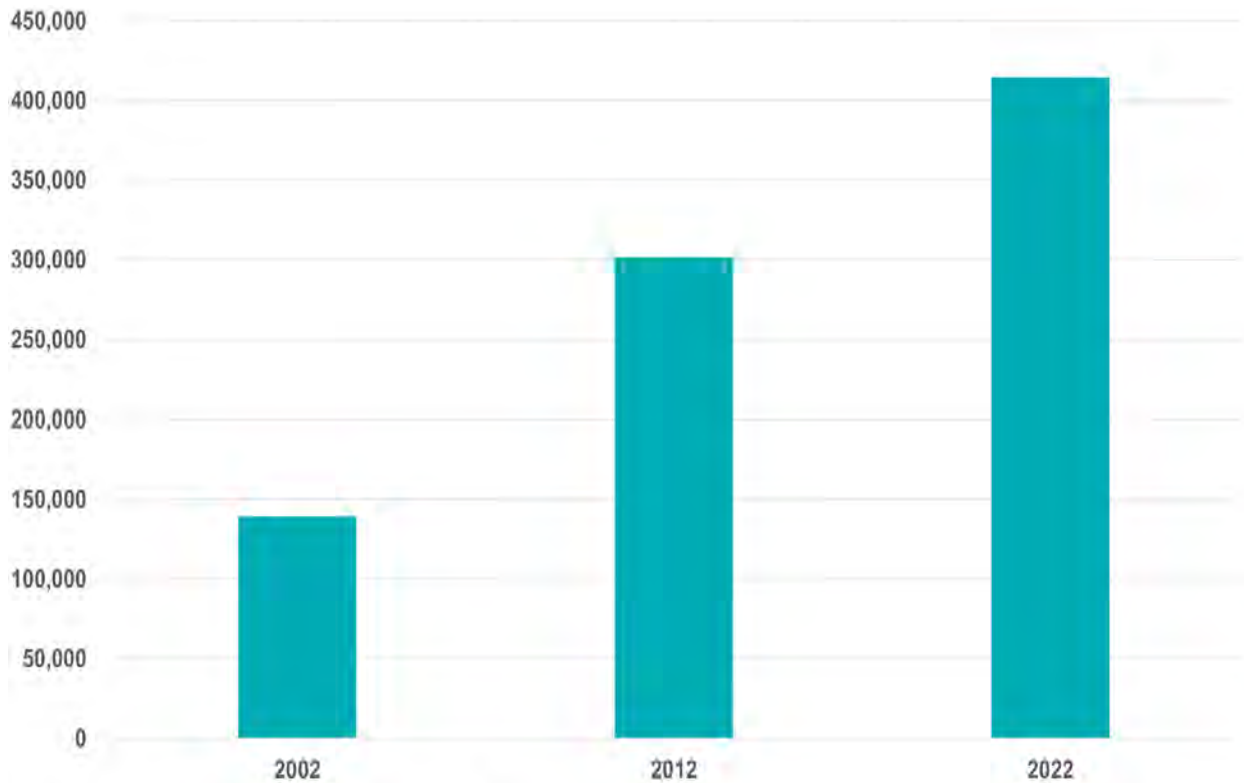
At the turn of the century, the infrastructure to provide wireless service was far from complete. As seen in Figure 1, the number of cell sites deployed nationally was only one-third the number today. The result was, as a survey conducted by the US Government Accountability Office in 2002 revealed, cell phone customers were experiencing “call quality problems, including a lack of coverage, limited network capacity at times, dropped calls, and poor sound quality.”<sup>1</sup> In the past 20 years, the number of cell sites deployed has tripled, increasing by more than 300,000 cell sites, with substantial improvements to cellphone coverage areas and reduction of dropped calls. Service that was limited to cities and major roadways twenty years ago now extends to the vast geographic regions of the country.<sup>2</sup> This expansion has substantially enhanced the quality of mobile wireless service, and has enhanced consumer welfare for wireless consumers.

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<sup>1</sup> United States General Accounting Office, “FCC Should Include Call Quality in Its Annual Report on Competition in Mobile Phone Services,” Telecommunications, GAO-03-501, April 2003.

<sup>2</sup> “Mobile LTE Coverage Map,” *Federal Communications Commission*, <https://www.fcc.gov/BroadbandData/MobileMaps/mobile-map> (accessed November 28, 2023).

**Figure 1**  
**Cell Sites in Commercial Use**



Sources: CTIA's Wireless Industry Indices Report, 2022, p. 53.

As the quality of wireless service has improved, one might expect prices to have increased as well. However, a review of both industry and government sources reveals that over the past decade or more, the opposite has occurred: the total cost of wireless services has dropped dramatically and marginal prices for additional usage have fallen to zero for the vast majority of wireless usage.

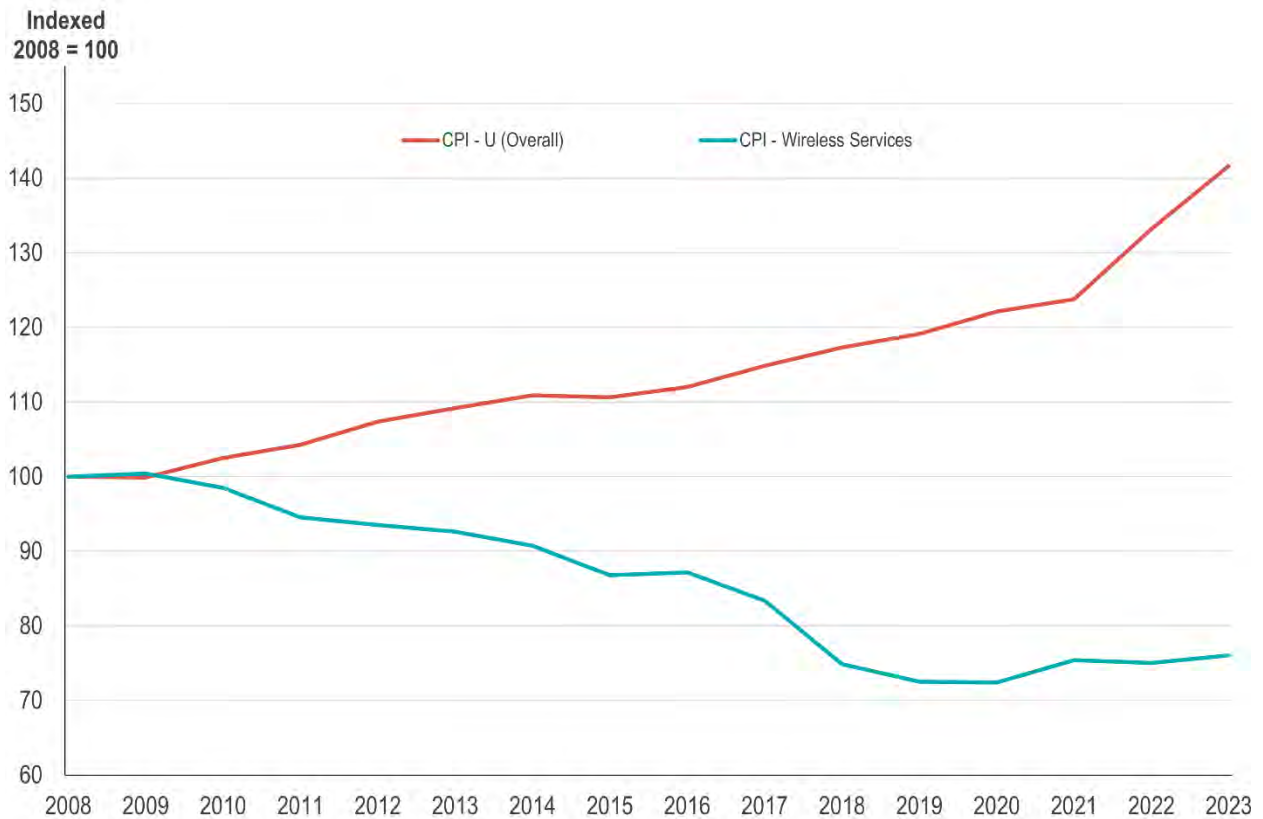
### **A. Bureau of Labor Statistics, Wireless Telephone Prices**

As part of its calculation of the overall Consumer Price Index (CPI), the Bureau of Labor Statistics (BLS) calculates a monthly price for a basket of wireless telephone services. This is defined as any “charges for personal wireless/cellular telephone services where the telephone is portable and sends and receives signals for calls through the airwaves.”<sup>3</sup> The indexed trend is shown in **Figure 2** alongside the overall CPI, from the beginning of 2008 to the beginning of 2023. Although prices for goods and services generally (shown in orange) have risen over

<sup>3</sup> “Measuring Price Change in the CPI: Telecommunications Services,” U.S. Bureau of Labor Statistics, <https://www.bls.gov/cpi/factsheets/telecommunications.htm> (accessed October 25, 2023).

this period, the real price of wireless service (shown in blue) has fallen by approximately 24% since 2008. Notably, during a period of pronounced inflation, December 2020 to December 2021, consumers faced price increases for 94% of goods and services, but prices for wireless devices and plans went down.

**Figure 2**  
**Indexed Price of Wireless Telephone Services vs. Overall CPI**



Sources: Bureau of Labor Statistics CPI series CUSR0000SA0 and CUUR0000SEED03.

## B. Average Revenue per Unit

Another, broader measure of consumer outlays for wireless goods and services is provided by an annual survey of the wireless industry. In particular, as part of its annual industry survey, CTIA gathers data that allows it to calculate the monthly average revenue per reported subscriber unit (ARPU). This measure provides a broader assessment of consumer expenditures than is calculated by the BLS as part of the CPI calculation. In particular, ARPU’s calculation of subscriber units includes phones, tablets, wireless broadband modems, and other

connected devices.<sup>4</sup> Figure 3 shows CTIA’s annual ARPU statistic from 2008 through 2022, adjusted for inflation. The trend shows real ARPU has been decreasing over the period, with the value in 2022 representing a 50% reduction from 2008, broadly consistent with the trend from the BLS.

**Figure 3**  
**Average Monthly Revenue per Subscriber Unit Adjusted to 2022 Dollars**



Sources: CTIA’s Wireless Industry Indices Report, 2022, p. 44; Bureau of Labor Statistics CPI series: CUSR0000SA0.

### III. Product Proliferation in the Mobile Wireless Service Industry

As seen in Section II, real prices for wireless telecommunications services, both narrowly and broadly defined, have declined precipitously over time. These declines provide direct gains in consumer welfare for existing consumers and generate additional consumer welfare by attracting new wireless consumers. The effects of these price declines on consumer welfare are quite intuitive: Consumers have benefited substantially from the evolution

<sup>4</sup> CTIA, "CTIA’s Wireless Industry Indices Report: Year-End 2020 Results," July 2021, p. 45.

of price levels in the mobile telephone industry. Above and beyond consumer gains associated with falling price levels, however, economic research has demonstrated that increased product variety can also be a significant source of consumer welfare gain, in some cases even eclipsing the gains from price reductions.<sup>5</sup> Accordingly, to better understand changes in consumer welfare that have emerged in the existing policy environment, it is important to examine the evolution of service features in the wireless industry.

Service plans for the earliest commercially available handsets offered only one feature: telephone (voice) calling, which was billed by the minute.<sup>6</sup> Over time, as technological advances have increased the capabilities of wireless devices and wireless networks, competition among service providers has led to the development of a vast array of service features and improved service quality. Today's consumers can choose connectivity options for a range of devices, in addition to mobile handsets, including tablets, vehicles, and other connected devices. These expanding connectivity options provide consumers with diverse portfolios of devices to tailor connectivity options that best satisfy their individual needs, with corresponding gains in consumer welfare.

Beyond growing connectivity options, service features in the wireless industry have moved well beyond the initial offering of "voice." Numerous service packages have come into existence, including (1) evolving core features, (2) video and audio streaming options, and (3) *de novo* additional features.

### A. Core Features (Calling, Texting, and Data)

Initially, the core feature of mobile wireless service was the ability to make and receive phone calls when away from a landline. SMS messaging (also known as text messaging) was introduced in the mid-1990s and broke through to mainstream use in 2001-2002.<sup>7</sup> In 2007, the number of text messages sent surpassed the number of calls made for the first time.<sup>8</sup> With today's IP-based wireless network technologies, mobile data is the most used service feature. IP-based networks have enabled a wide variety of functions including video streaming, social media browsing, and health monitoring. Nearly all wireless phone plans today include some combination of three core features: calling, texting, and data.

The types of service plans offered have also evolved. In the mid- to late 2000s, leading up to the launch of 4G, most providers offered monthly plans with buckets of minutes for calling. SMS and data options typically included pay-per-use (per message or per kilobit) or buckets of messages or data, and data was primarily marketed as an

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<sup>5</sup> Amil Petrin "Quantifying the Benefits of New Products: The Case of the Minivan," *Journal of Political Economy*, Vol. 110, No. 4, August 2002, pp. 705-729. Erik Brynjolfsson et. al., "Consumer Surplus in the Digital Economy: Estimating the Value of Increase Product Variety at Online Booksellers," *Management Science*, Vol. 49, No. 11 (November 2003): 1580-1596; Kelvin Lancaster, "The Economics of Product Variety: A Survey," *Marketing Science*, Vol. 9, No. 3, Summer, 1990, pp. 189-206.

<sup>6</sup> Marguerite Reardon, "Cell phone industry celebrates its 25th birthday," *CNET*, October 13, 2008, <https://www.cnet.com/tech/mobile/cell-phone-industry-celebrates-its-25th-birthday/> (accessed March 29, 2022).

<sup>7</sup> Alexa Lemzy, "When was texting invented: from Telegraphs to Enterprise SMS," *TextMajic* (blog), June 11, 2019, <https://www.textmagic.com/blog/the-history-of-texting-from-telegraphs-to-enterprise-sms/> (accessed March 29, 2022).

<sup>8</sup> Alexa Lemzy, "When was texting invented: from Telegraphs to Enterprise SMS," *TextMajic* (blog), June 11, 2019, <https://www.textmagic.com/blog/the-history-of-texting-from-telegraphs-to-enterprise-sms/> (accessed March 29, 2022).



add-on.<sup>9</sup> Carriers experimented with unlimited calling, texting, and data plans in the late 2000s, but due to network limitations at the time, most reverted to bucketed data plans in 2010 and 2011. By the late 2010s, 4G-LTE allowed service providers to offer more robust unlimited data plans.<sup>10</sup> Today, consumers can choose from a variety of unlimited plans that allow them to tradeoff between cost and data speeds.<sup>11</sup>

In addition, consumers now have options for a wide variety of feature packages to suit their individual needs. For example, flip phone owners who don't need cellular data can choose from a number of call and text only plans, and those who want high speed internet on their tablets, for example, but don't need traditional calling service can select from a number of data-only plans.<sup>12</sup> These data-only plans are taking up an increasing share of overall wireless connections. A CTIA survey last year found 42 percent of wireless connections are now data-only devices, up from 32% in 2017 and 15% in 2013.<sup>13</sup> These connections provide service to a wide range of consumer and enterprise devices—many laptops, smart watches, and cars are now sold with a cellular data plan. Connected point-of-sale devices allow for mobile payments and business management. Today, 5G networks are increasingly able to support dense deployments of Internet of Things (IoT) devices, which include these data-only devices, helping provide solutions for smart city tools, fleet management, utility monitoring, and precision agriculture.

## B. Video and Audio Streaming

Many of the top-tier plans offered by major carriers today come bundled with subscriptions or discounts for video and audio streaming services, e.g., Netflix, Apple TV, Hulu, or Apple Music.<sup>14</sup> In addition to specific streaming platform partners, mobile operators differentiate their offerings and plan tiers in terms of streaming quality. As recently as six years ago, many carriers offered streaming which did not count against contract data limits, but as the majority of plans with streaming perks today are unlimited, customers now have a range of plan options with no

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<sup>9</sup> Federal Communication Commission, "Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services," Twelfth Report, WT Docket No. 07-71, January 28, 2008, pp. 55-56, 58-59.

<sup>10</sup> Federal Communication Commission, "Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services," Twentieth Report, WT Docket No. 17-69, September 26, 2017 (Hereafter referred to as "FCC 2017 Mobile Report"), pp. 36-37.

<sup>11</sup> "Compare our unlimited data plans," AT&T, <https://www.att.com/plans/unlimited-data-plans/> (accessed October 25, 2023) (hereafter "AT&T Postpaid Tiers"); "Compare Plan Details," T-Mobile, <https://www.t-mobile.com/plan-details> (accessed October 25, 2023) (hereafter "T-Mobile Postpaid Tiers"); "Compare Our Best Prepaid Phone Plans," T-Mobile Prepaid, <https://prepaid.t-mobile.com/prepaid-plans> (accessed April 4, 2022) (hereafter "T-Mobile Prepaid Tiers"); "myPlan: Best Unlimited Data Cell Phone Plans for You," Verizon, <https://www.verizon.com/plans/unlimited/> (accessed October 25, 2023) (hereafter "Verizon Postpaid Tiers"); "Unlimited Talk & Text 5G & 4G LTE Cell Phone Plans," Cricket Wireless, <https://www.cricketwireless.com/cell-phone-plans> (accessed March 23, 2022) (hereafter "Cricket Wireless Tiers").

<sup>12</sup> Kelsey Sheehy and Tommy Tindall, "Best Basic Cell Phone Plans 2022," NerdWallet, March 7, 2022, <https://www.nerdwallet.com/article/finance/basic-cell-phone-plans> (accessed March 30, 2022); "Data-only Plans for Tablets, Mobile Hotspots and Other Devices," AT&T, <https://www.att.com/support/article/wireless/KM1048698/> (accessed April 4, 2022); "Data Plans for Hotspots, Tablets & Smartwatches," T-Mobile, <https://www.t-mobile.com/cell-phone-plans/affordable-data-plans> (accessed April 4, 2022); "Get a Low Monthly Plan for all your Connected Devices," Verizon, <https://www.verizon.com/plans/devices/tablets/> (accessed April 4, 2022); "Data Plans for Hotspots, Tablets & Smartwatches," T-Mobile, <https://www.t-mobile.com/cell-phone-plans/affordable-data-plans> (accessed April 4, 2022); "Simply Data Plans," Cricket Wireless, <https://www.cricketwireless.com/support/plans-and-features/data-only-plans.html> (accessed April 4, 2022).

<sup>13</sup> "2022 Annual Survey Highlights," September 13, 2022, CTIA, <https://www.ctia.org/news/2022-annual-survey-highlights>.

<sup>14</sup> AT&T Postpaid Tiers; T-Mobile Postpaid Tiers; Verizon Postpaid Tiers; Cricket Wireless Tiers.

data limits.<sup>15</sup> In some instances, operators continue to offer streaming video at a lower bitrate that does not count against a threshold after which a connection may be limited during moments of network congestion in the user's area. This is an important tool for operators to manage the volume of data traffic flowing over any particular cell site at a given time, while providing consumers access to the content they desire. Even pre-paid unlimited plans generally offer a set amount of high-speed data, after which speeds are limited to preserve shared capacity, and do not charge overage fees for going over a cap.<sup>16</sup>

In addition to streaming subscriptions, customers have the choice between standard definition video streaming, which is sufficient for viewing on a handheld device, or high definition, offered with top tier plans, which allows users to view high quality video on a large television screen.<sup>17</sup>

Today mobile plans are generally unlimited, with some operators instituting “soft caps” whereby data speeds or video resolution may be limited under certain conditions. Prior public policy discussions focused on earlier, “hard” data caps, which would limit data connectivity regardless of whether or not the network was congested, and practices exempting particular services from those caps (“zero-rating”). The economic literature has supported zero-rating and other free data services as generally welfare maximizing.<sup>18</sup> This is true for both mobile and fixed services, but networks depending on limited wireless spectrum particularly benefit from various usage-based pricing mechanisms. Data caps, whether soft or hard, and usage-based pricing can help manage congestion, ration scarce capacity, and create powerful incentives for network operators to efficiently use limited resources to provide the most output in terms of services that consumers demand—generally more access to data-intensive services like streaming video.

Streaming video also plays a key role in the competitive dynamics around Fixed Wireless Access (FWA), discussed more generally in Section IV below. With the cable and wireless industries increasingly competing directly for broadband customers, the video component of the bundle is a core source of dynamic competition driving innovation to consumers' benefit.<sup>19</sup> Although FWA is a relatively new vehicle for households to receive streaming video, there is every reason to expect that this competitive option will increase consumer welfare as it has with mobile telephony.

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<sup>15</sup> FCC 2017 Mobile Report, p. 37; AT&T Postpaid Tiers; T-Mobile Postpaid Tiers; Verizon Postpaid Tiers; Cricket Wireless Tiers. This type of streaming arrangement is also undertaken voluntarily for public services, for example major carriers have entered into partnerships with the U.S. Department of Veterans Affairs (VA) to allow eligible subscribers to access to the “VA Video Connect” telehealth app using cellular data that doesn't count against plan limits. The app allows veterans and their caregivers to meet with VA health care providers via a computer, tablet or mobile device. See “Use VA Video Connect Without Cellular Data Charges,” *U.S. Department of Veterans Affairs*, <https://mobile.va.gov/cellular-data-program> (accessed March 30, 2022).

<sup>16</sup> “AT&T PREPAID,” *AT&T*, <https://www.att.com/prepaid/> (accessed April 4, 2022) (hereafter “AT&T Prepaid Tiers”); T-Mobile Prepaid Tiers; “Prepaid Phone Plans,” *Verizon*, <https://www.verizon.com/plans/prepaid/> (accessed April 4, 2022) (hereafter “Verizon Prepaid Tiers”).

<sup>17</sup> AT&T Postpaid Tiers; T-Mobile Postpaid Tiers; Verizon Postpaid Tiers.

<sup>18</sup> See William P. Rogerson, “The Economics of Data Caps and Free Data Services in Mobile Broadband,” (August 17, 2016), <https://api.ctia.org/docs/default-source/default-document-library/081716-rogerson-free-data-white-paper.pdf>.

<sup>19</sup> See e.g., Mike Dano, “Bundles emerge as a critical weapon in the US cable-wireless war,” *LightReading*, November 14, 2022, <https://www.lightreading.com/fixed-wireless-access/bundles-emerge-as-a-critical-weapon-in-the-us-cable-wireless-war>, (accessed November 13, 2022).

## C. De Novo Additional Features

In addition to the core wireless features, carriers have increasingly introduced new additional features to attract consumers and in so doing have acted to enhance consumer welfare. Some of these *de novo* features now come standard with select service packages, while others can be added for a fee. Examples of these new features abound:

- **Hotspot options:** Many plans today include a hotspot feature which allows customers to use their wireless device as an internet source for non-connected devices. Hotspot options for unlimited plans typically include a set quantity of high-speed data, ranging from 3 to 60 GB, and unlimited but slowed data after the limit is reached. Plans with fixed data caps and hotspot capabilities typically count hotspot data use toward the total data limit.<sup>20</sup>
- **Security features:** All major carriers now include some form of security features for free with their wireless plans. These include a combination of behind-the-scenes security technologies that proactively detect and prevent threats, with optional security apps that can be used to customize robocall protection, manage blocked caller lists, and receive data breach alerts. Some carriers also include apps to assist with the physical security of devices, allowing customers to remotely sound an alarm, locate their device on a map, and automatically save the device's location before the battery dies. Carriers also offer premium paid versions of these apps that include additional features such as identity theft monitoring, antivirus scans, and theft alert emails.<sup>21</sup>
- **International plan options:** All major carriers today offer plans that allow subscribers to access voice, text, and data services in Mexico and Canada at no additional cost. Many carriers also include these features in certain prepaid offerings.<sup>22</sup> For travel outside of North America, major carriers offer temporary international plans at a daily rate or monthly for longer trips.<sup>23</sup> Some plans also include in-flight Wi-Fi on airplanes.<sup>24</sup>
- **Visual voicemail and voicemail to text:** Carriers today have now also introduced “Visual voicemail” (VVM) applications, which display voicemails in a list, allowing the customer to play or delete them in any order. Some VVM applications feature “Voicemail to text” (VTT), which provides a text transcription of some or all of each voicemail. Some smartphones offer these capabilities regardless of provider and

<sup>20</sup> AT&T Postpaid Tiers; T-Mobile Postpaid Tiers; Verizon Postpaid Tiers; Cricket Wireless Tiers; AT&T Prepaid Tiers; T-Mobile Prepaid Tiers; Verizon Prepaid Tiers.

<sup>21</sup> “T-Mobile Scam Shield App,” *T-Mobile*, <https://www.t-mobile.com/benefits/scam-shield> (accessed November 12, 2023); “Lookout Mobile Security app,” *T-Mobile*, <https://www.t-mobile.com/support/devices/lookout-mobile-security-app> (accessed November 12, 2023); “AT&T ActiveArmor & Mobile Security Apps,” *AT&T*, <https://www.att.com/security/security-apps/> (accessed November 12, 2023); “Verizon Call Filter,” *Verizon Wireless*, <https://www.verizon.com/solutions-and-services/call-filter/> (accessed November 12, 2023).

<sup>22</sup> AT&T Postpaid Tiers; T-Mobile Postpaid Tiers; Verizon Postpaid Tiers.

<sup>23</sup> “International Calling and Data Plans,” *AT&T*, <https://www.att.com/international/> (accessed April 4, 2022); “International Plans: TravelPass,” *Verizon*, <https://www.verizon.com/plans/international/international-travel/> (accessed April 4, 2022).

<sup>24</sup> See “In-Flight WiFi,” *T-Mobile*, <https://www.t-mobile.com/benefits/travel/in-flight-wifi> (accessed November 13, 2023).

plan. Customers with other handsets have the option to purchase the capabilities from their service provider. Basic VVM is typically provided for free, and some providers offer VTT for an extra charge.<sup>25</sup>

In sum, although the most obvious source of consumer welfare gains within the existing policy environment have been from price reductions and obvious quality improvements, the less obvious evolution of core features of wireless service, the growth of video and audio streaming, and the introduction of a raft of new features available to wireless consumers today have produced substantial additional gains to consumer welfare in the wireless industry.

## IV. Pricing Options Proliferation in the Wireless Services Industry

Over the years, mobile carriers have been driven to both tailor and expand their service offerings to increasingly diverse and heterogeneous consumers. As these plans have proliferated, consumers also have enjoyed an increasingly wide array of pricing options from which to choose. This proliferation of available pricing options has created yet another vehicle for enhanced consumer welfare in the wireless services industry. Pricing options have spread throughout the range of wireless services, including for both prepaid and postpaid services and over the full range of quality tiers. The proliferation of pricing options has additionally created options for discounted wireless services for select consumer groups and for devices that accompany wireless services. These are reviewed below.

### A. Prepaid vs. Postpaid

Pricing options fall under two main umbrellas, postpaid and prepaid. Postpaid plans were the earliest offerings and are still the most common in the U.S. market today. In a traditional postpaid arrangement, the customer signs up for wireless service then pays for the amount of the service used at the end of regular billing periods, the way most people pay for electricity or water. Although today's unlimited plans don't typically incur additional charges during the billing period, payment is still made after the service is used. Postpaid plans may also come bundled with a new handset to be paid off in installments, factored into the monthly bill. Because postpaid plans provide services, and possibly hardware, prior to receiving payment, service providers typically require that a prospective postpaid customer pass a credit check.

Prepaid plans, introduced in the 1990s, allow customers to purchase a bundle of services *prior* to use.<sup>26</sup> With upfront payment eliminating the need for a credit check, prepaid plans provide service to "consumers with tight budgets or poor credit histories who traditionally would have been rejected [for postpaid] service."<sup>27</sup> Some prepaid

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<sup>25</sup> "Set Up and Use Visual Voicemail," *AT&T*, <https://www.att.com/support/article/wireless/KM1009152/> (accessed April 4, 2022); "T-Mobile Visual Voicemail app," *T-Mobile*, <https://www.t-mobile.com/support/plans-features/t-mobile-visual-voicemail-app> (accessed April 4, 2022); "Visual Voicemail FAQs," *Verizon*, <https://www.verizon.com/support/visual-voice-mail-faqs/> (accessed April 4, 2022).

<sup>26</sup> The patents covering the invention of prepaid service are: US-5291543-A (filed in 1990 and awarded in 1992) and US-5148472-A (filed in 1992 and awarded in 1994).

<sup>27</sup> Federal Communication Commission, "Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services," Second Report, March 25, 1997, p. 15.

plans in the early 2000s targeted youth specifically.<sup>28</sup> Competition in the early 2000s drove a proliferation in prepaid plans and a reduction in prices as nationwide providers moved into the prepaid segment.<sup>29</sup> All of the major carriers today offer prepaid options.<sup>30</sup>

Over time, as postpaid offerings have shifted away from metered services, carriers have begun offering high-end prepaid plans that are very similar to their postpaid offerings. For example, AT&T's postpaid Value Plus and prepaid Unlimited plans both offer unlimited 5G data that may be throttled when networks are busy, as well as unlimited talk and text and SD streaming for \$50 a month.<sup>31</sup>

## B. Entry-Level vs. Mid-Level vs. Flagship Tiers

Today, the major wireless carriers each offer three or four tiers of postpaid plans ranging from entry-level, to mid-level, to flagship plans. The higher-tiered plans provide customers with higher quality core features plus additional features and have higher prices, while less robust tiers have lower prices. Figure 4 below shows current plan offerings in the top three tiers from three major operators. Pricing for these tiers is shown in Figure 5; for each plan, the monthly price per line decreases if customers buy additional lines.

These same carriers also offer tiers of prepaid service; the number of tiers, however, is typically greater and often includes a very inexpensive basic option which comes with commensurately fewer features. Generally, these carriers offer at least one prepaid basic "talk and text" plan, at least one tier of talk and text with fixed data amounts, and at least one unlimited tier. Discounts for prepaid plans are applied by the number of months that have been purchased forward; plan durations extend from 1 month to 12 months. In addition to carriers' tiering structures, most plans provide the option to purchase add-on features or the ability to bundle with data plans also offered by the service provider.

Beyond the major vertically integrated wireless carriers that own major portions of their telecommunications networks (known as Mobile Network Operators, or MNOs), there are approximately 60 Mobile Virtual Network Operators (MVNOs).<sup>32</sup> MVNOs are wireless service providers that themselves do not own wireless network facilities, but instead buy wholesale minutes, data, and texts from one of the MNOs as a means to provide service. The MVNOs then resell the purchased minutes, data, and text to consumers under their branded service.<sup>33</sup>

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<sup>28</sup> Federal Communication Commission, "Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services," Ninth Report, WT Docket No. 04-111, September 28, 2004, pp.19-20.

<sup>29</sup> Federal Communication Commission, "Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services," Eleventh Report, WT Docket No. 06-17, September 29, 2006, p. 4; Federal Communication Commission, "Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services," Fifteenth Report, WT Docket No. 10-133, June 27, 2011, p. 62.

<sup>30</sup> MVNOs are carriers that do not own wireless network towers but instead buy wholesale minutes, data and text from an MNO then resell the purchased minutes, data, and text to consumer under their branded service.

<sup>31</sup> AT&T Postpaid Tiers; AT&T Prepaid Tiers.

<sup>32</sup> Adnan Kayyali, "The crucial role of an MVNO in the world of telecoms," *inside telecom*, June 7, 2021, <https://insidetelecom.com/the-crucial-role-of-an-mvno-in-the-world-of-telecoms/> (accessed November 13, 2023).

<sup>33</sup> Although typically a MVNO purchases directly from one of the big three service providers, this is not strictly the case. In some instances, MVNOs purchase from a mobile virtual network aggregator (MVNA) who has already purchased connectivity from one of

MVNOs typically offer prepaid plans at lower prices than the MNOs. In some cases, like MNOs, there are discounts offered for additional lines, but more often MVNOs offer different prepaid rates depending on the number of months that an individual signs up for a given plan.

While MVNOs are generally unable to directly differentiate on the network performance or transition to new generations of wireless, as they do not directly control these aspects of the service they offer, they do consistently innovate on product bundles and pricing practices to offer a wide variety of packages that appeal to different consumers.

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the larger mobile network operators (MNO). See "What's the Difference Between MNO, MVNO, MVNE, & MVNA," *Simon IoT*, July 23, 2021, <https://www.simoniot.com/difference-in-mno-mvno-mvne-mvna/> (accessed March 31, 2022).

**Figure 4**  
**Unlimited Plan Offerings**

<b>Provider 1</b>			
	<b>Tier 1</b>	<b>Tier 2</b>	<b>Tier 3</b>
<b>Plan Basics</b>			
Unlimited Talk & Text	Yes	Yes	Yes
Unlimited Data	Yes	Yes	Yes
Prioritized Data	Speeds may be reduced after 100GB/mo.	Unlimited (Internet speeds won't slow based on usage)	Unlimited (Internet speeds won't slow based on usage)
Mobile Hotspot Data	15GB high-speed data, then Unlimited @ 3G speeds	50GB high-speed data, then Unlimited @ 3G speeds	50GB high-speed data, then Unlimited @ 3G speeds
Wi-Fi Calling	Included	Included	Included
5G Access	Included	Included	Included
<b>Entertainment</b>			
Subscriptions Included	Netflix Basic: 1 Screen SD Apple TV+ for 6 months	Netflix Standard: 2 Screen HD Apple TV+	Netflix Standard: 2 Screen HD Apple TV+
Streaming Quality	SD quality (480p) standard	Up to 4K UHD video	Up to 4K UHD video
<b>International and Travel</b>			
In-Flight Connection	4 full-flight streaming sessions a year, plus, unlimited in-flight texting & 1 hour of streaming, where available	Full-flight texting and Wi-Fi with streaming where available	Full-flight texting and Wi-Fi with streaming where available
Calling while abroad	\$0.25/minute in 215+ countries and destinations	\$0.25/minute in 215+ countries and destinations	\$0.25/minute in 215+ countries and destinations
Texting and Data from Abroad	Unlimited text and up to 5GB of high-speed data in 11 countries, then unlimited data at up to 256Kbps in 215+ countries and destinations	Unlimited text and up to 5GB of high-speed data, then unlimited data at up to 256Kbps in 215+ countries and destinations	Unlimited text and up to 5GB of high-speed data, then unlimited data at up to 256Kbps in 215+ countries and destinations
Int'l Texting From Home	Unlimited	Unlimited	Unlimited
Use Your Device In Mexico and Canada	Unlimited talk and text, and up to 10GB of high-speed data, then unlimited data at up to 128kbps	Unlimited talk and text, and up to 15GB of high-speed data, then unlimited data at up to 256kbps	Unlimited talk and text, and up to 15GB of high-speed data, then unlimited data at up to 256kbps
1-Year AAA Membership	Included	Included	Included
Extra Travel Deals	Included	Included	Included
<b>Other Benefits</b>			
Phone Upgrades	-	Every two years	Every year
Scam Protection	-	Call control center for easy management of anti-scam features	Call control center for easy management of anti-scam features
Voicemail to Text	-	Included	Included
AutoPay Discount	\$5 discount per line	\$5 discount per line	\$5 discount per line

Provider 2			
	Tier 1	Tier 2	Tier 3
<b>Plan Basics</b>			
Unlimited Talk & Text	Yes	Yes	Yes
Unlimited Data	Yes	Yes	Yes
Prioritized Data	Data speeds might be slower if network is busy	After 50GB, data speeds might be slower if network is busy	Data speeds will not slow down based on usage
Mobile Hotspot Data	After 3GB, speeds slowed down to 128Kbps	After 15GB, speeds slowed down to 128Kbps	After 50GB, speeds slowed down to 128Kbps
Wi-Fi Calling	Included	Included	Included
5G Access	Included	Included	Included
<b>Entertainment</b>			
Streaming Quality	SD Streaming	SD Streaming	4K UHD
<b>International and Travel</b>			
In-Flight Connection	High-speed data, calls, and texting for \$10/line per day	High-speed data, calls, and texting for \$10/line per day	High-speed data, calls, and texting for \$10/line per day
Calling while abroad	Unlimited talk with \$10/line per day International Day Pass in 210+ destinations	Unlimited talk with \$10/line per day International Day Pass in 210+ destinations	Unlimited talk with \$10/line per day International Day Pass in 210+ destinations
Texting and Data from Abroad	Unlimited text and data with \$10/line per day International Day Pass in 210+ destinations	Unlimited text and data with \$10/line per day International Day Pass in 210+ destinations	Unlimited Text & Data in 19 Latin American countries, Unlimited text and data with \$10/line per day International Day Pass in 210+ destinations
Int'l Texting From Home	Included	Included	Included
Use Your Device In Mexico and Canada	Unlimited talk, text, and data	Unlimited talk, text, and data	Unlimited talk, text, and data
Extra Travel Deals	Included	Included	Included
<b>Other Benefits</b>			
Scam Protection	Yes	Yes	Yes
Voicemail to Text	Included	Included	Included
AutoPay Discount	\$10 per phone line	\$10 per phone line	\$10 per phone line



Provider 3			
	Tier 1	Tier 2	Tier 3
<b>Plan Basics</b>			
Unlimited Talk & Text	Yes	Yes	Yes
Unlimited Data	Yes	Yes	Yes
Prioritized Data	Data speeds might be slower if network is busy	Unlimited (Internet speeds won't slow based on usage)	Unlimited (Internet speeds won't slow based on usage)
Mobile Hotspot Data	-	30GB high-speed data, then Unlimited @ 3 Mbps/600Kbps	60GB high-speed data, then Unlimited @ 3 Mbps/600Kbps
Wi-Fi Calling	Included	Included	Included
5G Access	Included	Included	Included
<b>Entertainment</b>			
Subscriptions Included	Disney+, Hulu, ESPN+ included with \$10/line bundle, Apple Music, Apple TV+, Apple Arcade included with \$10/line bundle	Disney+, Hulu, ESPN+ included with \$10/line bundle, Apple Music, Apple TV+, Apple Arcade included with \$10/line bundle	Disney+, Hulu, ESPN+ included with \$10/line bundle, Apple Music, Apple TV+, Apple Arcade included with \$10/line bundle
Streaming Quality	Streaming quality up to 4K Ultra High Definition when using 5G Ultra Wideband network on a capable device, or up to 480p when on 5G or 4G LTE.	Streaming quality up to 4K Ultra High Definition when using 5G Ultra Wideband network on a capable device, or up to 720p when on 5G or 4G LTE.	Streaming quality up to 4K Ultra High Definition when using 5G Ultra Wideband network on a capable device, or up to 1080p when on 5G or 4G LTE.
<b>International and Travel</b>			
In-Flight Connection	\$20/line monthly plan for 50MB data to use on flights and cruise ships, Pay as You Go \$2.99/minute talking and \$0.50/message sending texts and \$0.05/message receiving texts	\$20/line monthly plan for 50MB data to use on flights and cruise ships, Pay as You Go \$2.99/minute talking and \$0.50/message sending texts and \$0.05/message receiving texts	\$20/line monthly plan for 50MB data to use on flights and cruise ships, Pay as You Go \$2.99/minute talking and \$0.50/message sending texts and \$0.05/message receiving texts
Calling while abroad	Unlimited talk with \$10/line per day TravelPass in 210+ countries and destinations	Unlimited talk with \$10/line per day TravelPass in 210+ countries and destinations	Unlimited talk with \$10/line per day TravelPass in 210+ countries and destinations
Texting and Data from Abroad	Unlimited text and data with \$10/line per day TravelPass in 210+ countries and destinations	Unlimited text and data with \$10/line per day TravelPass in 210+ countries and destinations	Unlimited text and data and up to 10GB/month of high-speed data, then unlimited 2G speeds, Unlimited text and data with \$10/line per day TravelPass in 210+ countries and destinations
Int'l Texting From Home	Included	Included	Included
Use Your Device In Mexico and Canada	Unlimited talk, text, and data, and up to 2GB/day of high-speed data, then unlimited 3G speeds	Unlimited talk, text, and data, and up to 2GB/day of high-speed data, then unlimited 3G speeds	Unlimited talk, text, and data, and up to 2GB/day of high-speed data, then unlimited 3G speeds
Extra Travel Deals	Included	Included	Included
<b>Other Benefits</b>			
Scam Protection	Yes	Yes	Yes
Voicemail to Text	\$2.99 per line add-on	\$2.99 per line add-on	\$2.99 per line add-on
AutoPay Discount	\$10 discount per line	\$10 discount per line	\$10 discount per line

**Figure 5**  
**Pricing on Unlimited Plans by Number of Lines and Consumer Group**

Provider 1															
Customer Type	Tier 1					Tier 2					Tier 3				
	Taxes & Fees Included					Taxes & Fees Included					Taxes & Fees Included				
	Number of Lines	1	2	3	4	5	1	2	3	4	5	1	2	3	4
Standard	\$75.0	\$65.0	\$43.3	\$38.8	\$36.0	\$90.0	\$75.0	\$50.0	\$46.3	\$44.0	\$100.0	\$85.0	\$60.0	\$56.3	\$54.0
55+	\$55.0	\$40.0	\$40.0	\$40.0	-	\$70.0	\$50.0	\$50.0	\$50.0	-	\$80.0	\$60.0	\$60.0	\$60.0	-
Military & Veteran	\$60.0	\$45.0	\$35.0	\$30.0	\$27.0	\$75.0	\$55.0	\$45.0	\$40.0	\$37.0	\$85.0	\$65.0	\$55.0	\$50.0	\$47.0
First Responder	\$60.0	\$45.0	\$35.0	\$30.0	\$27.0	\$75.0	\$55.0	\$45.0	\$40.0	\$37.0	\$85.0	\$65.0	\$55.0	\$50.0	\$47.0
Government Employee	-	-	-	-	-	\$76.5	\$63.8	\$42.5	\$39.3	\$37.4	\$85.0	\$72.3	\$51.0	\$47.8	\$45.9

Provider 2															
Customer Type	Tier 1					Tier 2					Tier 3				
	Taxes & Fees Included					Taxes & Fees Included					Taxes & Fees Included				
	Number of Lines	1	2	3	4	5	1	2	3	4	5	1	2	3	4
Standard	\$65.0	\$60.0	\$45.0	\$35.0	\$30.0	\$75.0	\$65.0	\$50.0	\$40.0	\$35.0	\$85.0	\$75.0	\$60.0	\$50.0	\$45.0
Nurse & Physician	\$48.8	\$45.0	\$33.8	\$26.3	\$22.5	\$67.5	\$56.3	\$37.5	\$34.7	\$33.0	\$75.0	\$63.8	\$45.0	\$42.2	\$40.5
Military & Veteran	\$48.8	\$45.0	\$33.8	\$26.3	\$22.5	\$67.5	\$56.3	\$37.5	\$34.7	\$33.0	\$75.0	\$63.8	\$45.0	\$42.2	\$40.5
Teacher	\$48.8	\$45.0	\$33.8	\$26.3	\$22.5	\$67.5	\$56.3	\$37.5	\$34.7	\$33.0	\$75.0	\$63.8	\$45.0	\$42.2	\$40.5
First Responder	-	\$45.0	\$33.8	\$26.3	\$22.5	-	\$48.8	\$37.5	\$30.0	\$26.3	-	\$56.3	\$45.0	\$37.5	\$33.8
Union Member	-	-	-	-	-	-	-	-	-	-	\$75.0	\$65.0	\$50.0	\$40.0	\$35.0
AARP	-	-	-	-	-	-	-	-	-	-	\$75.0	\$65.0	\$50.0	\$40.0	\$35.0
Student	-	-	-	-	-	-	-	-	-	-	\$75.0	\$65.0	\$50.0	\$40.0	\$35.0

Provider 3															
Customer Type	Tier 1					Tier 2					Tier 3				
	Taxes & Fees Included					Taxes & Fees Included					Taxes & Fees Included				
	Number of Lines	1	2	3	4	5	1	2	3	4	5	1	2	3	4
Standard	\$65.0	\$55.0	\$40.0	\$30.0		\$80.0	\$70.0	\$55.0	\$45.0		\$90.0	\$80.0	\$65.0	\$55.0	
Military	\$55.0	\$42.5	\$31.7	\$25.0		\$70.0	\$57.5	\$46.7	\$40.0		\$80.0	\$67.5	\$56.7	\$50.0	
Nurse	\$55.0	\$42.5	\$31.7	\$25.0		\$70.0	\$57.5	\$46.7	\$40.0		\$80.0	\$67.5	\$56.7	\$50.0	
First Responder	\$55.0	\$42.5	\$31.7	\$25.0		\$70.0	\$57.5	\$46.7	\$40.0		\$80.0	\$67.5	\$56.7	\$50.0	
Student	\$55.0	\$42.5	-	-		\$70.0	\$57.5	-	-		\$80.0	\$67.5	-	-	

### C. Discounts for Select Consumer Groups

As documented in Section II, the prices for wireless service have fallen generally, and substantially over time. Beyond these general price reductions, wireless carriers have increasingly embraced discounts and/or special plans for specific consumer groups. For example, as seen in Figure 5, numerous groups of customers have emerged as beneficiaries of specific pricing discounts. These include first responders, government employees, members of the military, nurses, physicians, seniors, students, teachers, union members, and veterans. These available discounts are often quite substantial. For example, as seen in Figure 3, members of the military can choose among discounts from the major carriers ranging from 19% to 25% for three lines of service. Additionally,

in a drive to retain existing customers and attract new customers, carriers have turned to providing discounts to their customers on non-telecommunications products and services, ranging from restaurant meals, to gasoline, to movie popcorn.<sup>34</sup> These discounts provide further increases to the consumer welfare enjoyed by wireless consumers in the U.S.

#### D. Device Discounts and Offers

As mobile handsets have added features and functionality, the upfront cost of this equipment has the potential to become a hurdle to consumers wishing to use mobile telephone services. In response, wireless carriers have increasingly responded by introducing a host of financial options for consumers to acquire mobile handsets in a way that accommodates a wide range of household budgets. All nationwide MNOs today offer installment plans for handsets purchased through the carrier. Financing may be without interest, depending on the credit quality of the customer. In addition, carriers offer various discounts on new devices with the trade-in of an old device. With used devices of a recent vintage, trade-in promotions can cover the full cost of a new smartphone.

Additional subsidies on new devices are offered to customers adding a new line or switching from another carrier. Carrier switching subsidies can also, in some cases, cover the cost of a new smartphone. Customers who already have a device and are signing up for a new line can choose from various “Bring your own device” promotions; such offers typically include a bill credit.<sup>35</sup> As of late October 2023, carriers are offering substantial discounts for top flagship smartphones, including the new iPhone 15, Samsung’s Galaxy S23, and the Google Pixel 8.<sup>36</sup> See **Figure 6** for examples of device subsidies and promotions offered. Lastly, carriers also provide device upgrade offers at various intervals ranging from every one to three years based on the tier.

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<sup>34</sup> “T-Mobile Tuesdays,” *T-Mobile*, <https://www.t-mobile.com/offers/t-mobile-tuesdays> (accessed November 28, 2023).

<sup>35</sup> “Shop Cell Phones, Smartphones, iPhone and Galaxy,” *AT&T*, <https://www.att.com/buy/phones/> (accessed April 7, 2022); “Cell Phones & Smartphones,” *T-Mobile*, <https://www.t-mobile.com/cell-phones> (accessed April 7, 2022); “Smartphones - Buy the Top Cell Phones,” *Verizon*, <https://www.verizon.com/smartphones/> (accessed April 7, 2022); “Bring Your Own Phone (BYOP & BYOD) - \$250 bill credits,” *AT&T*, <https://www.att.com/wireless/byod/> (accessed April 7, 2022); “Bring Your Own Unlocked Phone,” *T-Mobile*, <https://www.t-mobile.com/resources/bring-your-own-phone> (accessed April 7, 2022); “Bring Your Own Device (BYOD),” *Verizon*, <https://www.verizon.com/bring-your-own-device/> (accessed April 7, 2022).

<sup>36</sup> “The Best Phone Deals of October 2023: iPhone, Samsung Galaxy, and Google Pixel,” *WhistleOut*, October 23, 2023, <https://www.whistleout.com/CellPhones/News/Best-Cell-Phone-Deals>, (accessed October 29, 2023).

**Figure 6**  
**Sample Device Offerings from Nationwide MNOs, Late October 2023**

Carrier	Apple iPhone	Samsung Galaxy	Google Pixel
<b>Provider 1</b>	Save \$1,000 on the iPhone 15 Pro with trade-in	Get the Galaxy S23 5G for up to \$800 off with new line or trade-in	Free Pixel 8 with trade-in on select plans
<b>Provider 2</b>	Get up to \$1,000 off the Phone 15 Pro or Pro Max with trade-in; or get an iPhone SE (3rd gen) for \$5/month—no trade-in required	Get a FREE Galaxy S23 with trade-in; or get a Samsung Galaxy A14 5G for \$2/month—no trade required	Get the Pixel 8 Pro for free with trade-in; or get a Pixel 7a for just \$5/month
<b>Provider 3</b>	Save up to \$1,000 on the iPhone 15 series with trade-in	Get a FREE Galaxy S23	Get the new Pixel 8 for FREE with new line

## V. The Cumulative Effects: For Today’s Consumers and Tomorrow’s

Although precise quantification of the consumer welfare gains associated with product feature and pricing differentiation is beyond the scope of this paper, it is nonetheless possible to indirectly gauge the consumer benefits that have been produced by the confluence of price reductions, quality increases, increased service availability and the proliferation of pricing plans.<sup>37</sup> In particular, each of these developments acts to increase consumer value from usage of mobile telephone services. And beyond these benefits to today’s wireless customers, additional industry features bode well for consumer welfare gains to tomorrow’s customers. Consider these in turn.

Research indicates that mobile phone connectivity has led to a greater percentage of U.S. residents connected to the public switched network than ever before.<sup>38</sup> Another key indicator of changing consumer welfare is seen by examining changes in industry output and corresponding levels of consumption. In that regard, between 2000 and 2022, the number of wireless connections in the U.S. increased dramatically from 78.7 million to 491.2 million, an

<sup>37</sup> Previous efforts to quantify the consumer welfare effects of the evolution of mobile telephony point toward large effects. For example, a recent study (2016) estimates that the average monthly surplus (per-consumer) from the introduction of the smartphone was approximately \$35.50, which implies an aggregate monthly consumer surplus of approximately \$7.03 billion for wireless consumers in the United States. See Renhoff, Adam and P. Wesley Routon “Can You Hear Me Now?” *Telecommunications Policy*, Vol. 40, February 2016, pp. 39-51.

<sup>38</sup> Jeffrey T. Macher et al., “From universal service to universal connectivity,” *Journal of Regulatory Economics*, No. 52, July 2017, pp. 77-104; Jeffrey T. Macher et al., “Universal Connectivity in the United States” (Economic Policy Vignette prepared for the Center for Business and Public Policy at Georgetown University’s McDonough School of Business, July 2019).

increase of over 624%.<sup>39</sup> This figure reflects the considerable growth in device connections (e.g., tablets, smartwatches, hotspots, and medical sensors), indicating that the benefits of competition and differentiation to consumer welfare extend well beyond those attributable to mobile telephony (voice & data) service (e.g., smartphones). This dramatic increase in connectivity levels over time and across consumers of all income levels provides powerful evidence of consumer welfare gains from the combination of attractive pricing, improved quality, expanded service features, and a proliferation of pricing plans.

Not only are consumers increasingly connected, enabling the option of wireless services consumption, but they also spend substantial amounts of time utilizing their wireless services, indicating they are increasingly finding wireless service as a valuable use of their time. For example, in 2022, wireless consumers spent an average of 765 minutes (12.75 hours) per month using their voice-capable wireless devices.<sup>40</sup> Some consumers additionally spent considerable minutes utilizing non-voice wireless devices. As with connectivity, the intense use of wireless devices provides important evidence of consumer welfare associated with the provision of wireless services.

This value is perhaps nowhere more evident than in consumer behavior among vulnerable segments of the U.S. population. Consider, for instance, the Affordable Connectivity Program (ACP). Established in 2021, the ACP provides low-income households a flexible discount that can be put toward connectivity plans of their choosing. Of the over 21.6 million ACP subscribers, the majority choose to put their discount toward mobile service—more than cable, DSL, fiber, and satellite combined.<sup>41</sup> The variety of different mobile service offerings means that consumers can find a plan that fits their individual budget and specific needs.

Further, among U.S. adults who are “smartphone-only,” a growing share report that they do not have home broadband because their smartphone “does everything they need” (45% in 2021, up from 27 percent in 2015).<sup>42</sup> This rationale is now tied with the high monthly expense of home broadband as the reason for foregoing service.<sup>43</sup> This provides direct evidence of the increased value consumers have gotten from mobile wireless as the quality of service has improved.

These measures of consumer usage show a clear trend of increasing benefits to consumers coinciding with increasingly attractive price levels, improving quality, a proliferation of service features, and expanding pricing options.

While consumers to-date have benefited considerably, it is tomorrow’s consumer for whom policy will be most applicable. Fortunately, a virtuous circle of consumer-facing improvements (price and quality enhancements along with product and pricing plan proliferation) and industry-driven technological change is being driven by investments in next generation technologies. In particular, competition-driven investment among mobile wireless service

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<sup>39</sup> CTIA, “CTIA’s Wireless Industry Indices Report: Year-End 2022 Results,” July 2023, p. 18.

<sup>40</sup> CTIA, “CTIA’s Wireless Industry Indices Report: Year-End 2022 Results,” July 2023, p. 60.

<sup>41</sup> “Additional ACP Data,” *Universal Service Administrative Co.*, <https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/additional-acp-data/> (accessed December 22, 2023).

<sup>42</sup> Andrew Perrin, “Mobile Technology and Home Broadband 2021,” *Pew Research Center*, June 3, 2021, <https://www.pewresearch.org/internet/2021/06/03/mobile-technology-and-home-broadband-2021/> (accessed November 13, 2023).

<sup>43</sup> *Ibid.*

providers has normalized advances in wireless technologies across networks, handsets/smartphones, and other devices, as well as content and applications. Indeed, over the past thirty-five years, the mobile industry network operators have invested heavily in capital equipment (viz., more than \$674 billion).<sup>44</sup> The result has been the emergence of multiple generations of network technologies, expanding coverage, increased densification, increasing wireless internet speeds, and improving service quality.

By late 2019, mobile coverage was virtually ubiquitous, with 99.5% of Americans covered by one or more of the nationwide MNOs.<sup>45</sup> As of December 2021, 95% of Americans lived in an area with 4G LTE coverage by at least three service providers.<sup>46</sup> This proliferation has increasingly extended to Americans living in *rural* areas. The FCC reported that as of December 2021, one or more national operators covered 98.6% of Americans living in rural areas, with over 80% of the population having three or more options.<sup>47</sup>

Under previous generations of wireless, operators competed primarily on coverage when it came to network performance. Each company presented a different colored map of the nation, showing how broad their coverage was. Increasingly, however, other features of the network, such as capacity, download speeds, and reliability, feature much more prominently in the competitive struggle between carriers for the patronage of customers. With respect to internet speeds, in the first two years after the launch of 4G LTE, data speeds increased as much as two to eight times relative to 3G (depending on the carrier). Data speeds have continued to increase as network buildout and densification continue and network technologies evolve, as seen in **Figure 7**.<sup>48</sup> Today's 5G network technology is significantly faster than 4G LTE and promises continually improved speed and latency in the coming years.<sup>49</sup>

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<sup>44</sup> Capex reported is in nominal dollars and includes expenditure for equipment and structures (e.g., towers). See CTIA, "CTIA's Wireless Industry Indices Report: Year-End 2022 Results," July 2023, p. 6.

<sup>45</sup> Federal Communication Commission, "2020 Communications Marketplace Report," December 31, 2020, pp. 50-53.

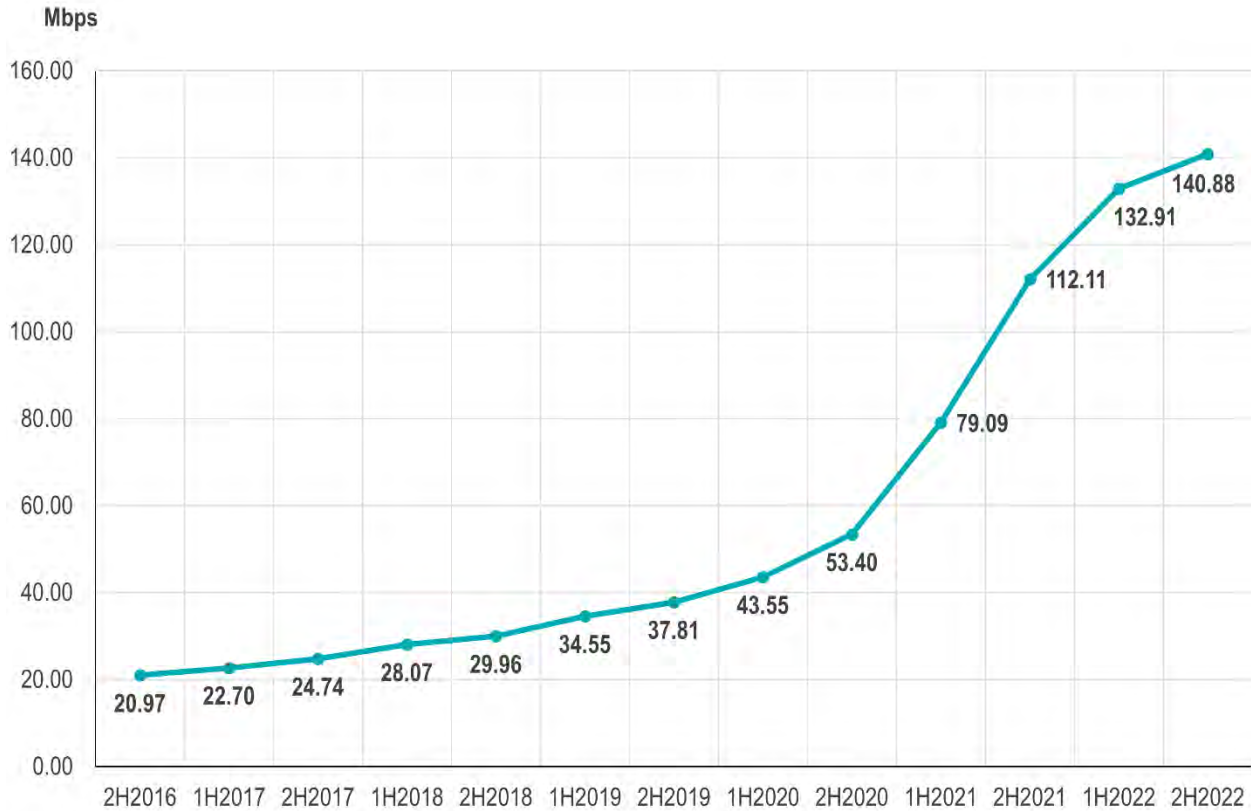
<sup>46</sup> Federal Communication Commission, "2022 Communications Marketplace Report," December 30, 2022, p. 109.

<sup>47</sup> Federal Communication Commission, "2022 Communications Marketplace Report," December 30, 2022, pp. 112-113.

<sup>48</sup> Mark Sullivan, "3G and 4G Wireless Speed Showdown: Which Networks Are Fastest?," *PCWorld*, April 16, 2012, [https://www.pcworld.com/article/469946/3g\\_and\\_4g\\_wireless\\_speed\\_showdown\\_which\\_networks\\_are\\_fastest\\_.html](https://www.pcworld.com/article/469946/3g_and_4g_wireless_speed_showdown_which_networks_are_fastest_.html) (accessed March 30, 2022).

<sup>49</sup> "5G speed: 5G vs. 4G performance compared," *Tom's Guide*, June 1, 2021, <https://www.tomsguide.com/features/5g-vs-4g> (accessed March 30, 2022).

**Figure 7**  
**Ookla Speed Test: Mobile Broadband Mean Download Speeds (Nationwide)**



Source: Ookla SPEEDTEST intelligence data.

Technological improvements have also allowed for improved voice quality, for example, with the development of Voice over LTE (VoLTE), an IP-based technology that allows carriers to deliver HD voice services. All major carriers now offer HD voice.<sup>50</sup> Voice over New Radio (VoNR), currently being deployed, is the next step in the evolution of voice service, offering higher quality and faster call set-up time.<sup>51</sup>

<sup>50</sup> “Get Higher Voice Quality With AT&T HD Voice,” AT&T, <https://www.att.com/support/article/wireless/KM1046244/> (accessed April 4, 2022); “Volte,” T-Mobile, <https://www.sprint.com/en/shop/services/volte.html> (accessed April 4, 2022); “HD Voice FAQs,” Verizon, <https://www.verizon.com/support/hd-voice-faqs/#:~:text=VoLTE%20delivers%20voice%20calls%20over,voice%20and%204G%20LTE%20data> (accessed April 4, 2022).

<sup>51</sup> Monica Allevan, “T-Mobile chases voice in 5G - Verizon, AT&T not so much,” *Fierce Wireless*, August 20, 2021, <https://www.fiercewireless.com/tech/t-mobile-chases-voice-5g-verizon-at-t-not-so-much> (accessed March 30, 2021).

The virtuous circle of consumer-facing benefits and technological investments and advances is nowhere more evident than in the emerging market for the provision of fixed wireless access.

Specifically, fixed wireless access (FWA) has emerged as one of the most compelling early use cases from initial 5G deployments. Leveraging 5G breakthroughs that can provide greater capacity where sufficient spectrum resources are available, FWA permits wireless service providers to compete directly for fixed broadband service. According to Leichtman Research, FWA is the fastest growing home broadband service with over 90 percent of new broadband subscribers transitioning to FWA from 5G mobile operators in 2022.<sup>52</sup>

Researchers have estimated that the competitive pressure from FWA stands to save consumers over \$8 billion a year, assuming operators have sufficient spectrum capacity to compete aggressively on price.<sup>53</sup> This expanded competition has, in turn, provoked cable companies to offer wireless plans bundled with fixed home broadband.<sup>54</sup> FWA is one of the most significant new additions to wireless providers' service offerings, providing increasingly direct competition against cable providers for home broadband. In short, the technological advances embodied in fixed wireless access are enabling the mobile telephone industry to evolve and provide new services with tremendous potential for enhancing consumer welfare.

Finally, although it is most natural to envision the direct consumer welfare benefits that flow to retail consumers of mobile telephony, a raft of indirect benefits accrue to these consumers as a consequence of the efficiency gains made available to enterprise customers which purchase ever-more affordable and versatile mobile services.

## VI. Conclusion and Policy Assessment

The merits of any regulatory framework depend substantially on whether it enhances or retards consumer welfare. Similarly, proposed changes to regulation reasonably face a test of whether the proposed change will credibly act to enhance consumer welfare relative to the extant regulatory framework. In some cases, economic analyses of the impact of regulation and/or changes to regulation struggle to yield clear conclusions, even when applying sophisticated methods. In other cases, systematic economic analysis provides a clear basis for policy.

Fortunately, in the case at hand, virtually every dimension of economic performance within the wireless telecommunications sector reveals that the light-touch regulatory approach that has governed the industry for decades has created a business-government framework that has generated nothing short of massive gains to consumer welfare in the United States. This success story has emerged by producing lower prices, higher quality,

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<sup>52</sup> See "Leichtman Research Group Research Notes 1Q 2023," *Leichtman Research Group*, <https://leichtmanresearch.com/wp-content/uploads/2023/03/LRG-Research-Notes-1Q-2023.pdf> (accessed November 13, 2023).

<sup>53</sup> Hal Singer & Augustus Urschel, "Competitive Effects of Fixed Wireless Access on Wireline Broadband Technologies," *CTIA*, June 15, 2023, <https://www.ctia.org/news/competitive-effects-of-fixed-wireless-access-on-wireline-broadband-technologies> (accessed November 13, 2023).

<sup>54</sup> Cable's mobile service is provided through MVNO agreements combined with offloading capacity to WiFi networks when possible. "Mobile & Home Internet Bundles," *Xfinity*, <https://www.xfinity.com/learn/deals/internet-and-mobile> (accessed November 28, 2023); "What Is Spectrum One," *Spectrum*, <https://www.spectrum.com/resources/internet-wifi/what-is-spectrum-one> (accessed November 28, 2023).



a proliferation of consumer-welfare-enhancing service features, and similar consumer-welfare-enhancing expansions in pricing options from which consumers may choose.

Moreover, the extant policy framework has not only produced consumer welfare benefits for today's customers, but has also resulted in a robust feedback loop in which firms, in competitive efforts to retain existing customers and attract new customers, are driven to constantly invest in next-generation network technologies that produce a steady stream of new innovations. These innovations, in turn, create new consumer welfare benefits for tomorrow's wireless customers.

Importantly, these innovations also create new and previously unattainable benefits to customers with increasingly diverse preferences, with some consumers more interested in voice, others in data (and the speed with which it can be uploaded and downloaded), and yet others in video.

Finally, investments in next-generation network technologies are producing new spillover benefits to consumers and enterprises. Most prominently today, fixed wireless access provided over 5G connectivity is providing substantial consumer welfare by stimulating intermodal competition for home broadband service. These spillover consumer welfare benefits are the direct result of the robust investment and innovation environment within the wireless telecommunications industry as manifested within the light-touch regulatory framework that has historically been embraced by the FCC.

Against this backdrop, the substantial revisions to the existing regulatory governance framework currently envisioned by the FCC are highly unlikely to increase consumer welfare benefits beyond those being produced with the current regulatory framework. Indeed, the envisioned process of classifying broadband, both wired and wireless, as a common carrier service under Title II of the Communications Act creates the real prospect of declining consumer welfare if enacted. Title II offers broad regulatory authority that was crafted for natural monopoly common carriers that operated in a massively different economic environment than wireless telecommunications carriers today. In that environment – not today's – economic analysis has shown the potential for the type of regulation contained in the basic provisions of Title II to produce consumer benefits relative to an unregulated natural monopolist offering an undifferentiated service in a static industry. Importantly, however, no economic analysis to date exists that credibly demonstrates that such a sweeping regulatory structure is capable of surpassing the existing regulatory governance mechanism for stimulating increases in consumer welfare.