Docket No.:	A.18-07-011 and A.18-07-012
Exhibit No.:	Joint Applicants-
Hearing Date:	
Witness:	Timothy F. Bresnahan
ALJ:	Karl Bemesderfer
Commissioner:	Clifford Rechtschaffen

REBUTTAL TESTIMONY OF TIMOTHY F. BRESNAHAN

ON BEHALF OF JOINT APPLICANTS

JANUARY 29, 2019

—PUBLIC VERSION—

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ATTACHMENTS

I. WITNESS IDENTIFICATION

Q. Please state your name and position.

A. My name is Timothy F. Bresnahan. I am the Landau Professor in Technology and the Economy in the Department of Economics at Stanford University.

Q. Please describe your professional qualifications and experience.

A. I received my BA from Haverford College in 1975 and my PhD from Princeton University in 1980. I have served on the economics faculty at Stanford since 1979, including as Associate Chair from 1998 to 1999 and as Chair from 2004 to 2008.

I am also a Senior Fellow and Director at the National Bureau of Economic Research, participating in the Productivity and Industrial Organizations programs that study technical progress and competition. I have been elected as Fellow of the American Academy of Arts and Sciences, as Fellow of the Econometric Society, and as a Vice President of the American Economic Association.

The major focus of my research has been on the use of empirical methods to construct economic models of firm conduct, competition, and entry. My research on these topics has been published in leading peer reviewed economics journals including the *American Economic Review*, the *Journal of Political Economy*, the *Review of Economic Studies*, the *Journal of Econometrics*, the *RAND Journal of Economics*, and the *Journal of Law and Economics*.

In 2017, I received the BBVA Frontiers of Knowledge Award for founding and shaping the field of empirical industrial organization. This is the field of economics that analyzes competition and addresses policy questions related to antitrust.

From 1999 to 2000, while on leave from Stanford, I served as Deputy Assistant Attorney General for Economic Analysis in the United States Department of Justice Antitrust Division. As head of the Economic Analysis Group, I supervised the

Division's economists, including on investigations of the competitive effects of proposed mergers. I have testified in Federal and State courts on matters of competition and technology, including mergers.

Q. Are you generally familiar with these proceedings at the Commission?

A. Yes. I understand that T-Mobile and Sprint have submitted two filings with the Commission. One filing seeks approval of the transfer of Sprint Communications, a wireline provider in the state, to T-Mobile. The other filing provides the Commission with information about the wireless merger. My understanding is that the Commission has set these hearings to consider various issues related to those filings

II. PURPOSE OF TESTIMONY

Q. Please describe what topics you have been asked to testify to here today.

A. I have been asked by counsel for T-Mobile and Sprint (the "merging parties") to respond to questions Dr. Lee L. Selwyn raised in this proceeding in his direct testimony submitted on behalf of the Public Advocates Office at the California Public Utilities Commission,[1] as well as to other competitive effects questions raised by the Communication Workers of America.[2]

I focus specifically on questions relevant to the competitive effects analysis of the proposed merger I conducted with my colleagues, John Asker and Kostis Hatzitaskos.[3] This includes our initial white paper in the related FCC proceeding,[4] our response to submissions filed by DISH and CWA in the same proceeding,[5] and our presentation of our findings to the FCC.[6] To provide context I begin today by first summarizing our analysis, which utilizes detailed, present-day data on consumer usage patterns and granular measures of network quality.

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[1] Lee L. Selwyn, "Direct Testimony on behalf of the Public Advocates Office at the California Public Utilities Commission," January 7, 2019 ("Selwyn Testimony").

[2] Debbie Goldman, Dr. Andrew Afflerbach, and Matt Dehaven, "Opening Testimony of Debbie Goldman, Dr. Andrew Afflerbach, and Matt Dehaven on behalf of Communications Workers of America District 9," January 7, 2019 ("CWA Testimony").

[3] John Asker is a Professor of Economics at the University of California at Los Angeles, where he holds the Armen A. Alchian Chair in Economic Theory. Kostis Hatzitaskos is a Vice President in the Chicago office of Cornerstone Research.

[4] Attached herein as Attachment A. See John Asker, Timothy Bresnahan, and Kostis Hatzitaskos, "Economic Analysis of the Proposed T-Mobile/Sprint Merger," November 6, 2018 ("Asker, Bresnahan, and Hatzitaskos White Paper"), available redacted at https://ecfsapi.fcc.gov/file/11060648404338/Nov.%206%20Public%20SuppResponse.pdf.

[5] Attached herein as Attachment B. See John Asker, Timothy F. Bresnahan, and Kostis Hatzitaskos, "Response to Dish and CWA Comments," December 18, 2018 ("Asker, Bresnahan, and Hatzitaskos Response to DISH/CWA").

[6] Attached herein as Attachment C. See John Asker, Timothy F. Bresnahan, and Kostis Hatzitaskos, "Economic analysis of the proposed T-Mobile/Sprint merger: Presentation to Federal Communications Commission," December 3, 2018 ("Asker, Bresnahan, and Hatzitaskos FCC Presentation"), available redacted at https://ecfsapi.fcc.gov/file/1206641006544/T-Mobile%20US%2C%20Inc.%20Sprint%20Corporation%20Dec.%206%20Ex%20Parte.pdf.

III. OVERVIEW OF COMPETITIVE EFFECTS ANALYSIS

Q. Dr. Selwyn discusses your competitive effects analysis at some length. Before we discuss Dr. Selwyn's specific criticisms, could you please give a high level overview of your analysis?

A. We conduct our analysis of competitive effects employing a merger simulation, the standard tool used in modern merger analysis. Our analysis uses the best available data to test the core proposition of the merging parties' business plan: that consumers will benefit from improved network quality and reduced marginal costs that arise from combining the Sprint and T-Mobile complementary spectrum assets, leading to enhanced consumer welfare. At a high level, we proceed in three steps.

- First, we use detailed data on actual consumer usage of wireless services to directly analyze patterns of consumer usage and network quality and thereby understand how different consumers use their phones, how network quality varies across locations, and the role that network quality plays in shaping current competitive outcomes.
- Second, we use these data to build a flexible econometric model of consumer demand (equivalently, wireless brand choices). Rather than looking at anecdotal data or measures of network quality that are not directly tied to consumer experience, our model uses data on actual consumer behavior to comprehensively explain how consumers choose wireless brands, including how they value network quality today (in terms of speed and coverage) after controlling for many other consumer and product characteristics.
- Finally, we use our demand model along with the standard model of pricing used by the antitrust enforcement authorities and the academic literature to analyze mergers in industries with differentiated products to simulate the competitive effects of the merger. Our resulting merger simulations quantify the potential benefits to consumers and effects on competition of the proposed merger under a variety of scenarios.

Q. What is your overall conclusion?

A. The data demonstrate that the proposed merger will likely be procompetitive, in that it is likely to expand output and enhance consumer welfare, with the merged firm gaining share at the expense of Verizon and AT&T. This conclusion holds true for a wide range of assumptions about merger-specific marginal cost reductions and network quality improvements.[7]

Q. How does expanding output make the proposed merger procompetitive?

A. Output expansion is a key metric when both quality and price may be changing. The conclusion that output is likely to expand demonstrates that the proposed merger is procompetitive and will enhance consumer welfare.

To understand why, note that consumers choose products that offer them value. By value I mean an appealing trade-off between price, quality, and other product characteristics. If the merged firm offers products that are a better value than the products the standalone firms offered, it can expand sales and attract additional customers at the expense of its competitors. If it does not, perhaps because it raises prices too high, then it will lose sales to its competitors. Therefore, a prediction that the merged firm gains share relative to the combined shares of the two firms pre-merger thus indicates that the proposed merger generates greater consumer value than the standalones. In other words, that the merger strengthens competition and is procompetitive.

[7] Asker, Bresnahan, and Hatzitaskos White Paper, §§ 1, 4.

Q. Does Dr. Selwyn's testimony regarding your analysis change any of your conclusions?

A. No. Dr. Selwyn's testimony makes a number of fundamental mistakes. Many of his statements about the wireless industry are factually incorrect. He misunderstands the basic economics of the workhorse model used in economic analysis of mergers in almost all industries. He makes elementary errors in econometrics, and misinterprets and misunderstands our data and the economic logic of our analysis. The claims he makes are wrong and unsupported. Moreover, he ignores analysis and explanation we and others have already offered that demonstrate that his points are wrong.

Q. Many of Dr. Selwyn's claims about your analysis are related to the data that you use. Before we discuss his specific claims, can you give us context by describing the data you use?

A. We conduct our analysis using data from multiple sources that the merging parties use in the ordinary course of business. The dataset we primarily rely upon to study consumer behavior and network quality is the Nielsen Mobile Performance ("NMP") dataset. NMP is produced by Nielsen, a leading independent third-party market research firm.[8] Sprint also uses NMP data in the ordinary course of business to evaluate, like we do, network performance.

This is the best available dataset about individual consumers who use different wireless brands of which we are aware. NMP follows tens of thousands of individuals as they go about their day through an application consumers download onto their mobile phones. The application records metadata based on the consumer's individual behavior, e.g., when and where they use their phone to access the internet.[9] These rich

[8] Nielsen, "About Us," available at https://www.nielsen.com/us/en/about-us.html ("For more than 90 years Nielsen has provided data and analytics based on scientific rigor and innovation, continually developing new ways to answer the most important questions facing the media, advertising, retail and fast-moving consumer goods industries. An S&P 500 company, Nielsen has operations in over 100 countries, covering more than 90% of the world's population.").

[9] Nielsen, "Mobile Performance," available at http://www.nielsen.com/us/en/solutions/capabilities/nielsenmobile-performance.html, accessed October 25, 2018 ("The product employs proprietary metering technology to passively measure a geographically representative opt-in panel of Android U.S. smartphone owners that captures over 400 million data points each month. The passive meter runs 24/7 in the background of the device,

data allow us to closely evaluate the actual quality of service individual consumers receive from their chosen brand given their individualized location and usage patterns. In my experience in academia, consulting, and at the DOJ, it is extremely rare to have the benefit of data this rich and comprehensive when evaluating consumer choice.

Q. What information do the NMP data provide you regarding consumer behavior?

A. To demonstrate the richness of the data, in Exhibit 1 I present all the download events the NMP data recorded for a single Verizon consumer from March 1 to May 31, 2018. [**BEGIN SPRINT CONFIDENTIAL- ATTORNEYS EYES ONLY ("BSC-AEO")]** [redacted]

continuously capturing data speeds and hundreds of other metrics across different file sizes and applications. With a sample of 45,000 devices at the national level across the top 41 cities in the U.S., NMP measures the key metrics related to consumers' mobile experience.").

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[**END SPRINT CONFIDENTIAL- ATTORNEYS EYES ONLY ("ESC-AEO")** Source: Nielsen Mobile Performance Data

[BSC-AEO] [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted][10]

[ESC-AEO]

[10] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 161.

Q. How does this information on each individual help you understand consumer choice?

A. The NMP data show us where different individuals use their phones and thus where they are most likely to care about network quality. For instance, **[BSC-AEO]** [redacted] **[ESC-AEO]**

Because we have data on many other consumers who also visit many of the same locations, we can ask the following question: what experience would the consumer in Exhibit 1 have were he or she to switch to a different brand, e.g., T-Mobile (or similarly, any other wireless service brand)?

In Exhibit 2, I present the answer to this question: by examining the speeds experienced by consumers who visit the same areas but choose T-Mobile in the NMP data, we calculate the average standardized delivered speeds T-Mobile offers in the locations where the Verizon consumer in Exhibit 1 uses his or her phone.[12]

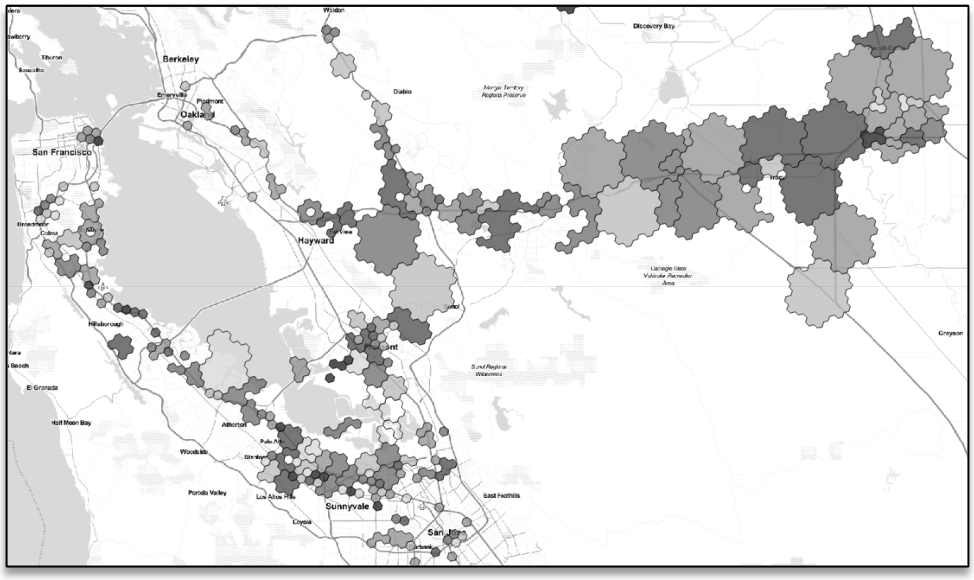
[11] As we explain in our white paper, the NMP data **[BSC-AEO]** [redacted] **[ESC-AEO]** See Asker, Bresnahan, and Hatzitaskos White Paper, § 5.1.8 ("Assigning demographics to NMP consumers").

[12] **[BSC-AEO]** [redacted]. **[ESC-AEO]**As we explained in our initial white paper, delivered speeds may be affected by factors that are only partially related to the quality of the network, such as the size of the file being downloaded. We measure *standardized* download speeds, which allow for apples-to-apples comparisons of different network experiences. See Attachment A, Asker, Bresnahan, and Hatzitaskos White Paper, Appendix § 5.1.4, "Calculating standardized speeds" for more details. As we explained in our white paper, delivered speeds tend to be slower than but consistent with the speeds in speed tests such as Ookla that are used in the merging parties' network engineering modeling and the Israel, Katz, and Keating Declaration. For additional discussion on the relationship between the two measures of speed, see Asker, Bresnahan, and Hatzitaskos White Paper, fn. 7, 78, and Asker, Bresnahan, and Hatzitaskos Response to DISH/CWA, ¶¶ 43–45 and fn. 34.

EXHIBIT 2

Experience of exemplar NMP consumer [BSC-AEO] [redacted] [ESC-AEO]: average T-Mobile download speeds across the area where the consumer travels

Average T-Mobile standardized delivered speeds



Standardized speeds in Mbps:
Slower <=0.85 >=0.85 and <1.0 >=1.0 and <1.1 >=1.1 and <1.2 >=1.2 and <1.35 >=1.35 Faster

Source: Nielsen Mobile Performance Data

Notes: The selected NMP consumer has ID: **[BSC-AEO]** [redacted] **[ESC-AEO]** and is on Verizon. Average standardized delivered speeds for each geogrid are based on the events of all T-Mobile NMP consumers in these geogrids during March 1, 2018 through May 31, 2018.

The map in Exhibit 2 illustrates how granularly network quality can vary, even within the same network in the same broad geographic area. As the legend makes clear, the average standardized delivered speeds T-Mobile offers in the areas this consumer uses his or her phone can vary by more than 50 percent.[13]

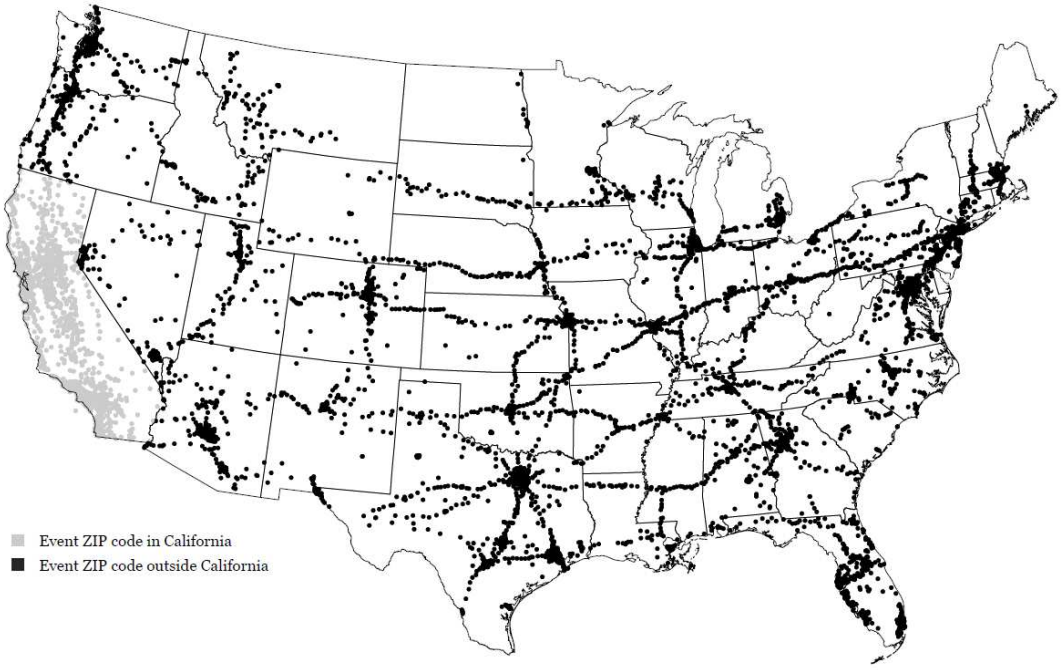
[13] Compare average standardized delivered speeds below 0.85 Mbps and above 1.35 Mbps.

Q. What information do the NMP data provide you about where Californians use their phones?

A. The consumer usage data show that while some Californians have more local usage patterns, many others use their phones all over the United States. In Exhibit 3 we present a map of the continental United States where each dots represents locations where the NMP data records usage by California residents. Most of the usage is within California (the gray dots), but **[BSC-AEO]** [redacted] **[ESC-AEO]** of Californians in the three-month NMP data used their phones outside the state (the black dots).

EXHIBIT 3

Many Californians use their phones not just within the state but also across the country



Source: Nielsen Mobile Performance Data

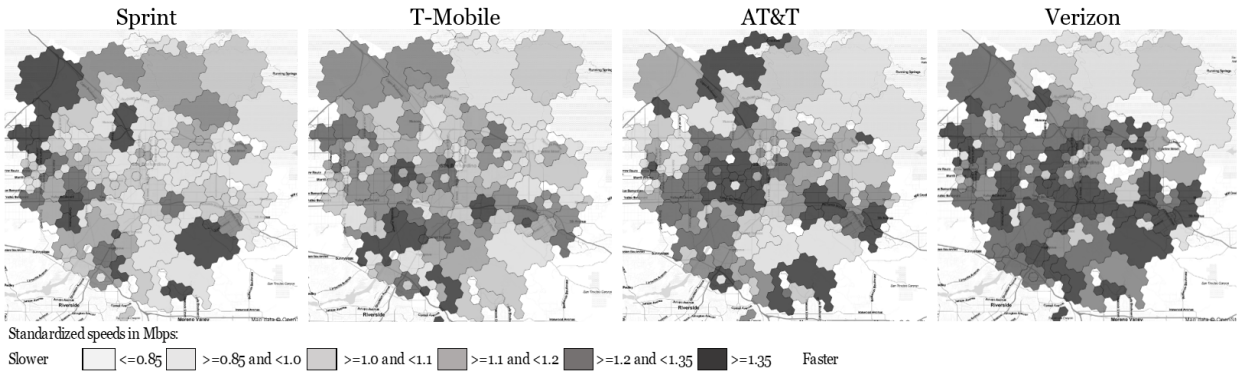
Q. You mentioned that, at a high level, there are three steps to your analysis and that the first step is a direct analysis of the data. You also mentioned that network quality is individualized. Is individualized network quality directly apparent in the data?

A. Yes. We already saw in the examples of the Mountain View resident and the broader travel patterns of Californians across the country that each individual uses their phone in different locations and for different tasks. Couple this with the fact that the performance of each network also varies across locations, sometimes on a very granular level, and you can conclude that network quality is highly individualized.

To further understand how network quality can vary granularly, consider the standardized delivered speeds offered by Sprint, T-Mobile, AT&T, and Verizon across the greater San Bernardino, California area, which we present in Exhibit 4.

EXHIBIT 4

Illustration of how network quality can vary across different networks: standardized speeds in San Bernardino, California



Source: Nielsen Mobile Performance Data

We can see from this map that (a) all networks offer fast standardized delivered speeds in some areas and slow speeds in other areas; (b) some networks offer more consistent speeds across this area than others; and (c) each network tends to perform well in different parts of the broader San Bernardino area. As a result, different individuals living in the same broader geographic area can obtain very different quality of service from a given network, depending on their individualized usage patterns.

Q. Do consumers always choose the brand that offers them the highest individualized network quality?

A. Not always. However, the data do demonstrate that consumers are more likely to choose a brand when it offers them better quality, as one would expect if consumers switch to find better experiences or discuss network quality with their friends and families who use phones in similar ways.

There are two ways we see this in the data. First, by focusing on consumers who today choose T-Mobile or Sprint, we see that these tend to be consumers to whom the merging parties today offer better quality than they offer to other consumers.[14]

Second, by focusing on the customers of the two leading firms, we see that there are many millions of consumers who today choose AT&T or Verizon at least in part because those networks offer them good network quality given their individualized usage patterns. In particular, those millions of consumers would face significant network quality degradation if they were to switch to the current network of one of the two merging parties. And the converse is true: network quality improvements would mean that many more consumers would have an option that is more competitive than the two standalone firms on network quality.

Q. Have you done any analysis that quantifies the quality degradation these millions of AT&T and Verizon consumers would face if they were to switch to the current network of one of the two merging parties?

A. We demonstrate the magnitude of the network quality gap that many California consumers experience between Verizon and T-Mobile in Exhibit 5.

- There are 5.2 million California wireless consumers who choose Verizon today and would lose at least ten percent standardized delivered speed if they were to switch to T-Mobile (the solid gray bar on the left). Given our finding that consumers place substantial value on network quality, this network quality gap

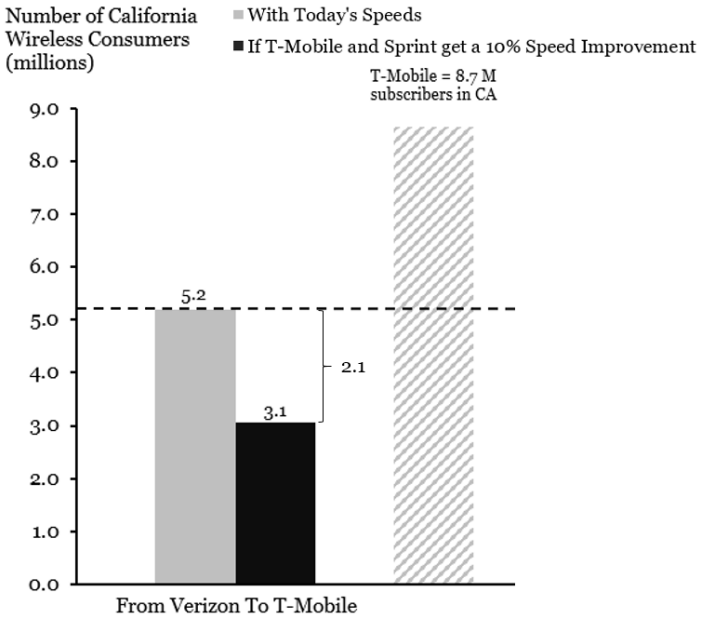
[14] Asker, Bresnahan, and Hatzitaskos White Paper, Exhibit 60.

represents an important competitive disadvantage that T-Mobile faces in competing against Verizon today.

- To put these 5.2 million Verizon California subscribers into perspective, T-Mobile's entire customer base in California corresponds to 8.7 million subscribers (the dashed gray bar on the right).
- If T-Mobile could increase its speeds by ten percent, only 3.1 million Verizon California subscribers would lose at least ten percent speed if they switch to T-Mobile (the black bar in the middle). By that metric, a ten percent improvement in speeds would mean that an additional 2.1 million Verizon subscribers in California have an additional choice of more competitive carriers.[15]

EXHIBIT 5

California consumers losing ten percent speed if they switch from Verizon to T-Mobile, with and without a network improvement



Source: KPMG StreamShare Data; Nielsen Mobile Performance Data

[15] Similarly, there are 4.4 million Verizon subscribers in California who would lose at least ten percent speed if they were to switch to Sprint. There are 3.3 and 3.5 million AT&T subscribers in California who would lose at least ten percent speed if they were to switch to Sprint or T-Mobile, respectively. These numbers drop by 1.6, 1.3, and 1.5 million consumers if T-Mobile and Sprint were each to increase their standardized delivered speeds by ten percent.

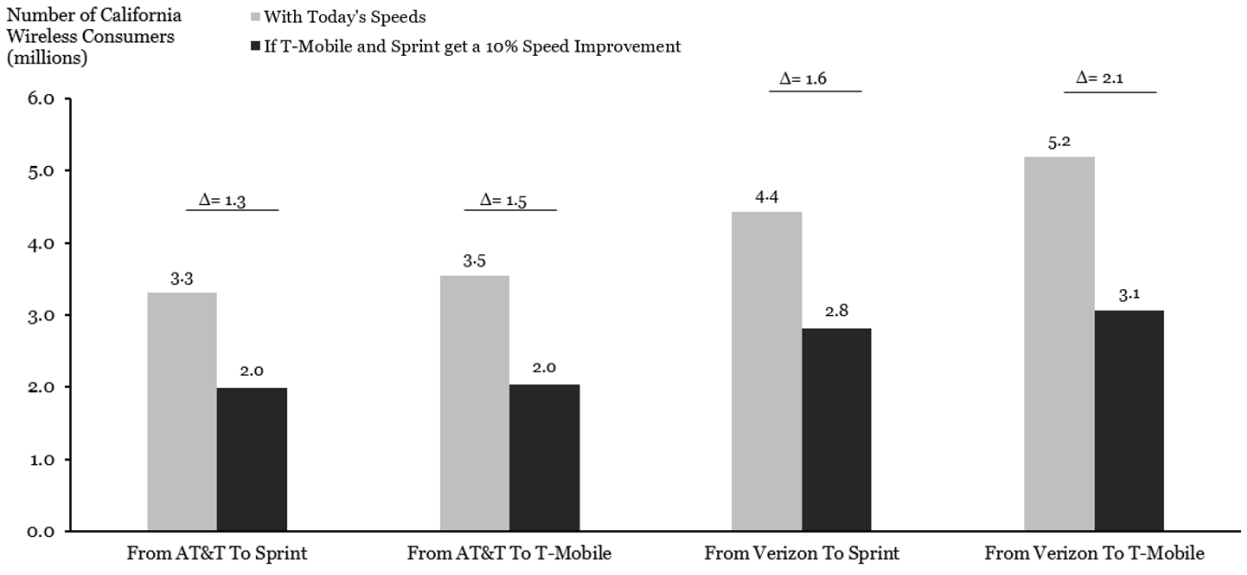
Q. Have you calculated similar statistics for the network quality gap California consumers experience between other carriers?

A. Yes. In Exhibit 6 we present the same calculation for other potential switches. The pair of columns on the right represent the network quality gap we just discussed: the millions of Californians who today choose Verizon and who would experience at least a ten percent degradation in speed were they to switch to T-Mobile. As before, this number is substantially reduced if T-Mobile were to increase its speeds by just ten percent.

The chart presents similar calculations for the millions of consumers currently on AT&T who face network quality gaps relative to Sprint or T-Mobile, as well as the millions of consumers on Verizon who face network quality gaps relative to Sprint. In each case, their numbers drop significantly with a modest ten percent speed increase.

EXHIBIT 6

California consumers losing ten percent speed if they switch, with and without a network improvement



Source: Nielsen Mobile Performance Data; KPMG StreamShare Data.

Note: Sprint had 4.9M subscribers and T-Mobile had 8.7M subscribers during March–May 2018. The KPMG Streamshare Data cannot be subset to specific states. For "California," we consider the following KPMG "areas" which cover California: SF Bay, South Bay, Upper Central Valley, Lower Central Valley, LA Metro, North LA, Riverside/San Bernardino, Orange County, and San Diego. These areas cover all of California but also parts of Nevada. Approximately 98.2% of the population of these areas is in California.

Q. What do you conclude from these direct examinations of the data?

These observations from present-day data help us understand the likely competitive effects of the proposed merger. First, the fact that there are many millions of consumers today to whom Sprint and T-Mobile offer substantially lower network quality than AT&T and Verizon helps explain why Sprint and T-Mobile have been unable to make substantial inroads in market share over the last few years.

Second, the fact that we see in the data, without any econometric analysis, that consumers tend to choose brands that offer better network quality to them helps provide a simple explanation of the bottom line result of our analysis: that the proposed merger

is procompetitive under a wide range of network quality improvements and marginal cost reductions that would result from the proposed merger.[16]

Q. What do you conclude from the second step of your analysis, the demand model?

A. The data show that the network quality each individual consumer experiences is an important factor in consumer choice, even after controlling for many other consumer and product characteristics that may affect choice. We find that most consumers place substantial value on the quality of their network experience as measured in the NMP data. Even the minority of consumers who use much less data than the average value incremental network quality. A merger that improves network quality therefore directly benefits consumers and strengthens competition.[17]

Q. What do you conclude from the third step of your analysis, the merger simulation?

A. Our merger simulation finds that the proposed merger will create consumer value, resulting in more consumers choosing the combined company. This is true under a wide range of conservative network quality improvements and marginal cost efficiencies. The proposed merger therefore increases output: New T-Mobile achieves greater share than the combined standalone companies, increasing their share at the expense of AT&T and Verizon and putting competitive pressure on the two leading firms. AT&T and Verizon would then have to improve their own network quality or lower their prices to retain those consumers. Given that the required network quality and marginal cost improvements necessary to make the proposed merger procompetitive is small relative to the improvements the merging parties anticipate and that are supported by the evidence on the record, the proposed merger is likely to be procompetitive.[18]

[16] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 14 and § 2 ("Direct empirical evidence").
[17] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 15 and § 3 ("Econometric model of demand").
[18] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 15 and § 4 ("Merger simulation").

Q. How does your analysis relate to the economic analysis submitted by Israel, Katz, and Keating?

A. Our work is complementary to the analysis done by Mark Israel, Michael Katz, and Bryan Keating.[19] They focus on the network engineering work done by the merging parties to measure the expected merger-specific benefits to marginal costs and to 5G speed improvements. Our work focuses on richly detailed data on user experience and network. We focus our analysis on how competition can improve if New T-Mobile experiences speed increases within the range we observe in today's LTE networks.

Furthermore, our work establishes that many of the scenarios that Israel, Katz, and Keating consider are conservative. Namely, our analysis demonstrates that the diversion ratio between the merging parties is in the more procompetitive end of the range that Israel, Katz, and Keating considered in their white paper. This means that many of their scenarios conservatively overestimate the extent to which Sprint and T-Mobile directly compete with one another relative to how much they compete with the two leading firms, AT&T and Verizon.[20]

I present this result in Exhibit 7, which presents the diversion ratios we calculate as part of our analysis. Diversion ratios are an economic tool to assess closeness of competition and expected substitution across firms.[21] Notably, we find that consumers who leave the merging firms' brands when faced with a price increase, are most likely to switch to either AT&T or Verizon, and not to brands of the other merging firm. This is also true of consumers that choose the merging parties' Boost/Virgin and MetroPCS brands. For example:

[19] Mark Israel, Michael Katz, and Bryan Keating, "Declaration of Compass Lexecon," September 17, 2018 ("Israel, Katz, and Keating Declaration"), available at https://ecfsapi.fcc.gov/file/109171182702890/Appendices%20A-K%20(Public).pdf.

[20] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 79.

[21] The diversion ratio from firm A to firm B answers the following question: If firm A raises its price and this leads some consumers to substitute away from its product, what share of those consumers will switch to one of the products of firm B?

- The diversion ratio from Sprint to T-Mobile is 19.2 percent (row 3, column 4), while Sprint's diversion ratio to AT&T and Verizon is 24.6 and 32.6 percent, respectively (row 3, columns 1 and 2).
- Similarly, the diversion ratio from T-Mobile to Sprint is 12.4 percent (row 4, column 3), while T-Mobile's diversion ratio to AT&T and Verizon is 27.5 and 34.8 percent (row 4, columns 1 and 2).

EXHIBIT 7

Diversion ratios measured using detailed analysis of demand show that AT&T and Verizon are the main competitors of each merging firm

	Diversion To:							
Diversion From:	AT&T	Verizon	Sprint	T-Mobile	Boost/Virgin	MetroPCS	Cricket	Regional Carriers and MVNOs
AT&T	-	40.0%	11.0%	19.1%	3.8%	5.4%	3.6%	17.1%
Verizon	33.8%	-	12.4%	20.4%	4.2%	5.5%	3.5%	20.3%
Sprint	24.6%	32.6%	-	19.2%	4.0%	5.2%	2.5%	12.1%
T-Mobile	27.5%	34.8%	12.4%	-	4.0%	6.9%	2.7%	11.7%
Boost/Virgin	22.0%	28.4%	10.3%	16.0%	-	5.9%	2.8%	14.5%
MetroPCS	22.7%	27.6%	9.9%	20.4%	4.4%	-	2.8%	12.3%
Cricket	25.9%	29.5%	8.2%	13.5%	3.5%	4.7%	-	14.6%
Regional Carriers and MVNOs	27.5%	38.7%	8.7%	13.0%	4.1%	4.7%	3.3%	-

Source: KPMG StreamShare Data; 2018 Nielsen Mobile Performance Data

Note: See the Appendix to the Asker, Bresnahan, and Hatzitaskos White Paper for details on the data, processing, and variable definitions. Diversion from carrier j to carrier k is calculated for individual consumers as the change in share of carrier k divided by the change in share of carrier j due to a $1 increase in price of carrier j.

Q. Is it appropriate to use porting data to infer closeness of competition, as CWA suggests?

A. No, CWA is wrong to infer that the merging parties closely compete from the porting data.[22] As we have previously explained in our prior submissions, the switching behavior that is relevant to assessing the competitive effects of a proposed merger is not the switching that is observed today, but rather switching that results from a brand increasing price or decreasing quality. This is what the diversion ratios that result from our analysis measure. It is not what porting data reflect.

[22] CWA Testimony, p. 29.

Porting data suffer from serious flaws that make them an inappropriate source for measuring diversion ratios and closeness of competition.[23] One important reason is that porting data do not distinguish between people who switch for their own reasons other than changes in the price or quality of the offering, from those responding to the relative competitive offers of the competitors. One way to see that this is the case is that consumers simultaneously switch in both directions (e.g., from T-Mobile to Verizon and vice versa). If porting data were driven by supplier behavior, i.e., changes in price or quality, then we would expect switchers to only move in one direction at any given point in time, away from the brand that raised quality-adjusted prices or towards the brand that lowered them. Instead, we routinely see sets of consumers porting in both directions at the same time, which is inconsistent with switching behavior driven exclusively by supply shocks, such as a price change. Israel, Katz, and Keating provide additional discussion of the problems with using porting data as a proxy for diversion ratios.[24]

IV. DR. SELWYN'S SPECIFIC CLAIMS REGARDING OUR ANALYSIS

Q. Let's turn to Dr. Selwyn's specific criticisms. How would you summarize Dr. Selwyn's testimony regarding your analysis?

A. First, much of Dr. Selwyn's testimony regarding our analysis critically relies on his repeated claim that we use a model that assumes that marginal cost savings are passed-through to consumers "dollar-for-dollar."[25] I will explain that this assertion is false and is a result of an elementary mistake made by Dr. Selwyn. Conclusions he draws from this false claim are therefore without foundation and should be dismissed.

[23] Asker, Bresnahan, and Hatzitaskos Response to DISH/CWA, § 2.1; and Asker, Bresnahan, and Hatzitaskos FCC Presentation, pp. 40–41.

[24] Mark Israel, Michael Katz, and Bryan Keating, "Additional Information Regarding the Estimation of Diversion Ratios," December 14, 2018.

[25] Selwyn Testimony, pp. 101, 119–121, 123, 124.

Second, Dr. Selwyn claims that our merger simulation makes assumptions that are inconsistent with the standalone plans of Sprint, standalone T-Mobile, AT&T, and Verizon. Namely, he argues that we assume that these firms will make no improvements to their networks without the proposed merger.[26] This claim is also wrong and misunderstands our analytical exercise and, indeed, misunderstands merger analysis as practiced in the academic literature and by antitrust enforcement agencies.

Third, Dr. Selwyn makes a number of statements regarding the NMP data that are incorrect, mischaracterize the data, or are otherwise misleading. Setting aside his factual errors, it is important to note that Dr. Selwyn has done no work to demonstrate that any of his claims regarding the NMP data would actually affect the bottom line conclusion that the proposed merger is procompetitive and benefits consumers.

Fourth, Dr. Selwyn argues that our econometric model of demand did not control for certain factors, such as plans offering "zero rating" or international roaming.[27] Our model does account for such plan features. Dr. Selwyn's arguments betray a lack of understanding of econometrics and the role of a technique called "fixed effects." This technique is an elementary building block of econometric analysis and allows us to take into account a variety of factors that might influence the result. Moreover, much like his arguments regarding the NMP data, Dr. Selwyn has done no work to demonstrate that any of these claims are relevant to the bottom line conclusion.

Finally, these are just some of Dr. Selwyn's most important errors. The main point is that there is no substance to Dr. Selwyn's claims, which are wrong and unsubstantiated by actual economic analysis.

[26] Selwyn Testimony, pp. 100–101, 107–108.

[27] Selwyn Testimony, pp. 114–115.

Q. Let's start with Dr. Selwyn's claim that your analysis assumes that any cost efficiencies will be passed on to consumers "dollar-for-dollar." What is your response to his claim?

A. Dr. Selwyn is wrong. The level of pass-through in our analysis is neither assumed nor "dollar-for-dollar." Dr. Selwyn references a simplified, theoretical model taught in undergraduate economics courses.[28] By contrast, in empirical models that are rooted in data, pass-through depends on the how responsive consumers are to price changes and on how quickly the costs of a firm change when its quantity changes.[29]

These are empirical questions which we have addressed in the relevant context of the wireless service industry using our real-world, detailed data. That is the foundation for the conclusions of our merger simulation, not a theoretical assumption.

[28] Hal R. Varian, *Intermediate Microeconomics: A Modern Approach, 7th edition*, (New York: W. W. Norton & Company, 2006), p. 494.

[29] The model we use, the Bertrand model of competition among firms with differentiated products, has been the workhorse of industrial organization research and antitrust practice for several decades. For example, see chapter 7 in the seminal 1988 textbook of Jean Tirole, *The theory of industrial organization*, MIT press, 1988, pp. 277–303 and the 2010 Horizontal Merger Guidelines, § 6.1. Industry facts dictate what economic model is appropriate. The wireless industry is clearly an industry where products are differentiated and firms compete by setting prices. In our white paper, we repeatedly explain that wireless offerings are differentiated not just on average (e.g., Verizon has broader coverage than Sprint) but also on an *individualized* level (i.e., two individuals who live in the same zip code may have very different experiences from the same network depending on their personal usage patterns). See Asker, Bresnahan, and Hatzitaskos White Paper, ¶¶ 23–30. Dr. Selwyn's testimony completely ignores this fundamental feature of the industry.

Q. Moving on to the second set of Dr. Selwyn's criticisms, he claims that your analysis assumes that the standalone firms will make no network improvements. How do you respond?

A. Dr. Selwyn's claim has no bearing on the validity of our analysis. He misunderstands the comparison we make, which is standard in the academic literature and in the practice of the antitrust enforcement agencies. Our analysis poses the following question, which is standard in merger simulation analysis: How is the competitive outcome today affected by the proposed merger if the merger also brings about merger-specific efficiencies? In particular, how is the competitive outcome affected if the proposed merger brings about the merger-specific network quality improvements and cost reductions that New T-Mobile expects to achieve, which by definition go *beyond* what standalone Sprint and T-Mobile would be able to achieve on their own?[30] Dr. Selwyn objects to our starting point, but what matters to the analysis is whether the proposed merger brings about meaningful merger-specific improvements.

Moreover, Dr. Selwyn has ignored Israel, Katz, and Keating, who have already performed the alternative calculation that utilizes Dr. Selwyn's preferred starting point: They compare future standalone network improvements and changes in marginal costs against the merged firm's further network improvements and marginal cost improvements.[31] Their complementary approach to our analysis also concludes that the proposed merger is procompetitive.[32]

[30] Asker, Bresnahan, and Hatzitaskos White Paper, ¶¶ 11–12.

[31] Israel, Katz, and Keating Declaration, §§ 3, 4.

[32] Israel, Katz, and Keating Declaration, ¶¶ 5, 152.

Q. What about AT&T and Verizon? Does your model assume that they will not invest in their network?

A. No, this is also incorrect. It is standard in merger analysis to look at the improvements in the efficiency of the merging firms relative to other competitors. This does not correspond to any assumption that the other competitors have stopped improving or investing. Indeed, we expect that they would respond to improvements by New T-Mobile.

Note that any improvements made by AT&T and Verizon as a competitive response to the increased quality and competitiveness of the merged firm will be a further benefit to consumers, above and beyond those quantified in our analysis. Once again, Dr. Selwyn's claim is false and has no bearing on the validity of our analysis.

Q. Dr. Selwyn claims that only "the most extreme" combinations of cost reductions and quality improvements lead to an improvement in market share for the post-merger New T-Mobile in your model. Do you agree with this characterization?

A. Not at all. Dr. Selwyn mischaracterizes the results of our analysis. Before I discuss Dr. Selwyn's claims, let me note that even a cursory read of our white paper shows that modest network quality improvements make New T-Mobile a much more effective competitor against AT&T and Verizon, which in turn means that the proposed merger is procompetitive and benefits consumers with only modest improvements in marginal costs.

For example, our analysis shows that a conservative scenario where network quality improvements are limited to Sprint closing the coverage gap with T-Mobile and T-Mobile closing the speed gap with Sprint would be procompetitive if the merging firm achieves a marginal cost reduction of only two dollars, well within the Israel, Katz, and Keating estimates.[33] The merging parties consider this scenario to be well below what they expect to achieve in that, for example, it does not account for the

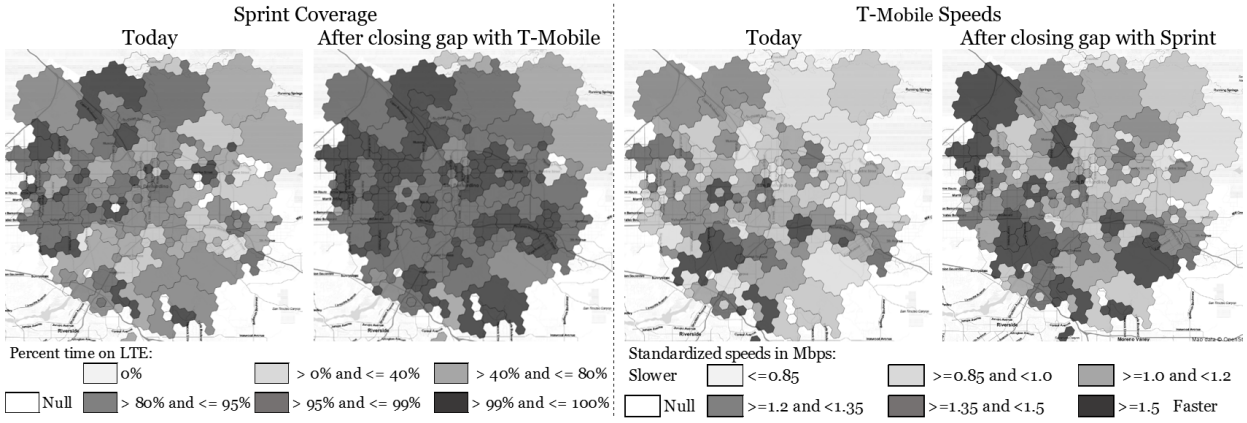
[33] Asker, Bresnahan, and Hatzitaskos White Paper, § 4.2.4 ("Critical marginal cost efficiencies assuming improvements for Sprint in coverage and for T-Mobile in speed").

multiplicative effects the merging parties expect will result from combining their complementary spectrum assets.[34]

Nonetheless, improvements of this nature would have meaningful impact on the network quality delivered by the merging parties, as we demonstrate in Exhibit 8 once again using San Bernardino, California as an example. In the first panel we present Sprint's coverage today, which is strong in certain areas but weak in others. On the second panel we show that Sprint's coverage would look much stronger and consistent in San Bernardino were Sprint to close the coverage gap with T-Mobile. Similarly, in the last two panels we compare T-Mobile speeds today with its speeds were it to close the speed gap with Sprint. T-Mobile consumers would clearly benefit in several parts of the greater San Bernardino area.

EXHIBIT 8

Network quality in San Bernardino, California today and under a conservative scenario where Sprint closes the coverage gap with T-Mobile and T-Mobile closes the speed gap with Sprint



Source: Nielsen Mobile Performance Data

Turning to Dr. Selwyn, note that he does not clarify what, if anything, makes any of our scenarios "extreme." To the contrary, his discussion appears to focus on two scenarios that are extremely *conservative*, namely one where there is no improvement in network quality and another where there is no improvement in marginal costs.[35] Dr. Selwyn does not explain why the proposed merger will result in either marginal cost

[34] See Declaration of Neville R. Ray at ¶¶ 23-24 , June 18, 2018, available at https://ecfsapi.fcc.gov/file/10618281006240/Public Interest Statement and Appendices A-J (Public Redacted) .pdf.

[35] Selwyn Testimony, pp. 123–124.

reductions or network quality improvements, but not both. Dr. Selwyn has pointed to nothing extreme in the corresponding marginal cost and network quality improvements that would make each scenario procompetitive.

Moreover, Dr. Selwyn ignores ample evidence in our white paper and the rest of the record that demonstrates that the scenarios we consider are actually conservative. First, he ignores the Israel, Katz, and Keating analysis, which carefully analyzes the merging parties' network engineering model and quantifies merger-specific marginal cost reductions and Ookla speed improvements for New T-Mobile. The scenarios we consider involve marginal cost and network quality improvements at or below the levels predicted by Israel, Katz, and Keating.[35] Second, he ignores that the improvements in the scenarios we consider are substantially smaller than differences observed in present-day data regarding service quality in different locations, even across the same network in the same metropolitan area.[36]

For example, one of our scenarios evaluates the competitive effects of the proposed merger if the merged firm improves its speed by 0.1 Mbps, but we see today that the same network in the same area can offer speeds that vary by more than 0.5 Mbps (e.g., see the example of San Bernardino in Exhibit 4). In other words, the scenarios we consider are entirely within the range of engineering feasibility today.

To appreciate the fact that the proposed merger is procompetitive under a wide range of reasonable assumptions regarding marginal cost reductions and network quality improvements, in Exhibit 9 I present a summary of the various conservative network quality improvement scenarios we consider in our white paper (the gray to black curves) as well as the best estimates of marginal cost improvements that are expected to result from the merger by 2021, as put forward by Israel, Katz, and Keating (the black dot on the upper right). The proposed merger is procompetitive if the realized

[35] Asker, Bresnahan, and Hatzitaskos White Paper, fn. 77–79.

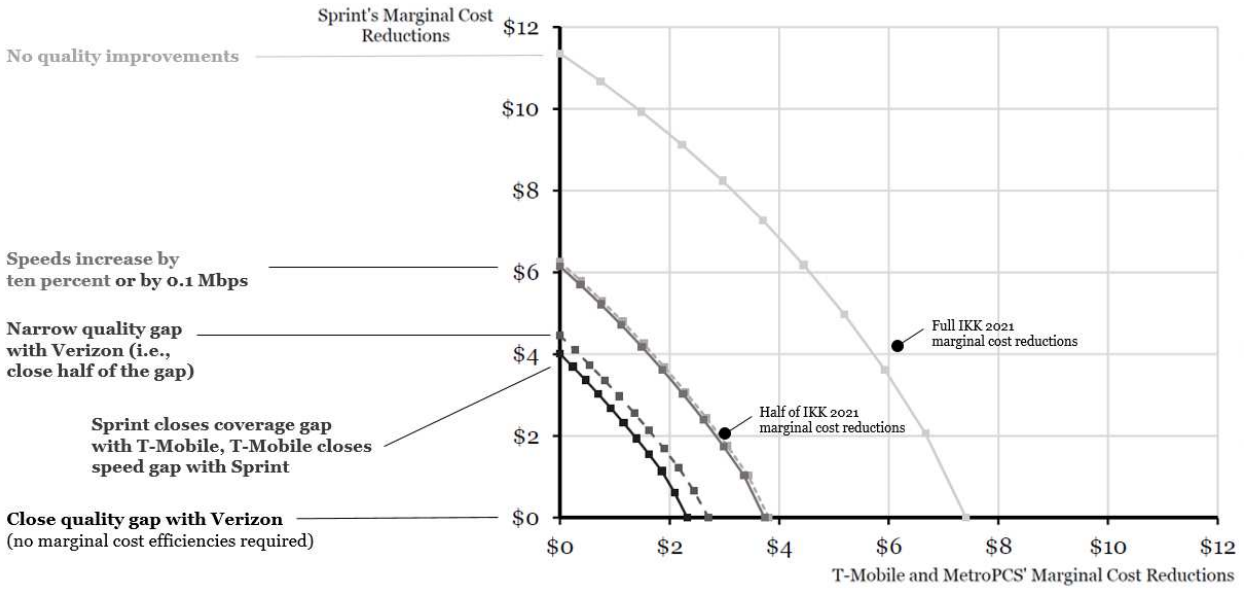
[36] For example, we consider a scenario where the merged firm brands improve their speeds by 0.1 Mbps in standardized delivered speeds. See Asker, Bresnahan, and Hatzitaskos White Paper, § 4.2.3. At the same time, we demonstrate that in present-day data, average standardized delivered speeds in different part of greater Des Moines, Iowa, vary by more than 0.5 Mbps. See Exhibit 4, above, as well as Asker, Bresnahan, and Hatzitaskos White Paper, Exhibit 3.

marginal cost reductions are above the curves defined by the network quality improvement scenarios.

For example, consider the scenario where speeds increase by ten percent. The chart demonstrates that the merger would be procompetitive if Sprint's marginal costs were to fall by a little more than $6, even if T-Mobile saw no improvement. Alternatively, the merger would be procompetitive if T-Mobile's marginal costs were to fall by $4, even if Sprint saw no improvement. Any point above and to the right of the curve represents a procompetitive outcome.

EXHIBIT 9

Summary of critical marginal cost efficiencies under different scenarios



Source: Asker, Bresnahan, and Hatzitaskos White Paper, Exhibits 14, 16, 18, 22, 25; Israel, Katz, and Keating Declaration, Table 12

Notice two important patterns in this graph. First, even in the unrealistic and extremely conservative scenario of *no* quality improvements (the lightest gray curve), the best estimate of marginal cost reductions is sufficient to make the proposed merger procompetitive. Second, under any of the conservative network quality improvement scenarios that we consider (e.g., speeds increasing by ten percent or Sprint closing the coverage gap with T-Mobile and T-Mobile closing the speed gap with Sprint), the proposed merger is procompetitive even if *only half* of the expected marginal cost

reductions are realized. The greater the consumer value of the network quality improvement, the smaller the marginal cost reductions that are needed to make the proposed merger procompetitive. Notice that the consumer benefits from closing the quality gap with Verizon are large enough that no marginal cost improvements would be required to make the proposed merger procompetitive.

Finally, Dr. Selwyn's conclusions once again rely on his misunderstanding of the basic economic implications of our model.[37] As explained above, our model lets the data speak to the amount of pass-through and in no way assumes that marginal cost efficiencies are passed on "dollar-for-dollar."[38] Any conclusion of Dr. Selwyn that relies on this erroneous assertion should be dismissed.

Q. Moving on to Dr. Selwyn's claims that your analysis does not account for specific network quality features of prepaid brands, such as roaming, deprioritization, and throttling. How do you respond to this claim?

A. Dr. Selwyn is incorrect in claiming that the model does not account for such aspects of network quality.[39] The NMP data measure consumer-specific experiences as individuals go about their daily lives. To give an illustrative example: **[BSC-AEO]** [redacted][40] **[ESC-AEO]**

[37] Selwyn Testimony, p. 124.

[38] Selwyn Testimony, p. 124.

[39] Selwyn Testimony, pp. 112–114.

[40] For example, see Asker, Bresnahan, and Hatzitaskos White Paper, Exhibit 61.

Q. Does your analysis account for plan features, such as T-Mobile and Sprint's "zero rating" of certain content?

A. Yes. Our model determines the relative importance of several factors that enter consumer choice. Aside from individualized network quality and how consumers with different characteristics make choices, it controls for any feature that is shared across the plans a brand offers, or that is more frequently offered by a brand's plans relative to other brands' plans.[41] This includes whether plans are particularly attractive to heavy data users because of "zero rating" policies, as well as other factors that commonly affect choice across a geographic area, e.g., advertising or retail stores. Note that when our model controls for these factors, it differentiates between multiple brands owned by the same carrier, e.g., T-Mobile and MetroPCS, Sprint and Boost, and AT&T and Cricket.[42]

[41] For example, to evaluate the impact that individualized network quality has on consumer choice, we hold constant everything that may be the same across two consumers within a geographic area and ask whether and by how much a consumer is more likely to choose a brand if the brand offers greater individualized network quality. Consider two consumers that live in the same city and who are considering whether or not to choose T-Mobile. These consumers face the same national price and the same level of national or local perception of overall network quality, plan features, advertising, reputation, service, and retail stores. However, the network quality that T-Mobile offers each consumer is ultimately *individualized* based on exactly where, when, and how each of them uses their phone. It is this variation in quality that our model focuses on when estimating whether and how incremental network quality can make a given individual better off and more likely to choose a brand. We addressed a similar question in the FCC proceeding, raised on behalf of DISH by Coleman Bazelon, Jeremy Verlinda, and William Zarakas of the Brattle Group, and on behalf of CWA by Heski Bar-Isaac of the University of Toronto's Rotman School of Management. See Asker, Bresnahan, and Hatzitaskos Response to DISH/CWA, § 2.5 ("Our model already controls for other differences across brands, such as advertising and retail stores.").

[42] Asker, Bresnahan, and Hatzitaskos White Paper, ¶¶ 10, 253, 256, 268, Exhibit 87; and Asker, Bresnahan, and Hatzitaskos Reply to DISH/CWA, § 2.5.

Q. Dr. Selwyn claims that you "concede that there is a significant income gap between Android and iPhone users." Do you agree with this characterization?

A. No. Dr. Selwyn misquotes our white paper. Our conclusion was the opposite of what Dr. Selwyn asserts.[43] Our white paper explained that Android phones represent a majority share of the U.S. smartphone market and that Android and iPhone users "are *not* substantially different in several dimensions" (emphasis added).[44] We never said that there is a "significant income gap" between users of the two device types.

The data contradict Dr. Selwyn's assertion. In our white paper we evaluated the distribution of median income of the home zip codes of consumers in the NMP data and found it to be reasonable and similar to the distribution of median income across all zip codes in the United States, meaning that Dr. Selwyn is wrong to assert that iPhone users are significantly different in this regard.[45]

To summarize, Dr. Selwyn has no basis for his claim other than misquoting us. He ignores the fact that the data contradict him. Furthermore, even if his assertion of a significant income gap between iPhone and Android phones were true, he has done nothing to demonstrate that it would meaningfully change the bottom line conclusion of our analysis.

Q. Dr. Selwyn criticizes your analysis for not accounting for the exact price each consumer paid for their plan. How do you respond?

A. Dr. Selwyn criticizes our analysis for using an average price for each brand, rather than explicitly modeling the different plans each brand offers.[46] Dr. Selwyn does not explain whether and how he expects this to affect our bottom line conclusion in any way. In fact, it has no effect on the validity of our analysis whatsoever.

[43] Selwyn Testimony, pp. 100, 103.

[44] Asker, Bresnahan, and Hatzitaskos White Paper, fn. 87.

[45] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 204.

[46] Selwyn Testimony, pp. 111–112.

Using average price is standard practice in the academic literature and the practice of antitrust enforcement agencies. What is important in the analysis of competitive effects is to capture average differences in *relative* prices, e.g., whether any given Verizon plan tends to be more expensive than the most equivalent T-Mobile plan.[47] This is exactly what we do in our analysis.

Furthermore, Dr. Selwyn has not even attempted to demonstrate that using alternative measures of price would have any impact on the bottom line conclusions of our analysis.

Q. Dr. Selwyn also claims that your analysis assumes that consumers respond to price changes by switching brands when they could instead switch plans. How do you respond?

A. Dr. Selwyn's assertion that our model assumes that all consumer responses to price changes are to switch across brands is wrong.[48] It is unclear if Dr. Selwyn means this false assertion as a criticism, since he does not explain whether and how this would change our overall conclusion that the proposed merger is procompetitive.

His claim also misunderstands the relevant economic question in merger reviews, which is whether the proposed merger will strengthen or lessen competition. An analysis of competitive effects therefore evaluates not the merging firm's incentive to raise a single plan price while keeping the prices of other plans constant, but rather its competitive incentives to raise prices relative to other firms.

[47] For example, the academic literature on automobile choice has evaluated policy questions using econometric models that use a single price for all Toyota Corollas, regardless of the drivetrain options a consumer chooses or the amount that they negotiated off the listed price. What is important in answering questions of competition is the extent to which a BMW 3-Series is more expensive, on average, than a Toyota Corolla, rather than getting the price that each consumer paid exactly right. Berry, Steven, James Levinsohn, and Ariel Pakes, "Automobile prices in market equilibrium." *Econometrica: Journal of the Econometric Society* Vol. 63 No. 4, 1995, pp. 841–890.

[48] Selwyn Testimony, pp. 111–112. Consumers that face a price increase in our model can choose to stay with their current brand, including switching to a different plan, or switch to another brand. The analysis of "diversion," to which Dr. Selwyn refers when making his erroneous claim, focuses specifically on which brands customers will tend to choose *for those customers who decide to switch brands*.

To the extent that the merged firm introduces multiple plans that entice some consumers to switch from one merged firm plan to another, rather than to a competitor, this can only make our analysis conservative. For example, T-Mobile has offered tailored plans that are uniquely attractive to certain groups of consumers that are different than others, e.g., with its "over 55" plan for consumers ages 55 and older.[49] If Dr. Selwyn's argument is that some consumers may value the New T-Mobile network quality improvements less than other consumers, the merged firm will be incentivized to offer plans that provide better value to these consumers. In other words, New T-Mobile would be incentivized to retain or win the business of these consumers by offering plans that they will find attractive. Again, Dr. Selwyn gets the economics backwards: By focusing on brand competition rather than these kinds of responses to demand by the merged firm, our analysis likely underestimates the procompetitive effects of the proposed merger.

Finally, Dr. Selwyn's statements regarding intra-brand switching providing a "simple solution that does not involve purchasing a new handset" betrays a lack of familiarity with competition in the mobile industry. Switching brands need not require purchasing a new mobile device, as evidenced by the many bring-your-own-device ("BYOD") deals in the industry.[50]

[49] T-Mobile, "Unlimited 55+, 2 lines $70/month," available at: https://www.t-mobile.com/offers/t-mobile-one-unlimited-55, accessed January 25, 2019.

[50] Verizon, "Bring your own phone," available at https://www.verizonwireless.com/bring-your-own-device/, accessed January 23, 2019.

Q. Dr. Selwyn claims that "by failing to separate postpaid from prepaid customers" in your data, your measures of network speed and coverage are not comparable across brands. How do you respond to his claims?

A. Dr. Selwyn is wrong.[51] As we explain in our white paper, our analysis distinguishes between the different brands owned by each carrier.[52] For example, we separate T-Mobile's MetroPCS brand from T-Mobile-branded plans. This distinction is important, because MetroPCS, Boost/Virgin, and Cricket are exclusively prepaid.

We explained in our white paper that the NMP data **[BSC-AEO]** [redacted].[53] **[ESC-AEO]** However, the vast majority of consumers that choose these brands are postpaid. This share is over 99 percent for Sprint, over 93 percent for Verizon and AT&T, and over 80 percent for T-Mobile.[54] Dr. Selwyn offers no evidence that the presence of some prepaid customers within these brands would have any meaningful impact on the bottom-line results of our analysis.

Moreover, Dr. Selwyn cites to his Table 9 to show that Sprint and T-Mobile account for 58.9 percent of prepaid subscribers.[55] However, Table 9 shows *carrier-level* subscriber shares, which comingle brands owned by each firm. As explained above, our analysis does not.[56]

[51] Selwyn Testimony, pp. 109–110.

[52] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 25 and fn. 19.

[53] Asker, Bresnahan, and Hatzitaskos White Paper, ¶ 25 and fn. 19.

[54] For a detailed discussion of how we calculate prepaid and postpaid shares, see Asker, Bresnahan, and Hatzitaskos White Paper, § 5.1.9 ("Weighting NMP consumers to align with subscriber shares.").

[55] Selwyn Testimony, p. 109.

[56] For example, Dr. Selwyn's Table 9 combines MetroPCS with all other brands owned by T-Mobile. Yet, it is MetroPCS that accounts for the vast majority of T-Mobile's prepaid customers, and as explained above, our analysis treats MetroPCS separately from other T-Mobile-branded plans.

Q. Dr. Selwyn claims that the NMP data underrepresents certain brands, such as AT&T, and seems to suggest this undermines the reliability of your analysis. Do you agree with his characterization of the NMP data and your analysis?

A. Dr. Selwyn's assertion is wrong on multiple counts.[57] Once again, his claims reveal that he has not examined or analyzed the data and that he misunderstands our methodology. His assertion has no impact on the validity of our approach.

Dr. Selwyn claims, without providing any empirical support, that AT&T customers are "likely" underrepresented in the NMP data.[58] Had he reviewed the NMP data or our initial white paper, Dr. Selwyn would have seen that this is not the case. There is no shortage of consumers who choose AT&T in the NMP data.[59]

Even if the sample included fewer AT&T consumers, his concern would be irrelevant because our methodology already weights consumers according to subscriber share to make the analysis representative at both local and national geographic levels. We already explained this process in our initial white paper.[60]

[57] Selwyn Testimony, pp. 104, 109.

[58] Selwyn Testimony, p. 104.

[59] Asker, Bresnahan, and Hatzitaskos White Paper, Exhibit 75.

[60] For example, suppose Dr. Selwyn is correct that the NMP data under-samples AT&T consumers in the LA Metro Area relative to AT&T's real-world subscriber share in that "market area." Our methodology would give relatively more "weight" to each AT&T consumer in the NMP dataset so that AT&T's relative share of subscribers in the LA Metro Area would be representative of its real-world share of subscribers. As we explain in our white paper, we do this for each brand, in each Sprint/KPMG "market area," and nationally. See Asker, Bresnahan, and Hatzitaskos White Paper, § 5.1.9 ("Weighting NMP consumers to align with subscriber shares").

Q. Dr. Selwyn suggests that your price measure does not appropriately account for taxes and fees. Do you agree with this characterization?

A. No. As we explained in our white paper, we use ARPU ("average revenue per user") as our measure of brand price.[61] Dr. Selwyn himself acknowledges that ARPU is widely used in the industry for comparisons between brands.[62] In particular, the ARPUs we use exclude taxes and fees for every brand, including T-Mobile. We therefore make an apples-to-apples comparison across brands.[63]

Dr. Selwyn also argues that we do not account for local variation in taxes and fees.[64] This claim is also false. Our model accounts for the extent to which brands are more or less attractive across different geographies, including the effect of local variation in taxes and fees.[65]

Q. Dr. Selwyn claims your analysis ignores the potential for coordinated effects after the proposed merger. How do you respond?

A. Our analysis is a unilateral effects analysis. It speaks to the change in the merged firm's incentives to independently raise or lower prices for its products, not directly to coordinated effects. Prof. Salop and Dr. Sarafidis have separately explained why the proposed merger is unlikely to lead to coordinated effects.[66]

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[61] Asker, Bresnahan, and Hatzitaskos White Paper, Exhibit 83 and § 5.2.3 ("ARPUs").

[62] Selwyn Testimony, p. 81.

[63] Dr. Selwyn also acknowledges that excluding taxes and fees is necessary to make prices comparable. See Selwyn Testimony, p. 26.

[64] Selwyn Testimony, pp. 116–117.

[65] Asker, Bresnahan, and Hatzitaskos Response to DISH/CWA, § 2.5 ("Our model already controls for other differences across brands, such as advertising and retail stores").

[66] Professor Steven Salop and Dr. Yianis Sarafidis, "Coordinated Effects Analysis of the Proposed T-Mobile/Sprint Merger Transaction," June 18, 2018, available at https://ecfsapi.fcc.gov/file/10618281006240/Public%20Interest%20Statement%20and%20Appendices%20A-J%20(Public%20Redacted)%20.pdf; and Professor Steven Salop and Dr. Yianis Sarafidis, "Reply to Harrington / Brattle Declaration on the Coordinated Effects Analysis of the Proposed T-Mobile/Sprint Merger Transaction," September 17, 2018, available at https://ecfsapi.fcc.gov/file/109171182702890/Appendices%20A-K%20(Public).pdf.

However, I note that two of our findings support the conclusion that the transaction will not have any adverse coordinated effects and thus further reinforce the conclusion of Prof. Salop and Dr. Sarafidis. Dr. Selwyn ignores these two results.[67]

- Product quality in the wireless industry is strongly individualized and depends on where, when, and how each individual consumer utilizes his or her mobile phone. Because brands compete based on individual network quality, reaching and monitoring agreements to coordinate to compete less aggressively is much harder than it would be in an industry where this was not the case.
- Our analysis shows that the proposed merger will make New T-Mobile a more effective competitor against AT&T and Verizon than the standalone companies. This injection of competition against the two leading firms also makes it unlikely that there will be an increase in coordination.

[67] Selwyn Testimony, pp. 118, 125.

V. CWA'S CLAIMS REGARDING LOW-INCOME AND PERSONS OF COLOR

Q. In its testimony, CWA argues that the proposed merger is likely to harm low- and moderate-income consumers as well as persons of color. How do you respond to their claims?

A. Ms. Goldman, Dr. Afflerbach, and Mr. Dehaven are wrong in their belief that the proposed merger is likely to harm lower income consumers and persons of color.[68] Our analysis finds the opposite. Precisely because these consumers rely on their wireless service more heavily than others do, they are among the consumers that will benefit the most from network quality improvements and therefore from the proposed merger.[69] And, consistent with that conclusion, our analysis finds that the heaviest data users are the consumers who value quality the most.[70] One explanation for this may be that these consumers are less likely to invest in expensive in-home broadband connections than others, and therefore rely more heavily on their cell phone as their main access to the internet.[71]

Q. Can you explain in more detail what the NMP data show regarding California consumers who rely more heavily on their wireless service than other consumers?

A. First, I show in Exhibit 10 that California consumers who choose the merging party brands are more likely to be heavy data users, meaning that they use at least 3 GB of data or more per month. For instance, 53 percent of MetroPCS subscribers in California are heavy data users. By contrast, only 39 percent of AT&T consumers in California are heavy data users.

[68] CWA Testimony, pp. iii and 15.

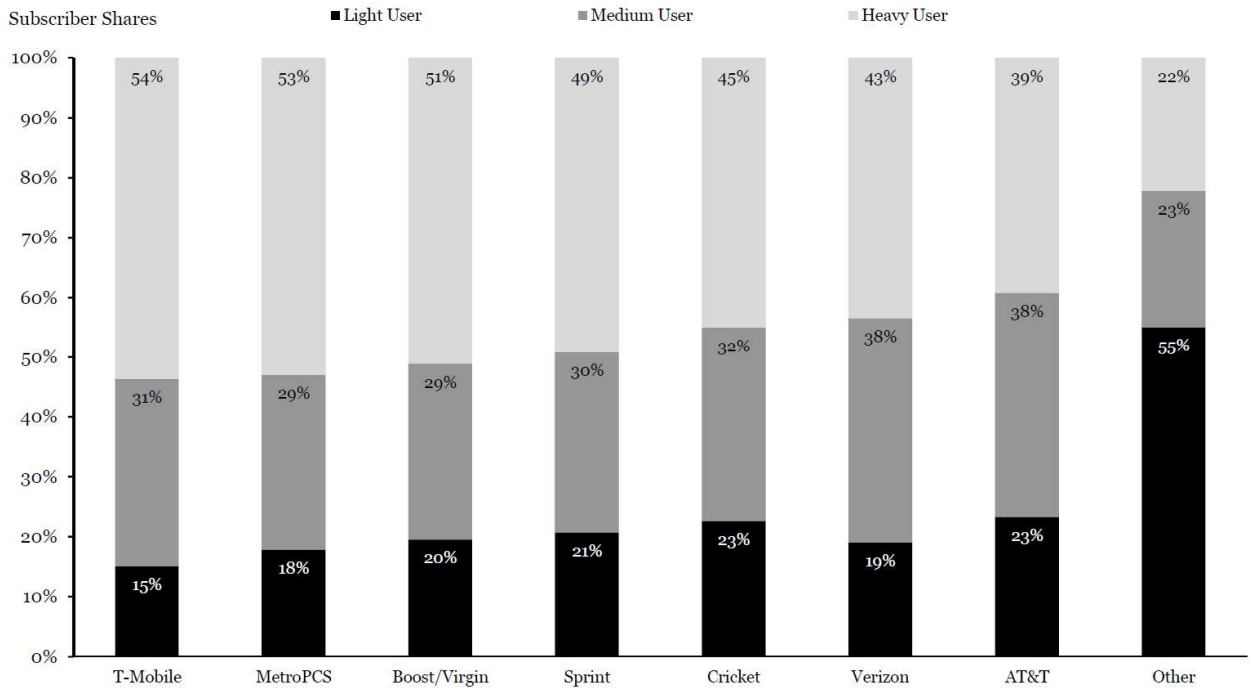
[69] Asker, Bresnahan, and Hatzitaskos White Paper, § 3 ("Econometric model of demand"); and Asker, Bresnahan, and Hatzitaskos FCC Presentation, pp. 27–32.

[70] Asker, Bresnahan, and Hatzitaskos White Paper, Exhibits 5 and 6.

[71] Pew Research Center, "Internet/Broadband Fact Sheet," February 5, 2018, available at http://www.pewinternet.org/fact-sheet/internet-broadband/, accessed January 25, 2019.

EXHIBIT 10

Share of California subscribers who are light, medium, and heavy data users for each brand in the NMP data



Source: KPMG StreamShare Data; Nielsen Mobile Performance Data

Note: Light data users are users that on average utilized less than 30 megabytes of data per day. Medium data users utilized on average between 30 and 100 megabytes of data per day. Heavy data users utilized on average more than 100 megabytes per day. For each category, the bar shows the shares of subscribers for each brand by using the consumer choices as found in the NMP data, and weighing them according to the KPMG subscriber shares.

Second, the NMP data show that heavy data users in California are more likely to be in areas with lower median incomes, lower average credit scores, and higher proportion African American or Hispanic.

- **Zip code median income.** Heavy data users make up 48 percent of consumers in the lowest quartile of zip code incomes (under $46 thousand), compared to 40 percent in the highest quartile (over $78 thousand).
- **Zip code average credit score.** Heavy data users make up 49 percent of consumers in the lowest quartile of zip code credit scores (less than 660), compared to 39 percent in the highest quartile (greater than 706).

- **Zip code share African American or Hispanic.** Heavy data users make up 52 percent of consumers in the highest quartile of zip code proportion African American or Hispanic (more than 66 percent), compared to 39 percent in the lowest quartile (less than 27 percent).

Q. You have explained that heavy data users are more likely to be located in areas with lower median incomes, lower average credit scores, and higher proportion African American or Hispanic. Can you explain what the NMP data show regarding which brands tend to be chosen by California consumers located in these areas?

A. The NMP data show that although the merging firms do relatively better with California consumers in zip codes with lower median incomes, lower average credit scores, and higher proportions of African American or Hispanic consumers, AT&T and Verizon are still significant competitors in these areas. For example:

- **Zip code median income.** Together, even setting Cricket aside, the AT&T and Verizon brands account for 45 percent of consumers who live in the lowest quartile of zip codes by median income (where the median income is under $46 thousand).
- **Zip code average credit score.** Together, even setting Cricket aside, the AT&T and Verizon brands account for 43 percent of consumers who live in the lowest quartile of zip codes by average credit score (where the credit score is less than 660).
- **Zip code share African American or Hispanic.** Together, even setting Cricket aside, the AT&T and Verizon brands account for 38 percent of consumers who live in the highest quartile of zip codes by the share of consumers who are African American or Hispanic (zip codes where the share is more than 66 percent).

These statistics explain the high rates of diversion we calculated between merging party brands and AT&T and Verizon brands in Exhibit 7. AT&T and Verizon are significant competitors for all consumers, including consumers who live in zip

codes with lower median incomes, lower average credit scores, and a higher share of African American and Hispanic consumers.

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

Attachment A

John Asker, Timothy Bresnahan, and Kostis Hatzitaskos, "Economic Analysis of the Proposed T-Mobile/Sprint Merger," November 6, 2018

AVAILABLE REDACTED AT
https://ecfsapi.fcc.gov/file/11060648404338/nov.%206%20public%20supprespon se.pdf

—PUBLIC VERSION—

Attachment B

John Asker, Timothy F. Bresnahan, and Kostis Hatzitaskos, "Response to Dish and CWA Comments," December 18, 2018

—PUBLIC VERSION—

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December 18, 2018

VIA HAND DELIVERY

Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

HIGHLY CONFIDENTIAL INFORMATION – SUBJECT TO PROTECTIVE ORDER IN WT DOCKET NO. 18-197 BEFORE THE FEDERAL COMMUNICATIONS COMMISSION

Re: Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations; WT Docket No. 18-197

Dear Ms. Dortch:

Pursuant to Section 1.1206(b) of the Commission's Rules, 47 C.F.R. § 1.1206(b), notice is hereby provided of a written *ex parte* presentation in the above-referenced docket. On December 4, 2018, DISH Network Corporation and the Communications Workers of America submitted comments[1] regarding a study prepared by John Asker, Timothy Bresnahan, and Kostis Hatzitaskos of Cornerstone Research that was submitted by the Applicants in this proceeding (the "Cornerstone Analysis").[2] In the attached response, Drs. Asker, Bresnahan and Hatzitaskos address the arguments raised by DISH and CWA as well as those commenters' misunderstandings or misrepresentations about how the Cornerstone Analysis relates to and is complementary of the analysis submitted by Mark Israel, Michael Katz and Bryan Keating.[3]

[1] DISH Network Corporation, Comments in Response to Public Notice Regarding Cornerstone Report, WT Docket No. 18-197 (Dec. 4, 2018); Comments of Comments of Communications Workers of America on Applicants' New Econometric Study, WT Docket No. 18-197 (Dec. 4, 2018).

[2] Economic Analysis of the Proposed T-Mobile/Sprint Merger, attached to Letter from Nancy J. Victory, Counsel for T-Mobile US, Inc., to Marlene H. Dortch, Secretary, FCC, WT Docket No. 18-197 (Nov. 6, 2018).

[3] Declaration of Mark Israel, Michael Katz and Bryan Keating, App. F to Joint Opposition of T-Mobile US, Inc. and Sprint Corporation, WT Docket No. 18-197 (Sept. 17, 2018).

Also being submitted are certain back-up support for the response as well as data referenced in footnote 121 of the Cornerstone Analysis.

This filing contains information that is "Highly Confidential" pursuant to the Protective Order filed in WT Docket No. 18-197.[4] Accordingly, pursuant to the procedures set forth in the Protective Order, a copy of the filing, including the attached disk, is being provided to the Secretary's Office. In addition, two copies of the Highly Confidential Filing, including the attached disk, are being delivered to Kathy Harris, Wireless Telecommunications Bureau. A copy of the Redacted Highly Confidential Filing is being filed electronically through the Commission's Electronic Comment Filing System.

Please direct any questions regarding the foregoing to the undersigned.

Respectfully submitted,

DLA Piper LLP (US)

/s/ Nancy Victory

Nancy Victory
Partner

cc: Kathy Harris

[4] Applications of T-Mobile US, Inc., and Sprint Corporation for Consent to Assign Licenses, Protective Order, WT Docket No. 18-197 (June 15, 2018). Pursuant to discussions with Staff, custodial documents and data and materials being provided with this response, unless specifically reviewed and downgraded, have been classified as "Highly Confidential." Notwithstanding that default classification, Applicants are not asserting Highly Confidential status for any documents that have been publicly released (which would be Public) or for third party materials that are copyrighted (which would be considered Confidential).

ATTACHMENT A

CORNERSTONE RESEARCH
ECONOMIC AND FINANCIAL CONSULTING AND EXPERT TESTIMONY

RESPONSE TO DISH AND CWA COMMENTS

By John Asker,[*] Timothy F. Bresnahan,[†] and Kostis Hatzitaskos [‡]

December 18, 2018

[*] John Asker is a Professor of Economics at the University of California at Los Angeles, where he holds the Armen A. Alchian Chair in Economic Theory.

[†] Timothy Bresnahan is a Professor of Economics at Stanford University, where he holds the Landau Professorship in Technology and the Economy.

[‡] Kostis Hatzitaskos is a Vice President in the Chicago office of Cornerstone Research.

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1. Introduction

1. We previously submitted an economic analysis of the proposed merger that empirically assessed its likely competitive effects using rich, present-day data.[1] We later discussed our analysis with Commission staff.[2]

2. As we described in our initial white paper, our analysis employed the Nielsen Mobile Performance ("NMP") data. These data provide extremely granular information on consumer behavior: where, when, and how more than consumers use their mobile phones.

3. We used this rich variation to estimate a flexible model of consumer demand. Controlling for price and a multitude of product and consumer characteristics, our demand estimation demonstrates that different consumer types all value network quality and are more likely to choose a brand if it offers good network quality given their individualized usage patterns. We focused our analysis on two dimensions of network quality: speed and coverage. In addition to average speed and coverage, we also evaluated how the worst speed and coverage experienced by each consumer affected their brand choice, which speaks to consumer preferences for consistency.[3]

4. Building on these estimates, we conducted a series of merger simulation analyses to quantify the likely effect of the proposed merger on pricing incentives for the merged firm and its competitors. We found that the proposed merger is likely to increase competition among wireless carriers. In particular, under a range of assumptions about marginal cost efficiencies and network quality improvements, we found that New T-Mobile will gain subscriber share, consistent with an expansion of output and welfare gains for consumers.[4]

5. We have already described our analysis in great detail in our initial white paper, including its extensive and detailed technical appendix.

[1] John Asker, Tim Bresnahan, and Kostis Hatzitaskos, "Economic Analysis of the Proposed T-Mobile/Sprint Merger," November 6, 2018 ("Initial White Paper").

[2] John Asker, Tim Bresnahan, and Kostis Hatzitaskos "Economic Analysis of the Proposed T-Mobile/Sprint Merger: Presentation to Federal Communications Commission," December 3, 2018 ("Presentation to FCC Staff").

[3] Initial White Paper, § 3.1.

[4] Initial White Paper, ¶ 4.

6. DISH Network Corporation ("DISH") and Communications Workers of America ("CWA") recently submitted economist declarations by Coleman Bazelon, Jeremy Verlinda, and William Zarakas of the Brattle Group,[5] and Heski Bar-Isaac of the University of Toronto's Rotman School of Management,[6] respectively. We have been asked by counsel for the merging parties to respond to the DISH and CWA comments. We do so in the rest of this document.

7. Bazelon, Verlinda, Zarakas, and Bar-Isaac make certain theoretical arguments, claiming that some of our assumptions and results are faulty. We begin with a high level review of certain aspects of our analysis and reiterate why they are appropriate, in line with the academic literature, and have strong foundation in detailed consumer behavior data (§ 2).

8. We then clarify some of the misunderstandings or misrepresentations by DISH and CWA about how our analysis relates to and is complementary of the analysis submitted by Mark Israel, Michael Katz, and Bryan Keating (§ 34).[7] In particular, we discuss the relationship between the measures of speed each analysis uses, as well as the network quality improvements and marginal cost reductions the merging parties expect to result from the network integration.

9. Finally, we review the analytical critiques conducted by Bazelon, Verlinda, and Zarakas and explain that they are incomplete, rejected by the data, and inconsistent with the academic literature (§ 4). We then conclude (§ 5).

[5] Coleman Bazelon, Jeremy Verlinda, William Zarakas, "Further Reply Declaration," December 4, 2018 ("Bazelon, Verlinda, and Zarakas Declaration").

[6] Heski Bar-Isaac, "Comments on T-Mobile/Sprint Cornerstone Study," December 4, 2018 ("Bar-Isaac Declaration").

[7] Reply Declaration of Mark Israel, Michael Katz, and Bryan Keating, September 17, 2018 ("Israel, Katz, and Keating Declaration").

2. Our merger simulation offers a robust, economically coherent framework, grounded in detailed industry data, for understanding the competitive significance of the proposed merger

10. In this section, we review certain elements of our analysis and reiterate why they are appropriate, in line with the academic literature, and have strong foundation in detailed consumer behavior data.

2.1. The diversion ratios between the merging parties that our analysis estimates are more appropriate to the analysis of competitive effects than the historical porting between the two carriers

11. Both Commission staff and the academic literature recognize that the question that is relevant to evaluating a proposed merger's competitive effects is how many consumers would switch away from a product and what other products they would substitute to *in the event of a price increase or quality decrease*.[8] This last qualifier is important, as any evaluation of the merged firm's incentives must focus on substitution that arises from changes in supplier behavior. This is not just about the quality of a data source that measures switching; it is something fundamentally different from generalized switching data.

12. The NMP data enable the estimation of a detailed and flexible demand model that, consistent with the academic literature, estimates the diversion ratios that are actually relevant to assessing the competitive effects of the proposed merger. These diversion ratios reflect the closeness of competition between any two brands, taking into account product and consumer characteristics, including the individualized quality each brand offers to particular consumers given their unique usage patterns.[9]

13. Such estimates have not been available to the Commission when it has assessed prior wireless mergers. The Commission has previously relied on porting data to proxy for diversion ratios while recognizing its potential shortcomings, including the fact that switchers may do so in response to factors other than changes in price or quality and the fact that porting data capture a

[8]Federal Communications Commission Staff Analysis and Findings, Appendix C, ¶ 8 and fns. 9 and 10; Horizontal Merger Guidelines § 6.1.

[9] Initial White Paper, § 2.2.3.

non-random sample of switchers.[10] The availability of our estimates of diversion ratios allows the Commission to avoid determining which sources of switching data (e.g., porting data versus survey data) are a more accurate proxy here and to use a more appropriate estimate.

14. Data on consumer switching from one product to another, whether derived from porting data or other sources, mix changes in demand and supply, making them generally inappropriate measures for the purpose at hand. To understand why, consider automobiles. If we evaluate switching data, we might observe many men in their thirties switching from sports cars to minivans. This does not mean that sports cars and minivans are close substitutes, or that raising the price of one would lead many to switch to the other. Instead, it suggests that these individuals are experiencing a life event that is causing them to switch.

15. Similarly in the case of wireless phone service, consumers may switch from one brand to another for a variety of demand-driven reasons, e.g., because they or a family plan member moved, because their old phone broke down, or because they missed a monthly payment.

16. Although the availability of appropriate estimates of diversion ratios makes it unnecessary to determine the best source of switching data, it is important to understand that porting data suffer from additional shortcomings relative to other forms of switching data. Specifically, porting data catalogue switching only by those consumers who choose to "port" or transfer their number from one brand or network to another. We understand from discussions with executives that porting data do not reflect all switching in the wireless industry and that the non-random sample of switches that they reflect tends to overstate switches between Sprint and T-Mobile.[11]

17. Even though we understand business people use porting data to consider directional changes, porting data is clearly inferior to our estimates of diversion ratios for purposes of a competitive effects analysis. If porting data were driven by supplier behavior, i.e., changes in quality-adjusted prices, then we would

[10] Federal Communications Commission Staff Analysis and Findings, Appendix C, ¶¶ 9–10. For other examples of porting data being used to review wireless telecom mergers, see Israel, Katz, and Keating Declaration, fn. 172 on p. 126.

[11] For example, we understand that MVNOs rarely tie promotions and pricing to porting and so are underrepresented in porting data. For a further discussion of the potential problems with using porting data as a proxy for diversion ratios, see Israel, Katz, and Keating Declaration, Appendix I.C.3; and Mark Israel, Michael Katz, and Bryan Keating, "Additional Information Regarding the Estimation of Diversion Ratios," December 14, 2018.

expect switchers to only move in one direction at any given point in time, away from the brand that raised quality-adjusted prices or towards the brand that lowered them. Instead, we routinely see sets of consumers porting in both directions at the same time,[12] which is inconsistent with switching behavior driven exclusively by supply shocks, such as a price change. Our analysis avoids this and other concerns raised by the Commission in prior transactions about relying on porting data.

2.2. We are not aware of any promotions that can reliably be used to study diversion ratios

18. Given the high frequency of pricing promotions in this industry, we are not aware of isolated pricing or promotional events that could be used to cleanly estimate diversion ratios, or to study the relationship between diversion ratios and historical porting data.[13] Nor are we aware of ordinary course analysis that attempts this task.

19. Moreover, any study of promotions or other price changes as a driver of brand switching needs to focus purely on supply-driven promotions or pricing events. We are not aware of any evidence that establishes that the frequent promotions we observe are driven only by cost or other shocks to supply, as opposed to being at least partly based on business peoples' assessment of changing demand.

20. The simple facts remain that porting data capture a biased sample of switches and that it routinely mixes demand- and supply-driven switches, as evidenced by the movement of consumers in both directions. These facts mean that using porting data, even when focusing on a promotional period, is likely to lead to estimates of diversion ratios that are inferior to those that can be obtained by a rigorous econometric estimation of consumer choice. This is the approach followed by the academic literature, as well as the approach that we have followed in our initial white paper, using the granular NMP data.

[12] See our workpapers.

[13] For examples demonstrating the complex overlapping promotions in this industry, consider SPR-FCC-02396530–31 and SPR-FCC-02665524–25.

2.3. One cannot predict the competitive effects of the proposed merger simply by comparing different countries with three or four wireless competitors

21. DISH argues that a report from Rewheel Research commenting on mergers in Europe suggests that 4-to-3 mergers in the wireless industry increase prices.[14] Many factors vary between any two countries, including differences in landmass, population density, spectrum allocation, and regulatory conditions. Rewheel Research does not make any attempt to control for any of these factors. It is inappropriate to suggest that a cursory analysis that cannot control for any such factors and is focused on conditions in Europe and other parts of the world has any bearing on the likely competitive effects of the proposed merger which is a merger between US wireless providers.

2.4. Our analysis appropriately estimates consumers' sensitivity to price, while controlling for many other product and consumer characteristics

22. Our analysis directly incorporates consumers' sensitivity to price. DISH argues that our model ignores the role income plays in consumer willingness to pay for wireless services.[15] This argument is false. Our rich model of consumer choice estimates how consumers trade off price, network quality, and several other product characteristics, all the while controlling for various consumer characteristics, including income.[16] Our results show that, *everything else equal*, a consumer is more likely to choose a brand if it offers better individualized network quality given that particular consumer's unique usage patterns.[17] The data confirm that many consumers do not always choose the highest-quality brand.[18]

[14] DISH Network Corporation, "Comments in Response to Public Notice Regarding Cornerstone Report," December 4th 2018, fn. 41 on p. 21, citing http://research.rewheel.fi/downloads/The_state_of_4G_pricing_DFMonitor_10th_release_2H2018_PUBLIC.pdf ("Rewheel Report").

[15] DISH Network Corporation, "Comments in Response to Public Notice Regarding Cornerstone Report," December 4th 2018, pp. 3, 7. See § 4 for additional detail addressing the critiques of DISH and Bazelon, Verlinda, and Zarakas.

[16] We described our demand estimation framework in detail in our initial white paper, §§ 3.1, 5.3.1.

[17] For detailed results and discussion, see our initial white paper, § 3.2.

[18] For example, consider initial white paper fn. 44, on p. 19 [redacted]

23. In particular, our demand model allows for the data to speak to the extent that lower-priced, non-premium brands may be closer substitutes for certain consumers, e.g., consumers with lower income, lower credit scores, and consumers who tend to travel to fewer locations.[19] Our demand model also directly incorporates price and reflects that consumers differ in how much they are willing to pay for a brand that improves its quality.[20] This also means that when a brand lowers its price, some consumers will be willing to choose that brand even if it means a reduction in network quality, while other consumers will not.

2.5. Our model already controls for other differences across brands, such as advertising and retail stores

24. The Bazelon, Verlinda, and Zarakas and Bar-Isaac declarations present theories that our model omits important factors that are correlated with network quality, such as advertising intensity and retail store locations.[21] They claim these omissions may lead our results to overstate the value consumers place on network quality. Neither declaration provides any empirical evidence to support this speculation, which is incorrect and at odds with standard practice in demand estimation.

25. As described in our white paper, we use rich data at the individual consumer level to estimate our demand model using methods that are standard in the academic literature. To identify the effect that network quality has on consumer choice, our model holds constant everything that may be the same across two consumers within a geographic area and asks whether and by how much a consumer is more likely to choose a brand if the brand offers greater individualized network quality.

26. Consider two consumers that live in the same city and who are considering whether or not to choose T-Mobile. These consumers face the same national price and the same level of national or local perception of overall network quality, advertising, reputation, service, and retail stores. However, the network quality that T-Mobile offers each consumer is ultimately *individualized* based on exactly where, when, and how each of them uses their phone. It is this variation in quality that our model focuses on when estimating whether and

[19] Initial White Paper, ¶ 61 and Exhibit 5.
[20] Initial White Paper, ¶ 63 and Exhibit 6.
[21] See Bazelon, Verlinda, and Zarakas Declaration, p. 7 and Bar-Isaac Declaration, p. 4.

how incremental network quality can make a given individual more likely to choose a brand.[22]

27. Controlling for such differences across brands is standard practice. The criticisms of Bazelon, Verlinda, and Zarakas and Bar-Isaac are not only unfounded, they also reflect a misunderstanding of our model.

2.6. Nielsen's consumer recruitment and selection process for the NMP dataset

28. Based on conversations with Nielsen, we understand the following.

29. [redacted]

30. [redacted]

31. [redacted]

[22] Our model includes variables that account for factors that commonly affect the brand valuation of consumers of a specific data usage type. The model accounts for differences in perception of each brand between heavy, medium, and light data users. For example, if heavy data users are especially sensitive to marketing claims made by Verizon about the quality of its network, the model will reflect and account for this difference that specifically affects heavy data users' preference for Verizon. Similarly, the model will also account for the extent to which a brand offers unlimited plans that particularly appeal to heavy usage types. Our model also includes fixed effects that account for differences in consumers' valuation of each brand in each Sprint/KPMG "market area." For example, it will account for a brand that advertises more in a particular area, or if a brand invests in more retail stores in the area. For a detailed discussion of our demand specification, see initial white paper, § 5.3.1.

[23] [redacted]

[redacted]

32. [redacted]

33. [redacted]

34. In our initial white paper we also conducted a series of checks and found the NMP data to be [redacted].[25] [redacted].[26]

[redacted][24]

[25] Initial White Paper, § 5.1.8.

[26] Initial White Paper, Exhibit 49.

[redacted][27]

[27] Initial White Paper, Exhibit 46.

3. The analysis in our initial white paper is complementary to the results and approach Israel, Katz, and Keating took in their analysis

35. As explained in our initial white paper, our analysis is complementary to the analysis submitted by Israel, Katz, and Keating. Their analysis has strong foundations in the network engineering work done by the merging parties, while our work is based on detailed present-day micro data. Their work also focuses on the effects of 5G speed improvements, while our work focuses on the impact of network quality improvements within the range observed in present-day, LTE-era data.[28]

36. The analyses rely on different data. Israel, Katz, and Keating calibrate a model of demand and supply to aggregated data based on the best available projections about 2021 and beyond. Our analysis uses extremely granular and newly available data on consumer choice, usage behavior, and individualized network quality at the level of individual consumers. We then use that data to estimate a model of demand and supply based on competition today.

37. The analyses also differ in the analytical tasks they address. Israel, Katz, and Keating use the diversion ratio between Sprint and T-Mobile brands as an *input* and test the sensitivity of their results for a range of values. In contrast, diversion ratios are an *output* of our analysis, namely our detailed model of consumer choice. In that sense, our analysis reinforces the findings of Israel, Katz, and Keating, in that we find that the appropriate diversion ratios to use for purposes of merger analysis are among the lower end of the range that Israel, Katz, and Keating considered. Thus the merger is more likely to be procompetitive than would be indicated by their original baseline.[29]

38. In the rest of this section, we clarify other elements of how the two analyses relate to and reinforce one another.

[28] Initial White Paper, fn. 11 on p. 4.

[29] Initial White Paper, ¶ 79.

3.1. The standardized speeds in the initial white paper are lower than but consistent with the speeds in the merging party network model and the Israel, Katz, and Keating analysis

39. In our initial white paper, we explained that the measure of speed we rely on in our model is different from but related to the measure of speed that underlies the Israel, Katz, and Keating analysis and the network engineering work of the merging parties.[30] This is not surprising. The wireless industry uses multiple measures of quality, including multiple measures of speed. This is no different than other industries with complex products. For example, automobile manufacturers describe the performance of their vehicles by reporting measures such as horsepower, torque, acceleration, and top speed.

40. The speeds that underlie the Israel, Katz, and Keating analysis are outputs from a particular type of speed test, the Ookla speed test. The Ookla speed test first identifies the nearest available server and then initiates a download event for multiple large files.[31] In this sense, Ookla is optimized to measure the maximum speed that a network can bear at a certain time and location.

41. By contrast, the speeds recorded in the NMP data measure the actual speed experienced by phone users while they are using regular applications. In other words, the NMP application passively monitors the data that a phone exchanges with the network as users normally go about their day. There are several reasons why these delivered speeds would be lower than Ookla speeds, on average.

42. First, the difference in average speeds between the NMP and the Ookla data is partly due to the TCP/IP protocol that mediates communication over the internet. This protocol has the effect that smaller files tend to experience slower

[30] Initial White Paper, fn. 14 on p. 8.

[31] Ookla, "How does the Begin Test button select a server?," January 11, 2012, available at https://support.speedtest.net/hc/en-us/articles/203845410-How-does-the-Begin-Test-button-select-a-server- ("Once you press Begin Test, we take your location and determine up to five nearby servers (using spherical geometry). We then ping those nearby servers, and choose the server with the lowest result, meaning it took the shortest time for a response. This is the server that's 'closest' on the network, and usually provides the most accurate results. We can then begin the full test process: measuring your ping, download speed, and upload speed."); and Ookla, "How does the test itself work? How is the result calculated?," January 13, 2012, available at https://support.speedtest.net/hc/en-us/articles/203845400-How-does-the-test-itself-work-How-is-the-result-calculated- ("1. The client establishes multiple connections with the server over port: 8080. The client requests the server to send an initial chunk of data. 2. The client calculates the real-time speed of the transfers, then adjusts the chunk size and buffer size based on this calculation to maximize usage of the network connection. 3. As the chunks are received by the client, the client will request more chunks throughout the duration of the test. 4. During the first half of the test, the client will establish extra connections to the server if it determines additional threads are required to more accurately measure the download speed. 5. The test ends once the configured amount of time has been reached.").

speeds (lower Mbps) than larger files. Since they reflect average usage behavior, NMP data [redacted][32] Second, NMP data may measure [redacted] Third, NMP measures the [redacted]

43. Finally, as we explained in our white paper, Sprint uses [redacted][33] This guidance demonstrates that the network quality improvement scenarios that we considered in our initial white paper are well within the range of what the merging parties expect will result from the planned network integration.

44. For example, the merging parties' network engineering model predicts a [redacted] of Ookla speeds [redacted][34]

45. Thus, the fact that NMP speeds we use in our analysis are different in magnitude than Ookla speeds that are used by Israel, Katz, Keating is to be expected, and is immaterial for assessing the reliability of our analysis, or of those previously submitted by the merging parties.

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[32] Initial White Paper, ¶ 175. [redacted]

[33] Initial White Paper, fn. 78.

[34] For example, [redacted]

3.2. The network quality improvements and marginal cost reductions that we considered in our initial white paper are conservative for New T-Mobile but unattainable by the standalone firms

46. We understand that the reason that the merging parties expect to achieve such network quality improvements with their planned network integration is because of the complementarity of their assets, and in particular their spectrum assets. Our demand estimation analysis reinforces the Israel, Katz, and Keating analysis by confirming that consumers today would place substantial value on such network quality improvements.

47. Moreover, we understand that these improvements are not attainable by the standalone firms, in that they are not simply a matter of monetary investment but also hinge on access to spectrum and scale. In particular, we understand that Sprint would have difficulties with its coverage gap and so, while it might attain high speeds in areas with good coverage, consumers would get frustrated and average speeds would fall due to poor in-building coverage and coverage gaps. Conversely, we understand that T-Mobile would have good coverage but have difficulty adding capacity cost-effectively, leading to lower speeds and likely lower usage limits than New T-Mobile expects to achieve.

3.3. The merging parties would not move consumers currently on Sprint onto the New T-Mobile network before they could guarantee that consumers would not experience degraded network quality

48. We understand from discussions with the T-Mobile engineering team that their plan is that consumers will not experience network quality degradation when they are switched over to the New T-Mobile network. They have also repeatedly indicated that the network integration plan follows the template T-Mobile used in the successful integration of MetroPCS, which avoided such degradation.[35]

49. Our demand estimation results demonstrate that consumers value network quality and, consistent with the statements of the executives and Sprint's

[35] Description of Transaction, Public Interest Statement, and Related Demonstrations filed 06/18/18, pp 39-41; Joint Opposition of T-Mobile US, Inc. and Sprint Corporation filed 09/17/18, p 47.

experience during its Network Vision network modernization,[36] the merged firm risks losing consumers if it degrades their experience.

[36] For example, see Phil Goldstein, "Sprint's LTE rollout hampered by lack of backhaul and Network Vision issues," July 24, 2013, Fierce Wireless, available at https://www.fiercewireless.com/wireless/sprint-s-lte-rollout-hampered-by-lack-backhaul-and-network-vision-issues. See also SBG-000084933 showing poor network quality as a result of Sprint's Network Vision revitalization plan lead to increased churn.

4. The DISH analytical critiques are incomplete, rejected by the data, and portray a fundamental misunderstanding of demand estimation and merger simulation

50. In our initial white paper, we explained that the proposed merger is procompetitive under a wide range of marginal cost reductions and network quality improvements the merging parties expect to result from their planned network integration.[37]

51. Rather than examining the range of scenarios we consider in our initial white paper, Bazelon, Verlinda, and Zarakas only present analyses where the proposed merger either (a) leads to no marginal cost reduction whatsoever, or (b) leads to no network quality improvement whatsoever. They make these strong assumptions in the context of their other critiques, presumably to give the impression that these critiques have meaningful implications for the bottom line conclusions. They do not.

52. Our analysis has multiple steps. When we say that our merger simulation offers an economically coherent framework, we mean that it models demand, supply, and the interactions of the two in a way that is robust and internally consistent. This allows us to consider scenarios where Sprint and T-Mobile merge and ask how the merger and any resulting merger-specific marginal cost reductions and network quality improvements affect demand, supply, and the equilibrium of the two.

53. A common theme of the analytical willingness to pay arguments by Bazelon, Verlinda, and Zarakas is that they are internally inconsistent and incomplete. In particular, they tend to adjust the demand model of consumer choice in some way, without going through the rest of the analysis to investigate the effects that has on supply and critical marginal cost reductions, as we have done.

54. This effectively neglects to account for consumer choice. In particular, Bazelon, Verlinda, and Zarakas try to argue that pockets of consumers may not agree with the majority who are better off from network quality improvements. But individualized quality and fiercer competition from New T-Mobile means that consumers are frequently just as well off or better off switching to their previously second-best option, as evidenced from the merger simulation.

[37] Initial White Paper, § 4.

55. In addition, the Bazelon, Verlinda, and Zarakas analytical work is riddled with implementation errors that undercut their results and the reliability of their adjustments to our analysis.[38]

56. In the rest of this section we explain why the adjustments they have made are inappropriate, faulty, and rejected by the data. We also explain how, even if they are adopted, carrying their adjustments through the rest of the analysis shows that our bottom line results do not change and, indeed, are frequently strengthened.

4.1. The claim by Bazelon, Verlinda, and Zarakas that consumers with lower income have lower willingness to pay for network quality is an untested theoretical argument that they implement in ways inconsistent with the academic literature and rejected by the data

57. Bazelon, Verlinda, and Zarakas conjecture that consumers with lower income may be less willing to pay for network quality, and undertake a series of calculations they claim show that some consumers have lower willingness to pay for network quality than we have reported.[39] Theirs is ultimately a theoretical argument. It involves a series of extremely strong assumptions they have made no effort to empirically validate. In fact, the calculations they undertake are inconsistent with the academic literature and testing their conjecture reveals that it is rejected by the data.

58. First, the specification Bazelon, Verlinda, and Zarakas use is rejected by the data. The demand model where they have asserted their assumption about the relationship between price sensitivity and income does not fit the data as well as our demand model.[40]

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[38] For example, Bazelon, Verlinda, and Zarakas attempt to calculate the T-Mobile share of Verizon's port outs in various geographic areas and compare it to the speed differential between Verizon and T-Mobile (see their Table 15). Yet they make elementary spreadsheet errors in aggregating the underlying data and, without justification or explanation, selectively exclude certain counties from their calculations. As a result, their porting statistics do not correspond to the listed geographies, nor are they compared to the appropriate speed differential. Setting aside the fact that this analysis ignores the individualized nature of network quality and the need to control for other factors when estimating demand, correcting their methodological errors shows that porting from Verizon to T-Mobile tends to be [redacted] in areas where Verizon speeds are higher compared to T-Mobile's. See our workpapers. As another example, Bazelon, Verlinda, and Zarakas re-estimate our demand model imposing an unsupported assumption that income affects consumer choice in a specific and non-standard way. Setting aside the conceptual and empirical issues with their argument (see § 4.1 for a detailed explanation of why it is incorrect), they have implemented it incorrectly. In their prediction of post-merger prices, they adjust the estimation of demand but neglect to adjust the merger simulation, thus comparing inconsistent demand and supply responses.

[39] Bazelon, Verlinda, and Zarakas Declaration, § IV.A.

[40] In particular, the log likelihood of their model is lower. See our workpapers.

59. Second, they assume that, aside from income, consumers with lower and higher incomes have the same preferences over wireless service. This is highly unlikely to be the case. Consumers with lower incomes may be more likely to be cord-cutters and to more heavily rely on their smartphone for their communications and media consumption. Conversely, consumers with higher incomes may be more likely to offload to wi-fi or to consume media over cable or on additional electronic devices that are connected to the internet through a broadband connection. In that sense, whether willingness to pay for wireless service in general and for network quality improvements in particular is higher, lower, or roughly the same is an empirical question rather than something that can simply be assumed.

60. Third, not only do they assume that consumers with lower income have lower willingness to pay for quality, they assert a very rigid and specific relationship between income and price sensitivity. Not only is this relationship entirely assumed rather than estimated with data, but it is also entirely non-standard. While Bazelon, Verlinda, and Zarakas claim to cite to the academic literature,[41] their backup reveals that they use a different way for income to enter consumer utility than the papers to which they cite.

61. Fourth, while the literature does recognize that willingness to pay may change with income in certain circumstances (albeit in a different way from that employed by Bazelon, Verlinda, and Zarakas), the circumstances the literature identifies are very different. The papers Bazelon, Verlinda, and Zarakas cite talk about the choice of whether or not to purchase a brand new automobile within any given year, a purchase that many households choose not to make, that constitutes a very large proportion of their disposable income in any given year, and indeed that many households only make on credit. This is very different from wireless service, where most adults have at least one wireless device, they do not buy their monthly service on long-term credit, and where the choice consumers tend to make is whether to pay an incremental price to get a plan with better network quality and more relaxed usage limits.

62. Fifth, replacing the non-standard formulation Bazelon, Verlinda, and Zarakas use with the formulation that the academic literature uses in situations where income may directly affect willingness to pay demonstrates that this is not one of those situations. In particular, for large purchases like automobiles,

[41] Bazelon, Verlinda, and Zarakas Declaration, fn. 14 on p. 12.

the literature sometimes considers whether consumers care not about the price of what they are buying but about their residual income after paying the price. When we adjust our demand estimation to test whether consumer choice in the wireless industry responds in this way, we find that it does not.[42]

63. Sixth, even when we take the Bazelon, Verlinda, and Zarakas modeling critique at face value, we find that it has no impact on the conclusions of our analysis. Bazelon, Verlinda, and Zarakas' analysis of income effects is incomplete. They do not apply the estimates from their modified demand model to our merger simulation analysis. When we do so, we find that bottom-line metrics that inform whether the proposed merger is procompetitive, such as average compensating variation and change in merging party share, do not qualitatively change.[43]

64. In sum, our model already accounts for consumer price sensitivity. Bazelon, Verlinda, and Zarakas' critique of how our model accounts for consumer income and price sensitivity is unfounded, inconsistent with the academic literature, rejected by the data, and irrelevant to the conclusions of our analysis.

4.2. Our results are robust to how data usage types are categorized

65. The results we presented in our initial white paper indicate that a consumer's willingness to pay for network quality is related to the amount of data they use each month. In particular, we categorized each consumer in the NMP data into light, medium, and heavy data users. This allowed the data to demonstrate an important feature of consumers preferences, namely that consumers who use more data tend to value network quality more. Our results and overall conclusions are not sensitive to the particular method of categorizing data usage types.

[42] See our workpapers.

[43] See our workpapers.

66. Bazelon, Verlinda, and Zarakas argue that our data usage categorization leads us to overstate the willingness to pay for network quality for many consumers and suggest adding an additional data usage category, "very heavy" data users. They find that this decomposition leads to willingness to pay estimates that are different for "heavy" and "very heavy" data users. Their suggestion that this finding reveals a flaw in our analysis and conclusions is unfounded and misleading. Rather, their alternative specification confirms that our results are robust to alternative data usage categorizations.

67. First, their results reinforce our findings that all consumer types positively value network quality and that consumers who use more data tend to value network quality more.[44] Second, they adjust demand by adding very heavy data users but do not complete the merger simulation to ask what effect this has on supply and the calculation of critical marginal cost reductions. Taking these next steps shows that, when evaluated within the coherent framework of the merger simulation, their adjustment is trivial. Critical marginal cost reductions are qualitatively unchanged from those we presented in our initial white paper.[45]

4.3. The Bazelon, Verlinda, and Zarakas suggestion to estimate consumer sensitivity to price using Sprint rather than T-Mobile margins leads to more procompetitive outcomes

68. An elementary and well-understood result in economics is that firms that face more price sensitive demand have lower margins.[46] The reason we use T-Mobile margins to estimate consumer sensitivity to price is that doing so is *conservative*, in the sense that a merged firm that faces demand that is less sensitive to price is more likely, everything else equal, to raise prices.[47]

69. Bazelon, Verlinda, and Zarakas are correct to argue that using Sprint's margins instead would lead to demand being more price sensitive.[48] Yet they get the conclusion exactly backwards. They focus on what this price sensitivity may mean for consumers' willingness to pay for any given increment of network quality. They fail to take into account that higher price sensitivity will also

[44] See Bazelon, Verlinda, and Zarakas Declaration, Table 3.
[45] See our workpapers.
[46] Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics*, Seventh Edition, p. 355.
[47] Initial White Paper, ¶ 239.
[48] Bazelon, Verlinda, and Zarakas Declaration, pp. 15–16.

fundamentally change the equilibrium between demand and supply. This in turn means that the proposed merger will lead to significantly lower upward pricing pressure.

70. Tellingly, they do not run a merger simulation to test the bottom-line outcome of this sensitivity. Conducting a complete merger simulation analysis shows that using Sprint margins makes the proposed merger significantly *more* procompetitive, with critical marginal cost reductions falling by approximately [redacted].[49]

4.4. Bazelon, Verlinda, and Zarakas fail to allow for consumer choice

71. Another failing of the Bazelon, Verlinda, and Zarakas analyses is that they employ a non-standard approach to consumer welfare analysis. They focus on willingness to pay for network quality improvements based on the brand that consumers currently choose. This focus denies consumers the option to switch products when faced with a price increase, even if they have good alternatives that are becoming even more attractive as a result of increased competition.

72. This methodological choice biases their results towards an anticompetitive finding even where there is no consumer harm. In particular, our analysis demonstrates that New T-Mobile becomes a more effective competitor to AT&T and Verizon under a wide range of assumptions regarding marginal cost reductions and network quality improvements. In those scenarios, the two leading firms reduce prices in an attempt to retain share, making them even better alternatives for consumers who value network quality improvements but by less than the average consumer.

73. The standard approach in the academic literature to calculating consumer welfare when both prices and qualities are changing does not suffer from this issue and is the one we follow in our initial white paper.[50]

[49] See our workpapers. [redacted]

[50] For a detailed discussion of this approach, see our initial white paper, § 5.3.3, "Compensating variation" and, for example, for example, see Formula 7 in Nevo, Aviv, "Mergers with differentiated products: the case of the ready-to-eat cereal industry," *RAND Journal of Economics*, Vol. 31, No. 3, 2000, p. 404.

5. Conclusion

74. The merger simulation analysis we presented in our initial white paper offers a robust, economically coherent framework for understanding the competitive significance of the proposed merger. As we explained in our detailed white paper and its extensive technical appendix, our analysis is grounded in rich data on network quality and consumer behavior. It finds that the proposed merger is likely to increase competition among wireless carriers. It is also complementary to the analysis submitted by Israel, Katz, and Keating, which has strong foundations in the network engineering work done by the merging parties.

75. Bazelon, Verlinda, and Zarakas and Bar-Isaac have offered several conceptual and analytical critiques of our analysis. These critiques are incomplete, rejected by the data, inconsistent with the academic literature, and, where they are not entirely theoretical, are riddled with errors in their implementation. They do not test the bottom line outcome of their critiques. When we do so, we find they do not qualitatively change our results or conclusions.

76. Moreover, the Bazelon, Verlinda, and Zarakas analysis always assumes that the proposed merger will lead to no marginal cost reductions whatsoever, or no network quality improvement whatsoever. This selective focus on scenarios that do not reflect the merging parties' plans or the record about the likely effects of those plans is misleading. It thus does nothing to rebut our original conclusion that under a range of assumptions about marginal cost efficiencies and network quality improvements, the proposed merger is likely to increase competition among wireless carriers.

Attachment C

John Asker, Timothy F. Bresnahan, And Kostis Hatzitaskos, "Economic Analysis Of The Proposed T-Mobile/Sprint Merger: Presentation To Federal Communications Commission," December 3, 2018

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