APPENDIX A: REPLY DECLARATION OF G. MICHAEL SIEVERT
President and Chief Operating Officer, T-Mobile US, Inc.

REPLY DECLARATION OF G. MICHAEL SIEVERT
President and Chief Operating Officer, T-Mobile US, Inc.

I. INTRODUCTION

1. My name is G. Michael Sievert and I am the President and Chief Operating Officer for T-Mobile US, Inc. I have been with T-Mobile since 2012. Together with T-Mobile's Chief Executive Officer John Legere, I was directly involved in the acquisition of MetroPCS and the development of T-Mobile's Un-carrier business plan. Prior to joining T-Mobile, I had over two decades of experience at several Fortune 500 companies and as an entrepreneur. I received a Bachelor of Science in Economics degree from the Wharton School of the University of Pennsylvania, where I graduated magna cum laude.

2. In my capacity as T-Mobile President and COO, I have been engaged in the evaluation of T-Mobile's proposed merger with Sprint Corporation, and the discussions concerning the business plans for the merged entity, New T-Mobile. I will be President and Chief Operating Officer for New T-Mobile.

3. I have reviewed the Joint Opposition of T-Mobile US, Inc. and Sprint Corporation to Petitions (the "Opposition") filed with the FCC in response to various petitions to deny the transaction between T-Mobile and Sprint. In support of the Opposition, I am providing information with respect to New T-Mobile's broadband offerings and business plans for MetroPCS, Boost Mobile, and Virgin Mobile.

II. REPLY DECLARATIONS

A. The Merger Will Provide In-Home Broadband Choice Through a Broadband Replacement Option that Will Create Substantial Cost Savings for Consumers

4. The current in-home broadband marketplace is not fully competitive and many consumers have limited choices for broadband service. 79 percent of households have one or

less options for high-speed broadband (100 Mbps DL/10 Mbps UL), and 48 percent of households lack a choice for in-home broadband exceeding (25 Mbps+).[1] This lack of competition has harmed consumers who remain extremely dissatisfied with the high price and poor customer service they receive from their in-home broadband provider.

5. New T-Mobile's 5G network will change this competitive dynamic by closing the speed differential between mobile and wired broadband. By combining the resources of T-Mobile and Sprint, the combined company will create the capacity and coverage to provide in-home broadband services. Our business planning has confirmed that there is a large market for New T-Mobile's in-home broadband offering at the anticipated pricing and service levels. New T-Mobile's entry into the in-home broadband marketplace will cause incumbent providers to lower their prices and invest in their networks—benefitting all in-home broadband customers.

6. The wireless in-home broadband service will be deployed in areas where the available capacity exceeds mobile requirements and is sufficient to support the in-home services. Essentially, New T-Mobile will offer its home-broadband replacement product in places where it has sufficient capacity to do so without materially raising marginal costs. The combined company will be able to offer this service to over 52 percent of zip codes across the county. New T-Mobile will cover 64 percent of Charter's territory and 68 percent of Comcast's territory with its in-home broadband services by 2024. In addition, New T-Mobile expects to utilize caching and other network optimization techniques to increase the number of households that can be served. In sum, New T-Mobile will have the depth and breadth of network to deliver broadband speeds and capacity to consumers across the country.

[1] *See* PIS at 59.

7. In total, New T-Mobile expects to acquire 1.9 million in-home wireless broadband customers by 2021 and 9.5 million customers by 2024. Based on current customer figures, this would make New T-Mobile the fourth largest in-home Internet service provider ("ISP") in the United States in 2024. Of particular importance, T-Mobile estimates that 20-25 percent of its in-home fixed wireless subscribers will be located in rural areas where there is limited broadband availability. Rural consumers should be particularly attracted to New T-Mobile's broadband offerings given the high prices and limited competition for broadband services in rural areas today.

8. New T-Mobile also will offer its in-home wireless broadband services consistent with its Un-carrier approach, which eliminated extended service contracts and strict monthly data caps for mobile wireless services. Unlike other in-home broadband offerings, the wireless nature of the offering will also provide customers with the choice of avoiding installation appointments and related charges as they will be able to self-provision the necessary in-home equipment. New T-Mobile will also extend the Un-carrier customer care model to in-home fixed wireless broadband services, providing consumers with high-quality 24-7 customer support. This care model should force traditional providers to improve the poor customer service that has plagued the in-home broadband marketplace for many years.

9. New T-Mobile's in-home wireless broadband offering will provide consumers across the country with average download speeds of 100 Mbps. By 2024, New T-Mobile will be able to cover more than 250 million people with data rates greater than 300 Mbps and more than 200 million people at greater than 500 Mbps.[2] As noted in the PIS, these speeds far exceed those contemplated by Verizon or AT&T for their proposed 5G services, and match or exceed the

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[2] *See* PIS at 27.

offerings of most traditional ISPs.[3] The planned service area of New T-Mobile's broadband services will also dwarf the limited service areas of wired broadband providers. These speeds and coverage areas will be offered at a significant discount to the prices of traditional broadband providers, with monthly prices planned to be generally [redacted] lower than traditional services.

B. The Merger Will Also Provide Consumers with Choice and Cost Savings Through Broadband Substitution

10. As discussed in the PIS, in addition to creating consumer choice and value through an in-home broadband replacement option, New T-Mobile will also enable consumers to use their mobile services as a substitute for in-home broadband. T-Mobile has estimated that 5.8 million households will use their New T-Mobile 5G mobile services for all their broadband needs (whether in-home or mobile) by 2021 and a total of 6.3 million households by 2024, enabling even greater savings for these customers.

C. New T-Mobile Will Continue to Serve Customers Favoring Prepaid Plans Through MetroPCS, Boost Mobile and Virgin Mobile

11. Some merger opponents claim that New T-Mobile will consolidate or eliminate one or more ofthree major prepaid brands: MetroPCS, Boost Mobile, and Virgin Mobile. Contrary to these reports, each of these three brands will play an important role in New T-Mobile's ability to target different customer segments and there are no plans to consolidate or eliminate any of them.

[3] *See* PIS at 45-50.

12. I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed on September 17, 2018.

G. Michael Sievert
President and Chief Operating Officer
T-Mobile US, Inc.

APPENDIX B: REPLY DECLARATION OF NEVILLE RAY
Executive Vice President and Chief Technology Officer, T-Mobile US, Inc.

REPLY DECLARATION OF NEVILLE R. RAY
Executive Vice President and Chief Technology Officer, T-Mobile US, Inc.

I, Neville R. Ray, hereby declare the following:

1. I serve in the T-Mobile US, Inc. ("T-Mobile") technology organization in the capacity of Executive Vice President and Chief Technology Officer. My background and qualifications are described in my initial Declaration, filed on June 18, 2018 (the "Declaration").

I. INTRODUCTION AND SUMMARY

2. My initial declaration demonstrated that New T-Mobile can create a broad and deep, nationwide 5G and LTE network faster than either company could on a standalone basis. To analyze the potential for the LTE and 5G networks, we have developed an engineering model that measures capacity and congestion at the sector level for New T-Mobile (and the two standalone companies). This model is built upon the ordinary course engineering tool that T-Mobile has used since 2011/2012 and has been utilized to dictate capacity expansion and expenditures. I am therefore confident that this modeling provides a reasonable and accurate representation of how we run our network and how we plan for investments to maintain our network.

3. Our engineering model indicates that New T-Mobile would multiply the overall network capacity (that could not be matched by the standalone companies) and provide a significantly improved user experience for consumers more rapidly. Absent this transaction, T-Mobile would be unable to match the throughput and capacity needed to deploy a fully capable 5G network as quickly or as cost efficiently as New T-Mobile and any attempt to do so would necessarily lead to degradations in the LTE customer experience.

4. Through the combined network of New T-Mobile, we will deliver near term benefits to existing T-Mobile and Sprint subscribers. We will rapidly create a single, virtual core

network, where subscribers will have access to the best wireless experience possible in a very rapid timeframe. Following the merger, more than 20 million Sprint customers will have expeditious access to the New T-Mobile LTE network that will provide improved LTE coverage and services. Improvements in capacity and coverage for existing subscribers will occur, on a market-by-market basis, in the near term due to the increases in cell sites and spectrum resources brought by the transaction.

5. Opponents to the merger suggest alternatives or changes to the transaction that are impractical. T-Mobile cannot deploy a 5G network that matches the capabilities of New T-Mobile without expeditious access to spectrum and tower sites. Arguments that T-Mobile has expressed its ability to deliver a 5G network that would be comparable to New T-Mobile are incorrect.

6. In this Reply Declaration, I respond to these and related claims.

II. NEW T-MOBILE HAS UTILIZED A MODEL BASED ON ORDINARY COURSE PRACTICES TO DETERMINE CAPABILITIES AND REQUIREMENTS FOR THE LTE AND 5G NETWORKS

A. A 4G LTE Engineering Model Has Been Used to Estimate Network Capacity and Congestion

7. In the ordinary course of business, to help project where the existing T-Mobile LTE network will reach resource exhaust, we developed an engineering model to target congestion and to help target annual spending to achieve that goal. The key components to a capacity model of this type are a loading forecast (amount of traffic to be supported) and the congestion criteria (based on target levels for quality of experience).

8. ***Measurement of LTE Network Load.*** Having an accurate forecast of the traffic load on the network is a crucial step for maintaining a high quality of experience for subscribers. At a fundamental level, we created a measure of LTE resource utilization based on a normalized

number of users on the network. To measure the number of users per sector, we measured the number of radio resource control ("RRC") connections during the busy hour as a proxy for users in the sector.[1] To calculate this busy-hour measurement, we do the following for each sector:

[redacted]

9. Because LTE cell site sectors have different bandwidths and number of users, we then normalize the number of users per 5 megahertz, which is the smallest used LTE carrier bandwidth. This normalization process avoids focus on the highest raw number of users and instead applies a priority to sectors where overall loading of the available bandwidth is the highest. For example, a sector that has three users that are demanding a large amount of bandwidth would have a lower priority for resources than a sector that had 100 users demanding a smaller amount of bandwidth.

10. ***Congestion Criteria.*** The wireless standards do not define LTE congestion thresholds or recommend particular guidelines. Instead, wireless providers must define

[1] RRC is the protocol used in LTE on the air interface. This protocol layer exists in the eNodeB and user equipment to exchange signaling and determine the state of a user connection and activity. The resources in each sector will be shared by the connected users, which makes the number of RRC connected users an indication of sector loading.

[2] This hour is the time with the greatest number of RRC connections. It is not the same time for each sector in the network; rather it is based on the time when the greatest number of RRC connections occur for each individual sector.

congestion criteria based on target levels for customer quality of experience. As video is the most demanding, widely-adopted mobile data application, we utilized this service as our benchmark for user experience. Our congestion criteria seeks to maintain an average busy hour user throughput greater than [redacted] Mbps for the LTE network, with key geographies in all markets dimensioned at [redacted] Mbps.[3] Sectors that do not meet this criteria during busy hour are considered congested and the model triggers avoidance solutions at that sector/site. Our company goal is to fund and mitigate congestion in the network completely; however, absolute congestion avoidance is impractical due to issues with timely access to infrastructure, stochastic nature of traffic, and challenges with deploying congestion solutions.

11. These criteria ensure reliable video support, as well as most other LTE applications, without real-time data impairments such as buffering or frame loss. We developed these thresholds from vendor specifications as well as extensive testing. We then collected millions of data points from our radio network and analyzed them to determine the number of RRC connections per 5 MHz that would allow the [redacted] Mbps and [redacted] Mbps average throughput to be maintained in a sector during the busy hour and correlated it with measured data from Ookla.[4] From this data, we found that the practical limits are:

- [redacted] users per 5 megahertz for [redacted] Mbps; and
- [redacted] users per 5 megahertz for [redacted] Mbps.

[3] This value for average user throughput during the busy hour has risen over time in line with user expectations and application demands.

[4] Ookla is a third party source that gathers crowdsourcing data (from its Speedtest application) to measure the actual user experienced data rate. *See* https://www.ookla.com/. Ookla data is an end-to-end measurement, reflecting what the measuring device is experiencing at the consumer end.

12. ***Model Accuracy.*** This model has been highly accurate. For example, when we studied the results of this modeling effort in 2018 (looking at actual congestion as compared to the forecasted congestion), we found that:

- The sector congestion forecasts were 99.4 percent accurate (only 0.6 percent difference in the actual network congestion levels);
- Of this 0.6 percent, only 0.4 percent were false positives (sectors that were forecast to congest but did not);
- The remaining 0.2 percent were false negatives (sectors forecasted as congestion-free but did have congestion).[5]

13. We have relied on the model to direct approximately [redacted] in annual expenditures for our network ([redacted] total in the past 5 years). This effort has led to a 71 percent reduction in congestion while traffic growth has increased by [redacted] (in addition to customer growth from 33M to 74M in the past five years)—with the highest average throughput of the national wireless providers the past 18 quarters (as measured by Ookla).[6]

14. ***Engineering Model Overview.*** The complete model used an extended version of our ordinary course LTE capacity planning model and integrated it with a 5G module described in the section below. We developed three separate worksheets that determined capacity for New T-Mobile, T-Mobile and Sprint, with separate modules for LTE and 5G. The LTE modules (while not identical for T-Mobile and Sprint to account for each operator's ordinary course practices) were derived from the ordinary course model described above. The same processes were used for the assessment of capacity and performance augmentation needs for T-Mobile and

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[5] The study looked at projections made for 2017. The projections for 2017 were made 18 months prior to 2017 and the actual results for 2017 were compared to those projections.

[6] See also https://www.mobileworldlive.com/featured-content/top-three/us-lte-speeds-on-the-rise/?ID=00Qw0000014L0qcEAC&utm_source=sfmc&utm_medium=email&utm_campaign=MWL_20180719&utm_content=https%3a%2f%2fwww.mobileworldlive.com%2ffeatured-content%2ftop-three%2fus-lte-speeds-on-the-rise%2f

Sprint—and aggregated to form the parameters for modeling of the combined company. For the Sprint standalone version of the model, the model was also extended to incorporate Sprint's business rules regarding asset deployment and congestion avoidance.

15. We did not model the 2019-2020 timeframe because the integration efforts would not be complete nationally until 2021 (assuming the transaction closes in 2019).[7] We consider the combined network baseline to begin in 2021 once the majority (if not all) of the fundamental consolidation of network functions is complete. New T-Mobile would build the projected combined network baseline for 2021 even if, hypothetically, traffic were substantially less than the sum of the projected standalone traffic levels. To do otherwise would cause us to forego the substantial cost savings that we expect to achieve from the merger. During 2019 and 2020, the integration efforts I describe below (integration of core network, early transition of Sprint customers, augmenting radio capacity, and optimizing of tower sites) would occur and the near term benefits associated with those efforts are discussed therein.

16. Consistent with my original declaration, my analysis continues to focus on the standalone T-Mobile network plan that corresponds to the spending projections in the standalone T-Mobile long range plan (LRP). That plan, which has formed the basis of T-Mobile's strategic thinking, yields a network that is vastly inferior to what New T-Mobile will offer. I show this in terms of offered network capacity and network throughput, comparing T-Mobile's existing plan to what New T-Mobile will offer post-integration. I understand that others, including Peter Ewens[8] and Israel, Katz, and Keating,[9] examine the same issue through financial and economic, rather than an engineering, lenses and reach the same conclusion. In particular, even if

[7] The model reflects the network as of the end of 2021.

[8] Ewens Reply Decl. at ¶¶ 29-36.

[9] Compass Lexecon Decl. at ¶¶59-60.

standalone T-Mobile were to deviate from its plan of record to spend more to expand capacity, it would reach practical limits on what spending is possible without coming close to New T-Mobile's capacity level and without being able to serve anything close to the growth in consumer demand for increased usage. I further understand that they show that pushing spending to these levels would substantially increase T-Mobile's costs, while leaving substantial quality deficiencies, such that the merger would enhance competition by relieving these constraints.

17. ***LTE Modeling for Transaction.*** To model the LTE performance of New T-Mobile (and standalone T-Mobile and Sprint), we used many of the same concepts and requirements to model 2021-2024. Subject to any applicable financial constraints, we design our network to meet coverage objectives as well as provide sufficient capacity approximately to meet baseline traffic needs. The baseline network for standalone T-Mobile in 2021 through 2024 (for both LTE and 5G) that we use in the engineering model that we have submitted to the Commission followed these principles.

18. Our modeling projections demonstrate that average LTE performance for New T-Mobile will be maintained during the refarming process to 5G.[10] It is vitally important to maintain the LTE network as I would expect that New T-Mobile will continue to operate the LTE network substantially beyond 2024 to support existing users on the network and to allow for domestic and international roaming. The Sprint and T-Mobile PCS and AWS spectrum will provide a dense LTE layer in combination with the Sprint 800 MHz and T-Mobile 600 and 700 MHz spectrum assets and allow for 5G to be deployed without degrading the LTE experience. New T-Mobile's enhanced LTE network would be able to maintain the LTE user experience compared to the standalone companies without network congestion and a need for any additional

[10] The detailed results of the estimates are within the engineering model provided to the Commission.

costs for cell splits. In contrast, our standalone T-Mobile LTE network would have high levels of congestion absent substantial investment in additional cell splits or other network improvements.

19. As we enhanced this modeling since the PIS filing, we have found that we were able to more rapidly refarm spectrum from LTE to 5G for standalone T-Mobile. The table below demonstrates the refarming plan for spectrum by New T-Mobile and the two standalone companies.

[redacted]

Legend

3G (CDMA & HSPA) | LTE | Split LTE/5G | 5G

Table 1: Spectrum Holdings and Refarming Plan

20. The LTE engineering module was utilized to gauge the amount of spectrum that

could be refarmed from LTE to 5G without adverse effects to the user experience on the LTE network. The amount of spectrum devoted to LTE in 2024 is the minimum allocation necessary to run the LTE network with support for all devices. The tables below show that the LTE network will be maintained at least through 2024, even as spectrum is aggressively migrated to 5G use.

Entity	2021 Average LTE Throughput(Mbps)	2024 Average LTE Throughput (Mbps)
T-Mobile	[redacted]	[redacted]
Sprint	[redacted]	[redacted]
New T-Mobile	[redacted]	[redacted]

Table 2: LTE Average Throughput (Years 2021 and 2024)

Entity	2021 LTE Capacity (Exabytes)	2024 LTE Capacity (Exabytes)
T-Mobile	[redacted]	[redacted]
Sprint	[redacted]	[redacted]
New T-Mobile	[redacted]	[redacted]

Table 3: LTE Capacity Per Month[11]

B. The 5G Engineering Model Was Developed Based on the Fundamental Concepts of the Existing 4G LTE Model.

21. As our existing engineering model is based upon LTE technology, it needed to be modified to allow certain spectrum to be moved to the 5G network over time, and to add the ability to upgrade a site to 5G to the set of congestion-avoidance solutions. The 5G module for

[11] These figures have shifted slightly from the PIS as additional modeling occurred that determined that more spectrum could be refarmed to 5G services more quickly. This aggressive refarming reflects an anticipated reduction in LTE use because of customer migration to 5G and therefore less capacity dedicated to LTE in 2024 for New T-Mobile.

New T-Mobile and T-Mobile was created utilizing the normal course of business LTE model using the same fundamental concepts such as throughput, congestion, and GB/subscriber usage, along with the same types of congestion-avoidance solution sets (such as deployment of additional spectrum and cell splits) in order of lowest cost. Because T-Mobile does not possess Sprint-specific assets (*e.g.*, 2.5 GHz spectrum), the model was extended to incorporate deployment of these assets, along with logic to determine the effect of their deployment. For the Sprint standalone version of the model, the model was also extended to incorporate Sprint's business rules regarding asset deployment and congestion avoidance.

22. ***Measurement of 5G Network Load.*** Initially, we extrapolated estimates for subscriber capacity demands (using market projections and in cooperation with our business group for use cases expected for 5G) for 2024. This estimate in data consumption growth is based on: (1) the LTE data growth trends; (2) richer user experience expected for 5G; (3) increased engagement time for 5G; and (4) additional consumption methods for 5G.

23. Over time, we expect content delivered over a 5G network will provide a richer experience to the end user. Larger viewing screens, such as those in the recently announced iPhones, will drive the demand for higher video resolution. We have already seen a shift from standard definition video to DVD quality video, with Full HD and 4K UltraHD video requirements emerging. The bandwidth required to support video content is directly related to the resolution—DVD quality requires 1-2 Mbps data throughput rates while Full HD video needs 5-7 Mbps. Our 5G traffic model considers the amount of time 5G customers will use their devices to engage with video streaming, web browsing, augmented reality, virtual reality, gaming, IoT, audio streaming, and social media. We then applied estimates, based on our

engineering experience with these types of use cases and the written literature for future use cases, to determine a total estimate of usage per subscriber per month.

24. Based on these factors, we worked with our business team to develop a demand model for 5G (based on different categories such as video streaming, web browsing, augmented reality, virtual reality, gaming, IoT, audio streaming, and social media) that provides a foundation level of the expected demand. This combined effort resulted in an estimate of approximately [redacted] gigabytes per subscriber per month for subscribers with 5G-capable handsets in 2021, increasing to [redacted] gigabytes per subscriber per month for data demands in 2024, which would be the unconstrained mobile broadband usage per subscriber at that time (it does not represent the amount of traffic the networks could actually handle).

25. ***Congestion Criteria.*** Based on these discussions, we also determined that the congestion criteria would need to be increased to sustain the higher quality video expected to be handled by 5G. This is consistent with the engineering planning that we utilized for the LTE model—in that instance, we used HD video (720p and 1080p) for our capacity planning purposes with great success. For 5G, we believe that 4K Ultra HD video will play an equally crucial role for 5G capacity planning.[12] After extensive study of the established and new video codecs for 4K Ultra HD video, we found that the throughput requirement should be increased to [redacted] to ensure that the user experience of 4K Ultra HD video is unimpaired. 5G sectors that cannot maintain this throughput requirement at the busy hour are considered congested. Translating this to the metrics we used for LTE, this would mean the 5G network goal would be [redacted] connected

[12] 4K Ultra HD content is 3840 pixels wide by 2160 pixels tall (8.29 megapixels), which is four times the resolution of 1080p HD.

RRC users per 5 MHz.[13]

26. Due to non-existence of live 5G network data and measurements, a loading curve that modeled the reduction in user experience throughput based on loading from 4G data was created using measured values. 5G user throughput estimates were derived from historical LTE measurements. An average 5G throughput decline curve was developed as a function of utilization (a ratio of measured carried traffic over calculated offered traffic).

27. The derived loading curve is applied to the average spectral efficiency-based 5G sector throughput to obtain the user throughput under a specific loading condition. As we defined [redacted] as the congestion threshold for 5G, we consider a sector congested once the 5G busy hour user throughput, as calculated by the 5G model, falls below this level.

28. The 5G engineering modeling demonstrates the dramatic improvements in average and peak data rates as well as capacity for New T-Mobile as compared to the standalone networks.[14]

Entity	Average 5G Throughput (Mbps)	Peak 5G Throughput (Mbps)
T-Mobile	32	1000
Sprint	57	300
New T-Mobile	153	1600

Table 4: Average and Peak 5G Throughput Comparisons (Year 2021)[15]

[13] This is not used as part of the 5G module but is used for an LTE sector when 5G handsets are forced to the LTE network (no uncongested 5G sectors in range for the 5G handsets).

[14] These figures have shifted slightly from the PIS as additional modeling occurred that determined that more spectrum could be refarmed to 5G services more quickly.

[15] Average and user throughput (though strongly correlated) are not the same since user throughput will vary based on loading. *See* PIS at 18, fn. 48. The engineering model provides actual 5G user throughput values in addition to the average values provided here.

Entity	Average 5G Throughput (Mbps)	Peak 5G Throughput (Mbps)
T-Mobile	100	2800
Sprint	116	700
New T-Mobile	451	4200

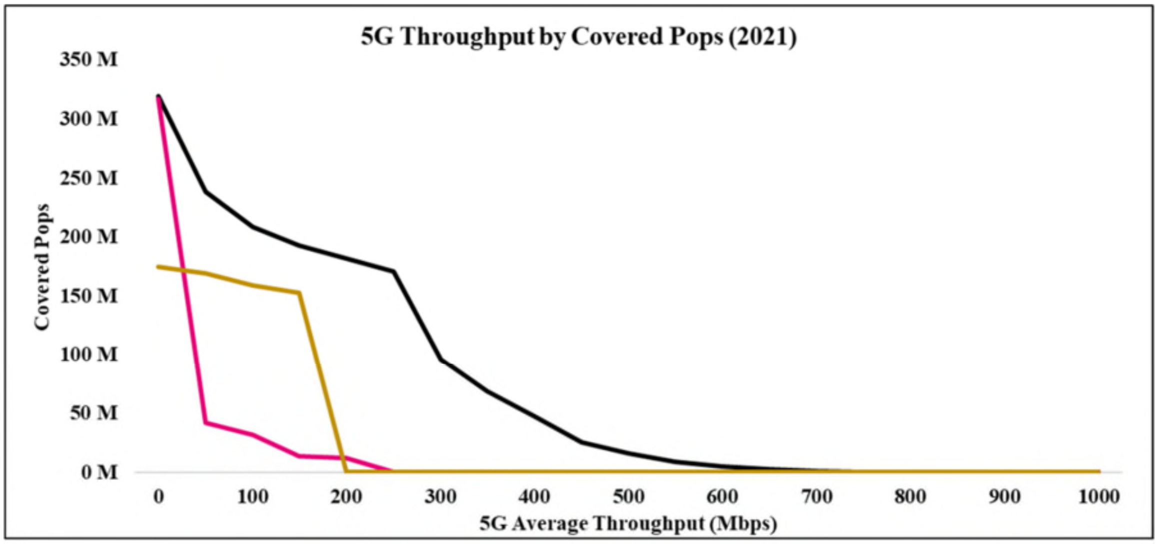
Table 5: Average and Peak 5G Throughput Comparisons (Year 2024)

Entity	2021 5G Monthly Capacity (Exabytes)	2024 5G Monthly Capacity (Exabytes)
T-Mobile	[redacted]	[redacted]
Sprint	[redacted]	[redacted]
New T-Mobile	7.1	21.0

Table 6: 5G Monthly Capacity (in addition to LTE)

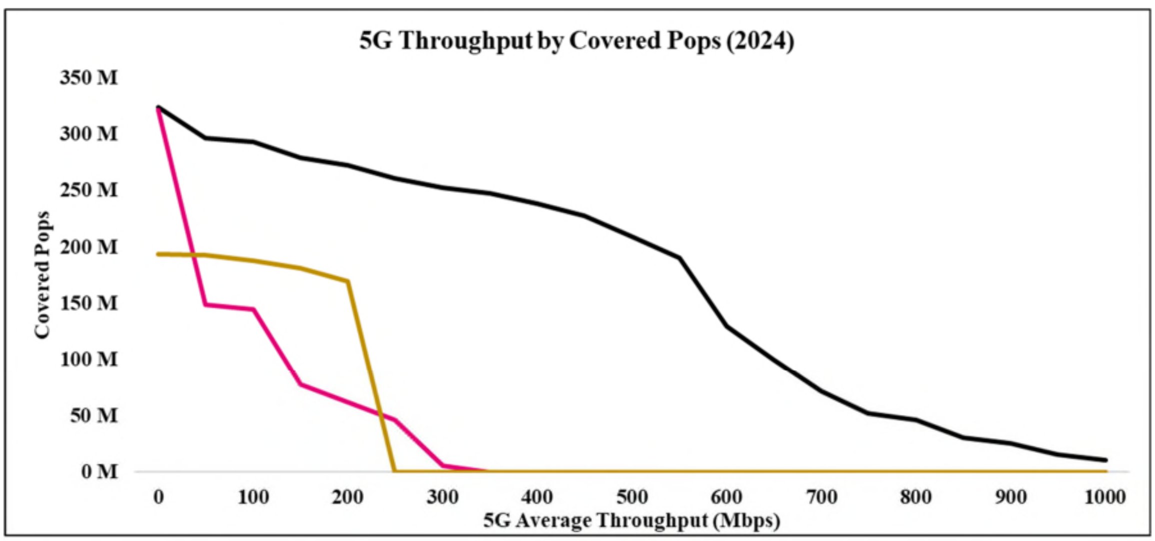
29. Contrary to arguments raised by petitions against the transaction, even if T-Mobile could move more spectrum from LTE to 5G, the standalone T-Mobile 5G network would still lack the bandwidth and infrastructure to deliver the data rate and capacity gains achievable by New T-Mobile's 5G network. Our lack of access to significant amounts of available mid-band spectrum that is not encumbered with LTE subscribers (as well as lack of large amounts of high-band spectrum nationally) significantly limits our ability to provide a nationwide 5G system that can deliver the speed and capacity necessary to deliver on the full promise of 5G to the vast majority of Americans. This is depicted graphically in the figures below.[16]

[16] These figures have shifted slightly from the PIS as additional modeling occurred that determined that more spectrum could be refarmed to 5G services more quickly.



2021	T-Mobile	Sprint	New T-Mobile
Pops with > 100 Mbps	31.6 M	159.3 M	208.7 M
Pops with > 150 Mbps	14.0 M	153.1 M	193.2 M
Pops with > 300 Mbps			96.4 M
Pops with > 500 Mbps			16.2 M

Figure 1: 5G Speed vs. Covered Population Distribution



2024	T-Mobile	Sprint	New T-Mobile
Pops with > 100 Mbps	144.7 M	187.8 M	293.1 M
Pops with > 150 Mbps	77.7 M	181.4 M	279.0 M
Pops with > 300 Mbps	5.9 M		252.8 M
Pops with > 500 Mbps			209.2 M

Figure 2: 5G Speed vs. Covered Population Distribution

30. By 2021, only 31.6 million covered POPs on the T-Mobile standalone 5G network will receive average data rates above 100 Mbps, only 14 million covered POPs will

receive average data rates above 150 Mbps, and no covered POPs will receive average data rates above 300 Mbps. In contrast, New T-Mobile's 5G network will deliver average data rates above 100 Mbps to 208.7 million covered POPs, average data rates above 150 Mbps to 193.2 million covered POPs, average data rates above 300 Mbps to 96.4 million covered POPs, and average data rates above 500 Mbps to 16.2 million covered POPs.

31. The differences between the networks will continue in 2024. 144.7 million covered POPs on the T-Mobile standalone 5G network will receive average data rates above 100 Mbps, only 77.7 million covered POPs will receive average data rates above 150 Mbps, 5.9 million covered POPS will receive average data rates above 300 Mbps and there still will not be any covered POPs receiving data rates above 500 Mbps. In contrast, New T-Mobile's 5G network will deliver average data rates above 100 Mbps to 293.1 million covered POPs, average data rates above 150 Mbps to 279 million covered POPs, average data rates above 300 Mbps to 252.8 million covered POPs, and average data rates above 500 Mbps to 209.2 million covered POPs.

C. Tower Site Assets Will Be Evaluated and Optimized for the New T-Mobile Network

32. The engineering model was then used to analyze T-Mobile and Sprint tower sites to select the sites to be retained from Sprint to supplement the existing T-Mobile sites. We reviewed the network coverage, traffic and subscriber distribution, and the spectrum and site configurations of each standalone system to determine which tower sites should be retained. Since the Sprint customers will be migrated to the existing T-Mobile infrastructure, we used the T-Mobile network as the base and added the Sprint traffic to identify sectors that would be affected by the new Sprint traffic. We then calculated the T-Mobile network sector load (based

on a growth factor that varies for every market), while taking the combined spectrum and subscribers of New T-Mobile into consideration.

33. With these criteria, we used the engineering model to determine what New T-Mobile sectors would be congested (or not). If there was no congestion, there was no need to consider any additional steps. If there was congestion, we looked for a Sprint network site to retain to offload traffic. We also analyzed the Sprint sites to see if any of their sites would improve the existing T-Mobile coverage grid. This preliminary process identified slightly more than 11,000 Sprint tower sites that should be retained that would either improve capacity or coverage (approximately [redacted] for capacity and [redacted] for coverage). To determine the retained sites from the Sprint standalone network, we needed to take into account the additional traffic from approximately 55 million Sprint subscribers as well as the coverage provided by the standalone Sprint network to make sure that the user experience for the Sprint customers migrating to New T-Mobile was not diminished.

34. We will add 2.5 GHz radios to a major portion of existing T-Mobile sites to boost capacity and create the foundation layer for the 5G experience. For all New T-Mobile sites, we will upgrade the radio base for the AWS and PCS spectrum (as needed and as equipment is available) to add radios capable of both LTE and 5G. Greater deployment of PCS spectrum for LTE will also allow 2.5 GHz band to be more quickly dedicated to 5G. The table below provides the details on 5G radio resources we will apply to the New T-Mobile cell site base.[17]

[17] These figures have shifted slightly from the PIS as additional modeling occurred that determined that more spectrum could be refarmed to 5G services more quickly.

[redacted]

New T-Mobile Total Network Sites	79.2k	80.7k	82.2k	**84.4k**

Table 7: 5G Site and Spectrum Comparison (Year 2021-2024)

35. Specifically, we will deploy the 2.5 GHz spectrum for 5G at [redacted] sites by 2021 and AWS spectrum at [redacted] sites (which is predominantly AWS-1 spectrum). For the retained Sprint cell sites, we will add 600 MHz radios to nearly [redacted] cell sites as well as additional 2.5 GHz radios to more sites than were projected by the Sprint standalone plans (nearly [redacted] more cell sites will have 2.5 GHz by 2021; [redacted] more by 2024). The existing 2.5 GHz radio equipment installed on the retained Sprint cell sites will require electronics replacement to ensure compatibility with the New T-Mobile network.[18] For the existing T-Mobile cell sites, we will deploy 2.5 GHz radios to the majority of sites to boost capacity ([redacted] cell sites by 2021, [redacted] by 2024) so in total, [redacted] sites will have 2.5 GHz spectrum deployed by 2024.

[18] The New T-Mobile network will be constructed based on a single vendor per market to ensure compatibility. Sprint's existing 2.5 GHz infrastructure has equipment from a variety of vendors that will need to be replaced to be consistent with the New T-Mobile equipment.

36. Because we will complete the cell site retention and radio base improvements on a market-by-market basis, the improvements in capacity and coverage for existing T-Mobile and Sprint customers that are in upgraded markets will occur much sooner than 2021. By selectively retaining Sprint tower sites and adding new radios to both Sprint and T-Mobile sites, we will be able to rapidly deploy a broader and deeper 5G network while simultaneously maintaining the existing LTE network for all subscribers.

D. New T-Mobile Will Incur Most of the Cost of Deploying the Nationwide 5G Network During the Integration of the T-Mobile and Sprint Networks

37. As described above, when we integrate the T-Mobile and Sprint networks, we plan to deploy 5G radios and other 5G-related infrastructure on both the T-Mobile sites and the Sprint sites that we retain. By 2021, the New T-Mobile network will have [redacted] 5G-capable sites. Over the next three years, we plan to deploy components that will make an additional [redacted] sites 5G capable. New T-Mobile consequently will incur most of the cost of deploying its 5G integration network during the integration of the T-Mobile and Sprint networks and will face a low incremental cost of completing the deployment of a nationwide 5G network. New T-Mobile will have substantial incentives to complete the deployment of its 5G network rapidly because this low cost of deploying 5G technology will take place during the transition to the next generation of cellular technology.

III. THE NEW T-MOBILE NETWORK WILL DELIVER NEAR TERM BENEFITS TO EXISTING SUBSCRIBERS

A. Sprint Customers Will Rapidly Transition to the New T-Mobile Network

38. Once the deal is finalized, we will initiate efforts to integrate and migrate Sprint customers on to the New T-Mobile network immediately. To accomplish this, we must move existing T-Mobile and Sprint subscribers to a common core network. In the near-term, our

engineering team will work to bridge the two standalone core networks together.[19] The core network is the backbone of the wireless system that manages mobility management, call and session setup, user authentication, and access authorization as well as traffic routing through the network.[20]

39. This temporary bridge between the two network cores will allow Sprint customers to seamlessly access the T-Mobile and Sprint networks. Sprint customers then will have expeditious access to the sites retained from standalone T-Mobile and Sprint on the combined network everywhere there is open, available capacity. This bridge will be accomplished through use of Multi-Operator Core Network ("MOCN") technology,[21] which allows for use of a virtual single core network by routing appropriate services to the "home" network—in this case, the existing T-Mobile core.[22] A majority of Sprint devices are compatible with LTE technology on New T-Mobile spectrum bands and would be able to take advantage of this feature without any software or handset changes.[23] Sprint customers, with activation of MOCN functionality, will be able to access the New T-Mobile LTE network with greatly improved LTE coverage and data throughputs.

40. At the same time, we will scale the New T-Mobile core network to allow for the increased traffic associated with adding the nearly 55 million Sprint customers to the existing T-Mobile core network, which will be a top priority.

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[19] In the MetroPCS transition, T-Mobile began this process within the first week after the close of the transaction.

[20] *See e.g.*, Frédéric Firmin, *The Evolved Packet Core*, 3GPP (2018), http://www.3gpp.org/technologies/keywords-acronyms/100-the-evolved-packet-core

[21] Ray Decl. at ¶¶66-70. MOCN is also utilized by T-Mobile and Sprint to implement their roaming arrangement.

[22] *Id.* at ¶66.

[23] Saw Reply Decl. at ¶17. Any Sprint device that uses LTE and spectrum bands that are used in the New T-Mobile network would be compatible with MOCN.

41. We also will use an over-the-air software update to upgrade the more than 20 million Sprint devices (or more than one-half of the branded customer base) compatible with the existing T-Mobile network to use VoLTE. This will allow existing Sprint customers to migrate (on their current devices) to the New T-Mobile network shortly after the deal close.[24] Rapid migration to VoLTE for voice communications will greatly improve the service and coverage for those Sprint customers and simultaneously free up spectrum resources used for CDMA voice services (and allow for faster refarming of spectrum for 5G).

42. We will migrate Sprint devices on a market-by-market basis, depending on market load and available engineering resources. For those markets with available capacity, the Sprint customer migration will be nearly immediate—improving coverage and user experience for these users. Other markets will undergo similar migrations as soon as we are able to upgrade network resources to handle the additional traffic, but every single market in the New T-Mobile network should have some customer migration from Sprint within the first year after completion of the transaction. All Sprint customers should be fully migrated to the New T-Mobile network within three years after the close of the transaction and we would not anticipate shutting down any portion of the existing Sprint CDMA network prior to the end of 2021.

43. As customers are migrated off the Sprint core, we will cease using MOCN on a market-by-market basis and a single New T-Mobile core network will remain.[25] As we are combining the networks, we will ensure that the transition occurs without any short-term

[24] Ray Decl. at ¶64. The remaining Sprint customers will require handset change outs. The majority of these will be accomplished through the natural upgrade cycle, but New T-Mobile (similar to how the MetroPCS transition was handled) will offer promotions to expedite the replacement of incompatible devices.

[25] *Id.*

disruption or service degradation to customers.[26] In fact, the coverage and service options for many customers, especially Sprint customers, will expand as they gain access to the more geographically widespread New T-Mobile network.[27]

44. We must also ensure that there is sufficient capacity (radio and core network resources) to handle the increased traffic before all the remaining Sprint customers are moved to the new network (including those customers who do not have handsets compatible with the new network).

B. The Merger Will Allow New T-Mobile to Drive 5G Equipment Development

45. The efforts I have described above will set the stage for deployment of more spectrum on more cell sites to deliver the capacity necessary to be competitive. In addition, because we will have vastly more spectrum dedicated to 5G and a substantially larger customer base than either standalone company, we will have the scale and incentive to convince chip and phone vendors to accelerate the development and deployment of 5G-capable devices. In addition, this will enable us to have greater influence on global standards efforts and overall 5G leadership across the world and help us to provide better devices to consumers more rapidly.

46. To date, much of the initial chip and phone vendor efforts have been focused on millimeter wave spectrum for 5G because the U.S. mobile industry has been fragmented in its approach to 5G in other spectrum bands. Verizon's focus has been on the 28 GHz millimeter wave spectrum band for 5G initially.[28] AT&T's initial 5G efforts are focused on the 700 MHz

[26] *Id*.

[27] *Id.* at ¶72.

[28] *See e.g.*, D. Jones, *Pedal to the Mobile: Verizon Completes 5G Drive Test With Nokia*, LIGHT READING (Aug. 21, 2018) (found at: https://www.lightreading.com/mobile/5g/pedal-to-the-mobile-verizon-completes-5g-drive-test-with-nokia/d/d-id/745516).

spectrum obtained through partnering with FirstNet[29] as well as the 39 GHz millimeter wave spectrum band.[30]

47. T-Mobile is utilizing the 600 MHz and 28/39 GHz millimeter wave spectrum bands for its 5G deployments. Sprint is solely focused on a portion of its 2.5 GHz band spectrum holdings for its 5G rollout. The merger will allow New T-Mobile to bring this fractured spectrum picture (with a much larger customer base) into better focus for vendors, offering vendors increased incentives to rapidly deploy equipment capable of operating across all relevant bands—it will use spectrum in the 600 MHz, PCS, AWS, 2.5 GHz, and millimeter wave spectrum bands in 2021 for 5G.

48. While we have a baseline plan for 5G for T-Mobile (as does Sprint), we would not have the subscriber nor purchasing scale to incentivize handset and chip manufacturers that is possible with New T-Mobile.

IV. THE SPRINT CUSTOMER MIGRATION WILL BE SIMILAR IN SCALE TO METROPCS IN MANY MARKETS

49. To migrate Sprint customers to the New T-Mobile network, we will rely upon the expertise gained from our MetroPCS transaction. In many markets, the migration of MetroPCS customers to T-Mobile was of similar magnitude as will be the case for this merger. As an example, the table below shows the number of customers moved from MetroPCS to T-Mobile in Florida, Los Angeles, and New York.

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[29] *See e.g.*, J. Horwitz, *AT&T says 5G will be a software upgrade to cell towers with FirstNet*, VENTUREBEAT (June 21, 2018) (found at: https://venturebeat.com/2018/06/21/att-says-5g-will-be-a-software-upgrade-to-cell-towers-with-firstnet/).

[30] *See e.g.*, D. Jones, *AT&T Tests in Austin: 5G High & Rising*, LIGHT READING (Aug. 9, 2018) (found at: https://www.lightreading.com/atandt-tests-in-austin-5g-high-and-rising/d/d-id/745300).

Market	MetroPCS subscribers to migrate	Sprint subscribers to migrate
Florida	2.48 million	2.35 million
Los Angeles	1.43 million	1.46 million
New York	1.03 million	1.50 million

Table 8: Subscriber Migration Comparison

50. The number of customers that were moved from MetroPCS to T-Mobile in these areas are roughly equivalent (and in Florida greater) than the number of subscribers to be relocated from Sprint to New T-Mobile. More importantly, the majority of the MetroPCS subscriber base utilized CDMA devices—meaning a substantial portion required new handsets to be transferred to the T-Mobile GSM/LTE network.[31] In contrast, a majority of the Sprint subscriber base (more than 20 million) have compatible devices that can be software updated (using an over the air process described above) to the New T-Mobile network.[32]

51. In addition, the timing for updating the New T-Mobile radio network is well aligned with the plans for deploying 5G-capable radios. T-Mobile (the anchor network) has been deploying radio resources that are software upgradeable to 5G at many of its existing cell sites—and will continue to do so during the transition process. These new radios are much more capable of managing broader spectrum bands for 4G and 5G and make inclusion of new spectrum resources into cell sites more cost effective and efficient. Moreover, New T-Mobile can replace existing antennas and radio equipment that can handle more spectrum bands and capacity without increasing the physical space or mass (weight of equipment) use at a site.[33]

[31] Ray Decl. at ¶¶36-37.

[32] *Id.* at ¶37.

[33] *Id.* at ¶31.

Therefore, deploying extensive new radio equipment would potentially avoid new zoning approvals and likely incur only minor adjustments to existing lease payments.[34]

52. We will use the same playbook for New T-Mobile that guided the MetroPCS transition. In contrast to other less successful transitions mentioned by petitioners,[35] we will build this process upon a methodology that delivered cost savings ahead of schedule, with synergies better than expected and without any customer disruption.[36]

V. THERE ARE NO ALTERNATIVES FOR T-MOBILE TO PROVIDE A ROBUST, NATIONWIDE 5G NETWORK IN THE SAME TIMEFRAME

A. The Spectrum Resources Available in the Near Term Are Not Practical Substitutions for Those Produced by the Transaction

53. Merger opponents have inaccurately suggested that T-Mobile could participate in the upcoming millimeter wave spectrum auctions or other non-scheduled mid-band spectrum auctions to match the performance of the combined company.[37] They have also incorrectly argued that the network modeling we conducted was flawed as it failed to consider future spectrum availability.[38] Millimeter wave spectrum, while vital to help support capacity needs in dense urban environments, cannot replicate the propagation of mid-band spectrum (like the 2.5 GHz band). The mid-band spectrum alternatives suggested have no certainty associated with their availability for 5G and have regulatory limitations.

[34] *Id*.

[35] *See DISH Petition* at 34; *AAI Petition* at 18.

[36] Ray Decl. at ¶72.

[37] *See DISH Petition* at 28-29; *Public Knowledge Petition* at 38.

[38] *See DISH Petition* at 29.

54. As I stated previously, millimeter wave spectrum is best utilized in dense urban markets where there are extreme capacity demands.[39] While I do believe there are invaluable uses for millimeter wave spectrum and T-Mobile has expressed its interest in participating in the auction for this spectrum,[40] it will not replicate the robust, nationwide 5G coverage and capacity that is available from the transaction. The physical and economic realities of this spectrum make it impractical to deploy for wide scale coverage. The operating radius around cell sites using millimeter wave spectrum would be significantly less than one-half of one mile, meaning that deployment to cover a single market would require thousands upon thousands of cell sites—much more than technically and economically feasible.

55. Similarly, the mid-band spectrum options suggested to support the standalone T-Mobile 5G network build are entirely theoretical. The 3.5 GHz CBRS spectrum band has a number of significant technical limitations, even if the auction timeline were clearly defined (which it is not). First, the power limits associated with the band are constrained. Initial deployments in the band are limited to use of an effective isotropic radiated power ("EIRP") of 30 dBm/10 MHz until a sensing capability is accepted by the government and then commercially deployed.[41] After that, the EIRP limit moves to 47 dBm/10 MHz.[42] In contrast, other licensed wireless services have EIRP limits in excess of 60 dBm for cell site transmissions.[43] As every 3 dB doubles the power (100 percent stronger), a 30 dB difference would mean the EIRP was 1000x stronger. After the sensing capability is deployed, the 3.5 GHz CBRS EIRP limit would

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[39] Ray Decl. at ¶37.

[40] *See Ex Parte* Presentation of T-Mobile US, Inc., AU Docket No. 18-85 (filed July 23, 2018).

[41] *See* 47 C.F.R. §96.41(b).

[42] *Id*.

[43] *See* 47 C.F.R. §27.50 (which contains the various EIRP limits for the 600 MHz, AWS, and 2.5 GHz spectrum bands.

still be more than 13 dB less than a typical wireless system (or approximately 20x weaker). Such a dramatic reduction in EIRP would necessitate deployment of much greater numbers of cell site transmitters to produce the same coverage. Therefore, the 3.5 GHz CBRS spectrum will be limited to providing capacity cell sites in support of other spectrum bands that are providing coverage and capacity (like the AWS, PCS, and 2.5 GHz bands).

56. In addition, the 3.5 GHz CBRS band suffers from a number of regulatory burdens, including a complicated sharing system requirement (where existing Federal and commercial incumbents must be protected),[44] very small geographic areas for the associated licenses,[45] a lack of license term and renewal expectancy,[46] and limited amounts of spectrum (70 megahertz in total and only 40 megahertz per licensee).[47] Each of these limitations further diminishes the viability of this spectrum as compared to other mid-band spectrum alternatives. Moreover, the near-term technical development efforts for the spectrum have been entirely focused on LTE not 5G.[48]

57. Finally, the timing of the auction for this spectrum band and all the other mid-band spectrum alternatives suggested (including the 3700-4200 MHz, EBS, and 3450-3550 MHz bands) is uncertain. The Commission has ongoing rulemaking processes that must be completed prior to any auction. Once finalized, the FCC will need to determine auction rules and procedures and schedule an auction. Even if the auction date, license rights, and amount of spectrum available were certain, which is not the case, there is no way that any of these mid-

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[44] See 47 C.F.R. §§96.15, 96.17, 96.21.

[45] *See e.g.*, *Ex Parte* Presentation of T-Mobile, GN Docket No. 17-258 (filed April 25, 2018) at 1.

[46] See 47 C.F.R. §96.25(b)(3).

[47] See 47 C.F.R. §§96.13, 96.31.

[48] *See e.g.*, https://www.cbrsalliance.org/ (heralding the use of CBRS spectrum for secure, cost-effective LTE coverage indoors and private LTE networks).

band spectrum resources would be available in the timeframe that could match our deployment plan for New T-Mobile. Assuming the transaction is approved in 2019, we would immediately begin efforts that year to start the 5G deployment process. None of these other mid-band spectrum options would be available earlier than 2020 (if the government rulemaking processes went expeditiously without delays) and many are likely to extend significantly past 2020—well after the time we could begin deploying a world class 5G network as a result of the merger.

58. Assertions that we should include any of these other mid-band spectrum options into our engineering model are therefore illogical.[49] Our capacity modeling is based on known spectrum resources that are within the control of the company. While we may model new spectrum bands to help determine the value of the spectrum at auction, we would not put them into our ordinary course models that are used to project congestion in the operating network. The model is based upon inputs that are within the control of the company and not based upon future, completely speculative assets that have not been allocated by the Commission or have a timeline associated with them. Including the spectrum resources suggested by DISH as part of future planning would lead to results that are impractical to rely upon. The whole point of our network modeling and planning is to determine the capabilities of the underlying network, along with the effects of potential solutions that are within the control of the company. What our current engineering model has done for the transaction is carefully and precisely estimate the capacity available for the New T-Mobile, T-Mobile, and Sprint networks based on the cell site and spectrum resources available to each company. Any other approach would be highly misleading and provide outcomes that are not factually based.

[49] *See DISH Petition* at 28-29.

B. T-Mobile Cannot Refarm Its Existing Spectrum Holdings More Rapidly to 5G Without Degrading Network Performance

59. Opponents of the transaction have suggested that, because we have fewer customers on our network than AT&T or Verizon, we have the capacity and spectrum to deploy more spectrum resources to 5G.[50] However, we have in as an aggressive manner as feasible targeted spectrum for refarming from LTE to 5G on a standalone basis (*see* Table 1). We have developed this refarming plan to migrate spectrum from LTE to 5G technology over time, carefully ensuring that the LTE performance will not degrade for our existing customers. If we were more aggressive in refarming, our current LTE customer user experience would degrade and, based on my experience, this would lead to lower customer satisfaction and an increase in churn to competitors.

60. New T-Mobile, however, will have the spectrum resources to more rapidly refarm spectrum from LTE to 5G without sacrificing network performance. Our network modeling projections demonstrate that there will be no negative impacts on LTE performance during the refarming process, while the 5G network performance will greatly exceed our standalone capabilities. The size and scale of New T-Mobile will drive 5G-capable device penetration rates up by 10 percent, year over year. Faster refarming of spectrum to 5G and more customers with 5G-capable devices will improve the overall spectrum efficiency on the New T-Mobile network —providing a multiplicative gain in capacity as compared to standalone T-Mobile. None of this is achievable without the resources provided by the transaction.

[50] *See DISH Petition* at 27; *AT&T Petition* at 10.

C. Massive MIMO Alone Cannot Match the Performance of the New T-Mobile Network.

61. Massive MIMO is a next generation technology that incorporates multiple antenna elements into a single device (or base station) transmitter to strengthen signals and provide greater capacity. We have extensively deployed 4x2 and 4x4 MIMO within the T-Mobile network and anticipate that we would utilize massive MIMO as part of the New T-Mobile network as we implement 5G. In recognition of this, the engineering models utilized for New T-Mobile (as well as for standalone Sprint) have included consideration of massive MIMO. However, massive MIMO on its own does not come close to replicating the multiplicative benefits associated with the increased cell sites, spectrum resources, and spectral efficiency of New T-Mobile.

62. I have reviewed the technical statements and findings in the Opposition to Petitions to Deny and agree with the methodology and conclusions reached in that document.

63. I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed on September 17, 2018.

Neville R. Ray
Executive Vice President and Chief Technology Officer
T-Mobile US, Inc.

APPENDIX C: REPLY DECLARATION OF PETER EWENS
Executive Vice President, Corporate Strategy, T-Mobile US, Inc.

REPLY DECLARATION OF PETER EWENS
Executive Vice President, Corporate Strategy, T-Mobile US, Inc.

I. INTRODUCTION

1. My name is Peter Ewens and I currently serve as the Executive Vice President, Corporate Strategy for T-Mobile US, Inc. ("T-Mobile"). I have been at T-Mobile since 2008. I hold undergraduate and graduate degrees in engineering from the University of Toronto, and I earned a master's of science in management from MIT's Sloan School of Management.

2. I have reviewed the Joint Opposition of T-Mobile US, Inc. and Sprint Corporation to Petitions (the "Opposition") filed with the FCC in response to various petitions to deny the transaction between T-Mobile and Sprint. In support of the Opposition, I am providing information with respect to New T-Mobile's business plans and the financial bases for the proposed merger of T-Mobile and Sprint Corporation.

II. REPLY DECLARATIONS

A. Network Synergies are Necessary for the Success of The Merger and the Deployment of the New T-Mobile 5G Network.

3. As I mentioned in my initial declaration, at its core, this merger is about realizing synergies and achieving the scale and resources, including both spectrum and sites, to create the nation's leading 5G network. New T-Mobile's financials identify approximately $43.6 billion net present value ("NPV") in synergies generated by the merger. Of these $43.6 billion, network synergies gained by eliminating the duplication of T-Mobile's and Sprint's existing networks constitute the largest share, approximately [redacted], or [redacted] percent of the massive cost savings. Unleashing these synergies requires investment and has a cost to achieve of [redacted] ($[redacted] to decommission Sprint sites; [redacted] in incremental network investment for integration). These synergies are critical to New T-Mobile's future growth and investment.

B. Network Sharing Would Not Provide The Synergies and Efficiencies Available To The Combined Company.

4. A network sharing arrangement would not provide the same benefits as the merger. Network sharing arrangements have many detriments that make them completely unsuitable for achieving T-Mobile and Sprint's business objectives. Furthermore, the merger creates multiplicative benefits of merging the cell site and spectrum resources of T-Mobile and Sprint to drive capacity gains that could not be realized by a network sharing arrangement. A full review of all issues surrounding network sharing arrangements demonstrates that those disadvantages outweigh any potential cost savings benefit.

5. There are many different kinds of network sharing and, because all network sharing is arranged through negotiated agreements, the variations between network sharing arrangements can be wide-ranging. However, even the network sharing approach that would most closely approximate the benefits of a merger—some form of active sharing of both the T-Mobile and Sprint networks, or a Radio Access Network ("RAN") sharing agreement—would fail to match the proposed transaction's advantages. Network sharing would only partially enable the capture of network-specific synergies, leaving billions of dollars in non-network, commercial synergies unrealized, and still only enable a small fraction of the potential network-specific benefits created by the merger. That is, each separate company must maintain separate sales, customer care, advertising, and general administrative staff functions. Thus, costs for these functions would essentially double across two separate companies as compared to a merged New T-Mobile. Hardware costs and or network costs may also be redundant across two separate companies, depending on the degree of sharing.

6. Failing to capture commercial synergies would eliminate many of the potential benefits created by the deal. In particular, the companies would lose synergies related to retail distribution ($[redacted]), advertising ($[redacted]), equipment costs ($[redacted]), repair and logistics ($[redacted]), IT and Billing ($[redacted]), and other fixed G&A ($[redacted]). Together these commercial synergies amount to $[redacted] or approximately [redacted] percent of projected deal synergies. The $43.6 B in cost synergies that the merger will produce, $40 B of which will enable greater investment in the network and business, will be vastly reduced, resulting in a less than fully funded end network lacking the breadth or depth of what New T-Mobile will be able to achieve.

7. Network sharing arrangement participants must also maintain existing infrastructure because the potential for unwinding limits the incentive to permanently commit spectrum or become overly dependent on shared facilities. That necessary maintenance of at least some redundant assets translates into significant additional costs. In addition, network sharing would require the parties to invest in ensuring equipment interoperability and carrier integration. In other words, a substantial amount of the costs of combining two networks (and possibly more) would be incurred without fully achieving the efficiencies that could be achieved through a merger.

8. Network sharing would also introduce additional inefficiencies because capacity needs to be allocated for each company according to a preset formula, resulting in loss of efficiency as it is divided based on a prearranged agreement, rather than assigned based on user requirements. It is virtually impossible in such arrangements to anticipate how retail strategies, and therefore demands on the network, may diverge over the long term. These preset arrangements have much less ability to adapt to changing markets. This inefficient allocation of resources may also create incentives for using capacity that is not strictly market-driven. For

example, under a capacity splitting arrangement, the companies may agree to reallocate capacity based on specific usage conditions. To forestall a loss in what it can potentially offer, a company would have incentive to ensure that all available capacity is used, even if it is not currently needed, to fulfill customer requirements as a way of preserving what it can offer at some point in the future. Rather than a competitive market where each company can invest and advertise as to what it can offer, this leads to market distortions as one company can arbitrarily limit the ability of the other company to respond to changing conditions and satisfy customer needs.

9. Another shortcoming to network sharing is that it stifles innovation and is less responsive to market conditions than a singly-operated network after a merger. By necessity, a network sharing arrangement must be governed through agreement of the companies involved – often by consensus and through a negotiated set of governance procedures that could be complex and unwieldy as the companies, to protect their respective interests, must negotiate the minutest level of detail about the proposed sharing arrangement and the capital investments needed to construct the system. Regardless of the ultimate agreed upon arrangement and procedures, such a business structure is inherently inefficient at responding to rapidly changing market conditions. Rather than a single chain of command for decision-making, each participant must determine its preferred course of action separately. Any differences must be negotiated, and the result will not be optimal for either party. For example, T-Mobile's innovative Binge On program (which allows customers to stream video without fear of using significant portions of their data plans) would not have been possible under a network sharing plan. The lack of flexibility in allocating resources under a sharing plan would have made it impossible for T-Mobile to assign network resources to carry the additional video traffic created by Binge On, or to respond to changing

usage patterns as customers increase the amount of data they consume. Similarly, a sharing plan could preclude the flexibility needed to create or match a competitor's promotion.

10. Also, given that the benefits of a network sharing arrangement are shared by a competing carrier, these arrangements reduce the incentive to invest and coordination of the best technology path going forward may be difficult. The consequence of such reduced and slower paced innovation is comparatively lower ability to challenging market leaders in the dynamic wireless market. Furthermore, as competitors, the carriers in a network sharing arrangement cannot coordinate their commercial priorities. However, commercial priorities drive network priorities, creating unavoidable difficulties with respect to how competitors engaged in a network sharing arrangement determine how to invest finite capital or which commercial outcomes the company should optimize its performance to meet. Network capacity and expansion investments, and commercial pricing and distribution decisions are taken in tandem in a wireless company.

11. Network sharing could also result in less competition and higher prices. Network differentiation is the key source of competitive differentiation in the market. Pricing differentiation flows from network differentiation. With two major players relying on the exact same network, the ability to differentiate is diminished and the incentive for purely price-based competition would therefore also be diminished, due to the increased incentive for unintentional coordination.

12. Network sharing arrangements pose additional administrative issues as well. Changing conditions in the future may provide an opportunity for – or effectively require – each participant to go its own way. Often, this is no easy task. The fundamental challenge in unwinding network sharing arrangements is managing the separation of shared assets so that

each company can have its own asset base following the end of the arrangement and so that the distribution of assets reflects the differential investments and ownership interests of each company. As a result of these challenges, network sharing arrangements can have very high separation costs and significant logistical challenges. Out of necessity, parties to a network sharing arrangement must expend resources to plan for failure. Such planning, or actual failure, may lead to companies holding spectrum and sites as a hedge against a potential unwind or more favorable dissolution terms, resulting in possible inefficiencies to all parties. Furthermore, the interim time necessary to reach an uncertain outcome could limit both parties' competitive effectiveness pending resolution. T-Mobile and Sprint would face the same issues here.

13. Finally, while critics of the merger have raised concerns regarding service quality and continuity during the integration of the T-Mobile and Sprint networks, maintaining service continuity during network separation is even more difficult. The separation of T-Mobile and Sprint networks at the end of a network sharing arrangement could create significant service disruption for the customers of both networks. A merger would not lead to the same adverse consequences involved in network sharing and would allow New T-Mobile to make business decisions in its own interest, rather than T-Mobile and Sprint needing to subordinate their interests to a pre-negotiated operating structure that may not anticipate future technological or market changes.

C. T-Mobile Spurred Convergence of Prepaid and Postpaid Segments

14. Much of the narrowing between the features and prices of prepaid and postpaid plans has been due to T-Mobile's industry-leading Un-carrier approach, which takes the best features from prepaid and postpaid models. T-Mobile's introduction of its "Contract Freedom" program eliminated long-term service contracts for postpaid plans and replaced them with a transparent pricing model, spurring other providers to do the same. T-Mobile also borrowed a

successful attribute of prepaid plans to improve the value proposition of postpaid plans. Its "Taxes and Fees Included" program also introduced "what you see is what you pay" plans that bundle all monthly taxes, surcharges, and fees up front, giving subscribers consistent bill certainty comparable to prepaid offerings. Finally, T-Mobile pioneered separation of phone subsidies and phone payment plans from mobile rate plans that introduced programs to create greater bill certainty for customers on postpaid plans, and also pioneered unlimited usage in Mexico for prepaid plans.

D. Prepaid Plan Customers Will Benefit from Lower Costs, Higher Quality and Increased Competition

15. The massive increase in capacity of the New T-Mobile network will provide significant benefits for all customers, including those on prepaid plans. Consistent with the past twenty years of industry trends, the increased capacity will decrease substantially the cost per gigabyte of delivering service to consumers. This will allow New T-Mobile to price services more aggressively to attract customers, regardless of whether they are using prepaid or postpaid offerings. T-Mobile projects that New T-Mobile will create a number of other non-network efficiencies that will reduce its marginal costs by generating cost savings that could not be realized absent the transaction, likely resulting in an additional savings for prepaid customers. Customers on prepaid plans thus stand to benefit as much as those on postpaid plans from this capacity increase and corresponding lower costs.

E. MVNOs Will Benefit from Lower Costs and Increased Competition

16. New T-Mobile's nationwide 5G network, massive capacity gains, and lower operational costs resulting from the merger will allow it to lower wholesale prices to ensure that capacity is fully utilized. New T-Mobile's combination of coverage and capacity also will provide a significantly more attractive mobile network operator ("MNO") option for MVNOs,

intensifying competition for wholesale services. Moreover, pricing for many MVNOs, including TracFone's Simple Mobile brand and GoogleFi, are benchmarked off of retail prices. Thus, as T-Mobile branded subscribers benefit from lower pricing enabled by the merger's capacity gains, subscribers of many MVNOs also will benefit from lower pricing.

17. Though T-Mobile will be able to deploy a standalone nationwide 5G network, its 600 MHz spectrum lacks the bandwidth to deliver the full data rate and capacity gains possible for 5G. T-Mobile on a standalone basis lacks the network to deliver the combination of coverage and quality of service that New T-Mobile could provide. Moreover, T-Mobile's reliance on roaming in certain parts of the country makes it a less attractive option for MVNOs looking to offer their customers nationwide coverage. By way of example, StraightTalk, TracFone's flagship brand, is largely distributed by Wal-Mart, which has a large presence in rural and small communities. T-Mobile has historically been unable to compete for StraightTalk business due to its lack of coverage in these areas, particularly since Walmart desires a single, national solution that it can retail in all its stores. Conversely, New T-Mobile's combination of coverage and capacity will allow it to go toe-to-toe with Verizon and AT&T

18. Finally, just as it does when serving retail customers, T-Mobile seeks to keep MVNOs on the most spectrally-efficient technology available. Some MVNO customers have guaranteed this access by contract. But, even where they have not, in general, both T-Mobile and New T-Mobile would plan to provide MVNOs access to their 5G networks on the same terms as postpaid retail customers. In fact, historically, rather than keep MVNOs from accessing its most recent network, T-Mobile has actually pushed MVNOs to upgrade their customers' handsets more quickly so that T-Mobile could re-farm spectrum more efficiently.

F. Rural Americans Will Benefit from Improved Broadband Service and Rural Carriers Will Receive Continued Roaming and Technical Assistance

19. One of New T-Mobile's main opportunities for adding significant customer share is in rural areas and small towns—where neither T-Mobile nor Sprint has much of a presence today. T-Mobile's 600 MHz spectrum gives it the base frequencies to serve these areas—and T-Mobile has begun to build it out. However, it is the merger synergies, the combined company's complementary spectrum, and larger scale, that make New T-Mobile's proposed expanded investment in rural areas a sound business decision. As a result, the transaction will produce tangible benefits for rural consumers through faster and higher quality broadband and voice services, as well as expanded physical retail presence. Rural consumers will also experience increased competition, and the benefits it brings, due to the expanded presence of a new maverick competitor.

20. Additionally, New T-Mobile will continue to work with local rural carriers to improve wireless service. New T-Mobile will assist rural carriers who receive funding through the FCC's Universal Service Fund program to make it economical to serve more remote rural areas.

G. The Merger Will Create New Competition and Consumer Benefits in the Enterprise Segment

21. Today T-Mobile and Sprint have approximately a 9 percent combined share of the enterprise segment.[1] Verizon and AT&T dominate the segment with a combined share of 90 percent. However, T-Mobile projects that, with the benefit of the merger, New T-Mobile will

[1] In the business portion of the segment, T-Mobile and Sprint have current market shares of approximately [redacted] and [redacted] percent, respectively, for a combined share of approximately 9 percent. In the government/public sector portion, T-Mobile and Sprint have market shares of [redacted] and [redacted] percent, respectively, for a combined share of approximately 6 percent. The total combined T-Mobile and Sprint share of the entire enterprise segment is approximately 9 percent.

quickly double T-Mobile's and Sprint's combined existing business to claim 20 percent of the business segment by 2024.

22. The nationwide 5G network will provide dramatic quality and coverage improvements, and its drastically increased capacity will also enable New T-Mobile to offer more competitive prices and attractive features for businesses of all sizes.

23. Standalone T-Mobile and Sprint lack the network, sales and support, and technology platforms to offer competitive services across the breadth of the enterprise segment. Combining the companies' assets will provide the network improvements, sales force expansion, and investments in technology solutions, to offer enterprise customers a full portfolio of 5G wireless, wireline, and IoT solutions and bring strong competition to the segment.

24. One enterprise opportunity that T-Mobile is evaluating is the replacement of landline desk phones with wireless alternatives. Landline desk phones represent a multibillion business within the enterprise segment today. New T-Mobile will be able to introduce more advanced and adaptable wireless alternatives do landline desk phones. T-Mobile projects that, with its 5G network, New T-Mobile can provide a wireless product that will better meet the desk phone needs of enterprise customers.

25. Another enterprise service that could be revolutionized by New T-Mobile's 5G network is the provisioning of software-defined wide-area networks (SD-WANs). Today, SD-WANs are predominantly serviced by fixed line Internet service providers. The New T-Mobile network could open a range of opportunities in the SD-WAN space. For example, though most SD-WANs are fixed line, there is an opportunity for New T-Mobile to use its network to provide network redundancy for enterprise clients through a wireless backup option. Furthermore, because this backup function would require enterprise hardware to have integrated radios capable

of operating on the New T-Mobile network, these devices could also serve as in-building licensed "hotspots," leveraging New T-Mobile's licensed spectrum to improve network coverage indoors. Eventually, New T-Mobile could even provide primary SD-WAN services. This could involve using software to "slice" the 5G network and designate reliable, high-quality, capacity to individual enterprise customers to effectively serve as their internal network and connect offices, data centers, retail locations, workforces, etc. over large geographic distances. New T-Mobile will have strong incentives to leverage its world-leading robust, nationwide 5G network's capacity to open up innovative new wireless possibilities in this space.

26. Finally, commercial IoT represents a valuable opportunity for New T-Mobile in the enterprise segment. Because of IoT's heterogeneous nature, different use cases require different network capabilities. Accordingly, there are IoT use cases that T-Mobile and Sprint can, and are, serving with their existing assets. However, the heterogeneity of IoT is the very reason that the merger will increase the merged company's ability to compete in IoT services. For example, IoT services such as fleet management, remote sensing, and Unmanned Aerial Systems (UAS) may not require high bandwidth or capacity, but do require a degree of geographic range for which the standalone Sprint network is ill-suited. Some smart building/campus/city solutions may not require geographic ubiquity, but could require capacity beyond the capabilities of the standalone T-Mobile network. And some IoT solutions, such as autonomous vehicle services, require both capacity and geographic ubiquity. Therefore, the combined capacity and ubiquity of New T-Mobile's 5G network will enable new enterprise IoT solutions that neither T-Mobile nor Sprint can offer alone. Furthermore, the combination of T-Mobile and Sprint will meld an Un-carrier approach with the scale and complementary assets

required to enable strong competition with Verizon and AT&T, offering enterprise customers a truly competitive alternative.

27. On their own, each of New T-Mobile's enterprise services and features would be valuable to enterprise customers. However, with additional services, New T-Mobile will be able to offer more attractive combinations of wireless, landline-replacement, SD-WAN, wireline, or IoT services into single plans. By doing so, New T-Mobile will be able to manage and balance pricing and costs across multiple offerings to more economically provide appealing services to business customers.

28. Finally, expanding New T-Mobile's share in the enterprise segment will take more than a superior network or better, cheaper products. It will also take marketing and salespeople. Therefore, the New T-Mobile enterprise story is also a jobs story. With the merger, New T-Mobile plans to add 1,100 employees to the enterprise workforce to bring increased competition to the sector.

H. Network Investments and Operating Expenditures

29. In the ordinary course of business, T-Mobile develops a detailed financial and operating plan for the coming year, as well as a less-detailed, multi-year long-range plan (LRP). The coming year's detailed financial and operating plan is formulated each fall, and the LRP is typically updated then as well. The financial plans incorporate projected network-related operating expenditures ("OpEx") and capital expenditures ("CapEx"), among other things. The network plan for standalone T-Mobile described in the Ray Reply Declaration is consistent with the network OpEx and CapEx forecasts in these financial plans.

30. T-Mobile faces significant pressure from capital markets to adhere closely to the forecasted network OpEx and CapEx expenditures presented in the LRP. However, LRPs are subject to inherent uncertainty and potential revision as additional information, including through

new and improved network modeling, becomes available. As described further in the Ray Reply Declaration, T-Mobile maintains a network model that it uses to forecast network congestion and the costs associated with resolving that congestion in order to meet T-Mobile's network planning criteria. At the time that T-Mobile formulated the most recent LRP, its ordinary course network model applied only to its LTE network. T-Mobile has since extended the functionality of its network model to analyze its future 5G network. The results of this new 5G model make it clear that T-Mobile will face rising network costs to accommodate expected traffic growth and that the costs necessary to maintain the high-quality user experience that T-Mobile seeks to provide its customers will exceed the costs projected in the most recent LRP.

31. In particular, if T-Mobile were to maintain the levels of OpEx projected in the LRP for 2021-2024, it would not be able to satisfy the increasing usage demands of its customers. The middle column of Table A reports T-Mobile's 5G projections of the average usage levels its customers would demand in the absence of usage restrictions. The third column of Table A shows the usage levels that T-Mobile's 5G network could support while maintaining acceptable levels of congestion and maintaining OpEx within two percent of the levels projected by the current LRP. As is clear from comparison of the two columns, T-Mobile would fall substantially short of being able to meet its customers' needs.

Year	Unconstrained Traffic Demand (GB/Sub/Month)	Constrained Traffic (GB/Sub/Month)
2021	[redacted]	[redacted]
2022	[redacted]	[redacted]
2023	[redacted]	[redacted]
2024	[redacted]	[redacted]

Table A: Projected Standalone 5G Unconstrained and Constrained Traffic

32. Faced with such a shortfall, T-Mobile would have to incur additional costs in order to maintain, much less improve, the quality of the product it offers—failure to do so would result in T-Mobile falling significantly behind its principal rivals: AT&T and Verizon Wireless. However, as stated above, T-Mobile's ability to increase expenditures is limited by significant pressure from capital markets. Even as increasing network traffic will cause T-Mobile's total network expenditures to increase beyond those incorporated in its LRP, T-Mobile will be forced to maintain its network OpEx expenditures within a narrow band around its planned network OpEx expenditures. Although T-Mobile also faces constraints on the extent to which it can increase network CapEx, it generally has more flexibility to reallocate CapEx from other projects (e.g., technology upgrades or launching of additional coverage sites), meaning that OpEx represents the most binding short- to medium-term constraint on network expansion. It should be recognized, however, that the reallocation of CapEx from other projects can have the effect of slowing coverage improvements or deployment of new technologies and spectrum.

33. Historically, T-Mobile's network OpEx is equivalent to approximately [redacted] percent of service revenue. In T-Mobile's current LRP, network OpEx ranges from [redacted] percent of service revenue through 2024. In response to rising customer demand, T-Mobile could be forced to raise its OpEx to maintain sufficient network quality to compete effectively, but an increase of more than [redacted] percent over projected OpEx would be very difficult given

financial constraints. Taking the most realistic view of constraints from capital markets, my view is that T-Mobile would be most likely to raise OpEx by less than twenty percent and increase that amount over time. Based on the 5G network model, the current LRP, and the financial constraints that T-Mobile faces, I therefore expect that based on rising customer demand, the most likely path is that T-Mobile would expend OpEx amounts at least [redacted]-percent higher than the LRP amounts in years 2021 through 2024, respectively. As Table B below shows, although the resulting usage levels (shown in the third column) are considerably higher than they would be if T-Mobile were not to invest in greater capacity than forecast by the LRP, they are still lower than the unconstrained projections. These amounts represent a reasonable tradeoff between meeting financial expectations and consumer demands.

Year	**Unconstrained Traffic Demand (GB/Sub/Month)**	**Constrained Traffic (GB/Sub/Month)**
2021	[redacted]	[redacted]
2022	[redacted]	[redacted]
2023	[redacted]	[redacted]
2024	[redacted]	[redacted]

Table B: Adjusted Projected Standalone 5G Unconstrained and Constrained Traffic

34. Because such incremental expenditures would still be insufficient to handle the increasing network traffic, T-Mobile would take steps to restrict usage. Restricting traffic to manage network resources is reasonable and could be accomplished through a variety of mechanisms. For example, using T-Mobile's traffic forecast model for 2024, constraining video throughput to 5 Mbps (approximately the equivalent of 1080p video quality) would reduce projected data traffic from [redacted] GB/subscriber/month to [redacted] GB/subscriber/month. Other methods, including placing data limits on mobile hotspot usage or deprioritizing traffic in congested cells, both methods that T-Mobile currently utilizes, could also be employed to further restrict usage.

35. Although managing network resources to restrict traffic in this way would likely be the best course of action open to standalone T-Mobile, it could still significantly impair the company's ability to compete effectively with other providers that would be capable of offering less restrictive data usage. The fact that standalone T-Mobile would have to pursue such a course reflects the competitive challenges it would face absent the merger.

36. New T-Mobile would face similar constraints on its ability to increase network OpEx beyond planned expenditures. However, I understand that New T-Mobile would be able to accommodate unconstrained traffic demand without approaching the [redacted] percent incremental OpEx constraint; in fact, it could do so without even reaching [redacted] percent incremental OpEx.

I. Broad 5G Handset Availability Will Increase Industry Focus on 5G by 2021

37. 5G services and the 5G network will be the focus of pricing and strategic business decisions by 2021, and the overwhelming majority of new customers in 2021 and beyond are likely to be customers with 5G-capable handsets.

38. I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed on September 17, 2018.

Peter Ewens
Executive Vice President,
Corporate Strategy
T-Mobile US, Inc.

APPENDIX D: DECLARATION OF JOHN C. SAW
Chief Technology Officer, Sprint Corporation

DECLARATION OF JOHN C. SAW
Chief Technology Officer, Sprint Corporation

1. My name is John C. Saw. I am Chief Technology Officer for Sprint Corporation ("Sprint"). In this role, I am responsible for technology development, network planning, engineering, deployment and service assurance of the Sprint network.

2. My background and experience are fully summarized in my declaration submitted with the Public Interest Statement, filed on June 18, 2018 (the " Initial Declaration").

3. I hereby make this declaration.

I. OVERVIEW

4. Opponents of Sprint's merger with T-Mobile have made several claims in petitions and comments submitted to the FCC that misrepresent Sprint's current and future network capabilities and plans. Some commentators have stated that Sprint can build a nationwide 5G network on its own, claiming that Sprint's standalone 5G efforts undermine the merger rationale and benefits claimed by Sprint and T-Mobile (*See, e.g.,* DISH Petition to Deny at 22-28, 31-32, Free Press Petition to Deny at 60). Other petitioners have suggested that even if Sprint is not in a position to build out a nationwide 5G network today due to spectrum limitations, the company can obtain sufficient spectrum on the open market to launch nationwide 5G service in the near future (*See, e.g.,* Common Cause Petition to Deny at 38). Additionally, some petitioners misunderstand how Sprint's 2.5 GHz spectrum will enable the New T-Mobile to expand broadband service to rural areas (*See, e.g.*, DISH Petition to Deny at 40). For the reasons explained below, these comments and criticisms do not undermine the merger rationale or the public interest benefits associated with the transaction.

II. SPRINT'S 5G ROLLOUT CANNOT MATCH THE 5G NETWORK PERFORMANCE OF NEW T-MOBILE

5. Sprint expects to roll out its 5G network in the first quarter of 2019 utilizing massive MIMO technology on the company's 2.5 GHz spectrum. Our 5G sites will support 4G and 5G services simultaneously, providing substantial performance enhancements over the Sprint network's current 4G LTE performance.

6. However, Sprint's 5G services will initially be launched in metro areas in nine cities – Dallas/Fort Worth, Chicago, Los Angeles, Atlanta, New York City, Washington D.C., Houston, Phoenix, and Kansas City – and Sprint's 5G network will not extend beyond major metropolitan and surrounding areas for the foreseeable future. Sprint plans to deploy [redacted] 5G sites in 2018, an additional [redacted] in 2019, and reach [redacted] total sites by 2020. These [redacted] 5G sites will cover approximately 150 million POPs by 2020. Our current plan of record for the network covers 2018-2022 and includes [redacted] 5G sites through 2022.

7. As I explained in my Initial Declaration, Sprint must continue to devote its 800 MHz and 1.9 GHz spectrum to our 4G LTE and 3G CDMA networks, and will use these spectrum bands for 4G LTE beyond 2024. Sprint's 5G service, therefore, will only utilize our 2.5 GHz spectrum. Because 2.5 GHz spectrum has poorer propagation and penetration characteristics than lower frequency spectrum, utilizing 2.5 GHz spectrum as a coverage layer outside of population-dense metropolitan and surrounding areas would be impractical for us.

8. Sprint has no current plans or capability to make Sprint's 5G network blanket the entire geography of the United States or to cover as many areas of the country as New T-Mobile's network. Rather, 5G deployment will be limited to areas in and around major cities. Even if Sprint had the board-approved capital necessary to build additional 5G sites beyond major metropolitan areas, it lacks the low-band spectrum needed to ensure there is a robust 5G coverage layer underlying a capacity layer utilizing 2.5 GHz spectrum. Without a strong

fallback spectrum layer in 5G, building out 2.5 GHz spectrum beyond densely populated areas is unattractive because it would result in inconsistent subscriber experience as customers move in and out of range of 2.5 GHz sites. In addition, as stated in my Initial Declaration, it would be very challenging, expensive, and impractical to use 2.5 GHz spectrum alone to provide 5G coverage across the entire United States.

9. Although some low-band spectrum may hypothetically be available on the open market, there are no obvious sources of low-band spectrum that could effectively provide a continuous, nationwide, and deep coverage comparable to what the transaction would provide. Further, identifying, acquiring, and clearing disparate spectrum holdings to try to approximate the level of coverage and depth offered by T-Mobile's 600 MHz spectrum would be expensive and impractical. Sprint is already significantly increasing its network investment on improving its 2.5 GHz network and launching 5G. Attempting to acquire low-band spectrum holdings similar to those of T-Mobile on the open market and then build out that spectrum would require billions of dollars in additional spending and could not be done in the same timeframe New T-Mobile will provide robust, nationwide 5G service.

10. Similarly, some opponents of the proposed merger have suggested Sprint can acquire mmWave spectrum to enhance its 5G network instead of merging with T-Mobile. While Sprint is considering participating in the upcoming FCC auction for mmWave, acquiring this spectrum would not provide the coverage benefits that merging with T-Mobile would offer. While mmWave spectrum is well-suited for providing capacity to very dense urban areas, its propagation characteristics are poorer than Sprint's 2.5 GHz spectrum, and therefore, it is not suitable to use by itself, or in tandem with the 2.5 GHz band, to provide ubiquitous nationwide

5G coverage. Thus, acquisition of mmWave spectrum simply cannot provide Sprint with the same network benefits as the proposed transaction.

11. At least one petitioner has suggested Sprint could use massive MIMO technology to combine the company's 1.9 GHz (PCS) and 2.5 GHz spectrum to extend the reach of its 5G network. However, Sprint only holds an average of 40 MHz of 1.9 GHz holdings across the country and must continue to use this spectrum to support its 4G LTE network for the foreseeable future and its 3G CDMA/EVDO network for several years. Devoting Sprint's limited 1.9 GHz spectrum to 5G would cause significant user disruption on Sprint's 3G CDMA and 4G LTE networks. In addition, while 1.9 GHz spectrum propagates somewhat better than 2.5 GHz spectrum, it does not propagate nearly as well as the low band spectrum that New T-Mobile will use as a broad coverage layer to provide 5G across the country in more places than Sprint would be able to achieve on its own. Finally, combining 2.5 GHz and 1.9 GHz in a massive MIMO deployment would be expensive and time-consuming, as 5G standards may have to be revisited, and additional radio hardware and new compatible handsets would be necessary to simultaneously use 1.9 GHz for uplink and 2.5 GHz for downlink within a massive MIMO 5G framework. Thus, combining 1.9 GHz and 2.5 GHz spectrum resources in a massive MIMO deployment would be a poor alternative to the benefits associated with the transaction, given the incremental network capital and device investments required within the time frame assumed to maximize 5G coverage and the synergy benefits associated with the transaction.

12. The 5G network made possible by the New T-Mobile is fundamentally different than what Sprint could achieve as a standalone company. By combining the spectrum assets of Sprint and T-Mobile, New T-Mobile will be able to offer 5G coverage that is better in terms of coverage, capacity, and throughput than what Sprint could offer on its own. Sprint's 2.5 GHz

spectrum will provide an excellent capacity layer that will support high data speeds and large amounts of traffic. T-Mobile's 600 MHz spectrum lacks the capacity advantages of 2.5 GHz, but will provide significant coverage over a wide geographic area. T-Mobile's high-band mmWave holdings will provide additional capacity and increased throughput in high-traffic urban areas. In addition, because Sprint's spectrum will be added to existing sites, New T-Mobile will be able to launch a 5G network more quickly and at a lower cost than if Sprint had to construct completely new sites ourselves. Thus, as I indicated in my Initial Declaration, New T-Mobile will be able to combine Sprint and T-Mobile's highly complementary spectrum assets and create a 5G network with true nationwide coverage.

13. Not only will the New T-Mobile's 5G network provide nationwide coverage, but it will also have much more capacity and higher throughput than the 5G network Sprint would build on its own. The network plan calls for New T-Mobile to devote all of Sprint's 2.5 GHz spectrum to 5G by 2022, whereas Sprint would only be able to devote a portion of this band to 5G, since we need part of the spectrum to also support 4G LTE for the foreseeable future. Because New T-Mobile will be able to utilize the entire capacity of 2.5 GHz for 5G, users will experience greater data speeds and less latency. Additionally, this increased speed and capacity will make it easier for New T-Mobile to disrupt adjacent markets, including home broadband.

14. Some commentators have suggested that roaming agreements or network sharing agreements would be a viable substitute for the transaction. However, as discussed in my Initial Declaration, the T-Mobile roaming agreement does not provide nearly the same level of benefits as the transaction, includes a number of restrictions limiting Sprint's use of the T-Mobile network, and is limited to LTE data only (no voice or 5G). Further, network sharing

arrangements are challenging to administer and would not provide the synergies offered by the proposed transaction.

15. The results of T-Mobile's engineering model reflect the superior network capabilities of New T-Mobile compared to the standalone companies. Subject to applicable financial constraints, Sprint designs its network to meet coverage objectives as well as provide sufficient capacity approximately to meet baseline traffic needs. Sprint provided to T-Mobile the network plan used by T-Mobile to model Sprint's standalone network, and it is a reasonable projection of what Sprint would do in the future as a standalone company, assuming market demand and Sprint's financial ability. In addition, T-Mobile's engineering model is a reasonable representation of the way in which Sprint would invest in additional network facilities to expand capacity in response to increased traffic on the network. In its financial planning surrounding the network, Sprint amortizes capex over the lifespan of the capital investment using a weighted average cost of capital as a discount rate. Sprint has historically assumed a network equipment lifespan of seven years and a discount rate of 8.75 percent, and these assumptions were provided to Compass Lexecon for its economic analysis.

16. As I noted in my Initial Declaration, Sprint must rely on roaming agreements to provide nationwide service, which contributes significantly to our costs. To help control roaming costs, Sprint implements certain roaming governance policies. These policies include limiting most subscribers' total monthly usage to 100 MB for [redacted] and [redacted] and limiting data speeds to about 64 Kbps for [redacted] 256 Kbps for [redacted], and [redacted] Mbps for preferred roaming partners (other than [redacted]).

17. In my Initial Declaration, I indicated that approximately 20 million Sprint subscribers will be able to access the T-Mobile network almost immediately because they

already have handsets that are compatible with T-Mobile spectrum. This 20 million subscriber estimate is conservative and was based upon a 2017 assumption as to how many Sprint branded postpaid handset subscribers might be expected to utilize the Sprint / T-Mobile LTE roaming agreement. However, as of July 2018, we estimate that Sprint had more than 26 million postpaid devices that are capable of accessing at least one T-Mobile LTE spectrum band while also supporting voice features on at least one of Sprint's or T-Mobile's voice networks (to the extent a device has voice functionality) and more than 7 million Boost prepaid devices with this capability. Further, the total number of Sprint devices across all brands and channels (including postpaid, prepaid, and wholesale) that are capable of accessing at least one T-Mobile LTE spectrum band while also supporting voice features on at least one of Sprint's or T-Mobile's voice networks (to the extent a device has voice functionality) is over 37 million.[1] Sprint also expects the number of devices compatible with T-Mobile's network to grow over time.

IV. NEW T-MOBILE WILL OFFER BETTER RURAL COVERAGE THAN STANDALONE SPRINT

18. Sprint struggles today to provide strong coverage to its subscribers in rural areas and has the smallest LTE footprint amongst the four major operators. Sprint's current 4G LTE network covers only 302 million POPs, whereas Verizon, AT&T, and T-Mobile all cover between 317 and 322 million POPs. As I explained in my Initial Declaration, Sprint has significantly fewer macro cell sites than its competitors resulting in a network with significantly less dense coverage. As I've previously described, Sprint's 2.5 GHz spectrum is our primary band for providing data capacity, but its propagation characteristics make it ill-suited as a

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[1] Note that as of July 2018, Sprint had over 38 million total devices across all brands and channels that support at least one LTE spectrum band used by T-Mobile, but this figure does not account for applicable voice features.

coverage layer that can provide *ubiquitous* nationwide coverage. While Sprint's lower bands of 800 MHz and 1.9 GHz spectrum do help provide additional 4G LTE network coverage, Sprint's holdings in both bands are relatively small, especially when compared to other carriers. As a result, Sprint is limited in its ability to support customers' current LTE demand, let alone use these bands to launch 5G.

19. To this end, Sprint lacks the financial and network incentives to build additional 5G sites outside of population-dense urban areas. First, Sprint's limited subscriber base in such areas makes it difficult to justify such investments. Second, even if the company did add additional 2.5 GHz sites in rural areas, it would create an island of limited 5G coverage surrounded by an ocean of much slower coverage, provided by either Sprint (if its network footprint covers those areas) or one of the its roaming partners, leaving Sprint subscribers with an inconsistent user experience.

20. In the past few years, Sprint's foray into additional rural coverage has been limited to only building select sites to reduce roaming expense. Although the company has at times assessed the need for better coverage in rural areas, it has not funded any plans to substantially increase rural coverage beyond our current geographic footprint.

21. The rural incentives for New T-Mobile, however, will be very different. Armed with 600 MHz spectrum and an already denser T-Mobile network of sites, New T-Mobile will be able to provide a broad layer of coverage nationwide which will be supplemented with Sprint's capacity-rich 2.5 GHz spectrum. Although some commentators have suggested Sprint's 2.5 GHz band would not be suitable for rural coverage offered by New T-Mobile, the network plan for New T-Mobile calls for the 2.5 GHz spectrum on [redacted] sites by 2024, providing tremendous 5G capacity and throughput in more places. Increased build out of 2.5 GHz makes sense for the

New T-Mobile because T-Mobile's 600 MHz spectrum will be available to complement Sprint's 2.5 GHz spectrum with a strong coverage layer, and T-Mobile already has many more towers serving rural areas than Sprint. Thus, the combined company will have a nationwide network with deeper coverage over a larger geographic footprint, especially in rural areas, compared to standalone Sprint.

22. As noted in Neville Ray's declaration supporting the Public Interest Statement, the network modeling for New T-Mobile estimates the combined company would cover more than 95% of rural POPs by 2024.[2] Standalone Sprint will be unable to come close to this level of rural coverage, given the company's current network footprint and limited spectrum holdings with strong propagation characteristics. Moreover, the new T-Mobile's combined subscriber base and larger national footprint will make it easier to financially justify additional incremental buildout in rural areas in the years to come. As a result, there is no doubt the New T-Mobile will provide significantly better rural coverage than Sprint standalone.

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[2] Declaration of Neville Ray ¶ 74 (June 15, 2018).

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed on September 17, 2018.

Signed: ____________________________

Chief Technology Officer

Sprint Corporation

APPENDIX E: REPLY DECLARATION OF BRANDON "DOW" DRAPER
Chief Commercial Officer, Sprint Corporation

REPLY DECLARATION OF BRANDON "DOW" DRAPER
Chief Commercial Officer, Sprint Corporation

1. My name is Brandon "Dow" Draper, Chief Commercial Officer for Sprint Corporation ("Sprint"). My background and qualifications are described in my initial declaration, filed on June 18, 2018 (the "Declaration").

2. In my Declaration, I described the business challenges that Sprint has faced, and will continue to face, that negatively affect its ability to attract and retain subscribers.

3. Opponents to the merger of Sprint and T-Mobile have asserted that the merger is not necessary to ensure continued robust competition in the wireless marketplace, and that Sprint's recent turnaround will enable Sprint to remain a strong challenger over the long term in a manner that supports a stronger competitive environment than a post-merger world. (*See, e.g.*, Dish Petition at 15-16, C Spire Petition at 7, Rural Wireless Ass'n Petition at 5, Public Knowledge Petition at 23-24.) Opponents of the merger have additionally suggested that the merger is not necessary because Sprint can, on its own, build a 5G network. (*See, e.g.*, CWA Petition at 39-40, Dish Petition at 15-16, 23-24, and Free Press at 58.) Finally, opponents of the merger have suggested that the merger is unwarranted because it would eliminate head-to-head competition between Sprint and T-Mobile. (*See, e.g.*, Dish at 17-20, CWA at 23-24.).

4. As described more fully below and in my earlier Declaration, these contentions are incorrect. The merger of Sprint and T-Mobile will lead to stronger and more effective competition than Sprint can support as a standalone company.

I. SPRINT'S FINANCES CONSTRAIN NETWORK INVESTMENT

5. Opponents of the merger point to public statements asserting that Sprint's performance appears to be improving. For example, AT&T asserts that Sprint recently stated

that it is "delivering customer growth, profitability and improved network performance all at the same time." (AT&T Comments at 11.) Another commenter contends that Sprint reported its highest ever net income and operating income in 2017 and had publicly stated that Sprint was now "growing in all three segments of the market – consumer postpaid, business, and prepaid." (Public Knowledge Petition at 23-24.) Some of these commenters appear to suggest that these recent, modest, improvements in the performance of the Sprint business demonstrate that Sprint has turned a corner and is "already a healthy company" (Dish Petition at 15) that is capable of "thriving" on a standalone basis (Public Knowledge Petition at 23-24).

6. As I explained in my Declaration, however, these results were achieved largely through cost-cutting, including workforce reductions, and aggressive promotions that have pressured the company's cash flow and ability to invest in network improvements. Additionally, Sprint's plans to invest approximately $5-6 billion in Sprint's wireless network over the next three years will place significant and continuing pressure on cash flow and our ability to sustain promotional activity. The end result of these business challenges is that, as a standalone entity, Sprint will need to be more targeted in its investments. Sprint will not be able to compete as aggressively or as effectively on a national scale as would New T-Mobile.

7. While Sprint has reported some positive business results, of which I am proud, these positive results are not enough to sustain our current business model or reach our competitive goals. For example, nearly all of Sprint's 2017 net income—the first time Sprint has achieved net income in the prior eleven years—was largely the result of a one-time tax reform benefit. As I described in my Declaration and discuss further below, Sprint still has a considerable debt burden and looming debt maturities that will continue to constrain Sprint's cash flow and ability to invest.

8. Opponents of the merger point out that Sprint returned to positive adjusted free cash flow in 2017. (Dish Petition at 16.) However, Sprint's recent positive cash flow is largely the result of reduced CapEx spending and cost cutting efforts. Sprint would have been cash-flow negative had it invested in its network at the same amount as other national wireless carriers. Sprint would also have been cash-flow negative had it invested in its network at what the company considers a "standard" rate [redacted]

9. Opponents of the merger also point to Sprint's purported increase in subscribers and decrease in churn. (*See, e.g.*, Dish Petition at 15-16, C Spire Petition at 7, Public Knowledge Petition at 23-24, AT&T Comments at 11.) Unfortunately, as described in my Declaration, Sprint still has the lowest share of gross adds and the highest churn of the national wireless carriers. Recent increases in our pricing, although necessitated by Sprint's business challenges, have exacerbated our poor competitive position in this regard.

II. SPRINT'S NETWORK FACES OTHER CHALLENGES

10. A standalone Sprint will also be unable to achieve the kind of network coverage and quality that New T-Mobile would unlock.

11. Sprint is hampered by, among other things, the coverage and consistency limitations of its network. To succeed, Sprint must convince customers to purchase wireless services that are perceived as inferior to those offered by other national wireless carriers. Sprint is ranked behind AT&T and Verizon in nearly all network performance-related categories in major national markets. As John Saw explains more fully in his response declaration, Sprint particularly struggles to provide strong and consistent coverage in rural areas and in buildings. As a result, and as described in my Declaration, subscribers churn away from Sprint at roughly double the rate they depart AT&T and Verizon (1.60% versus 0.86% and 0.78%, respectively).

Even if Sprint's network performance were to improve, it would be challenging to convey that improvement to customers: Due to financial constraints, Sprint's advertising spend over the last three years ($1,734 million) is much lower than all three of Verizon ($3,130 million), AT&T ($2,308 million), and T-Mobile ($2,103 million).

12. Sprint is committed to being the first carrier to deploy a successful 5G network. By 2021, the majority of new customers will likely have handsets with 5G capability, and the 5G network and associated wireless services will be a key driver of pricing and strategy decisions. Nevertheless, Sprint's network limitations restrict the company's standalone 5G deployment plans. As I described in my Declaration, for both financial and technical reasons (including related to our spectrum holdings), Sprint's standalone 5G network will only cover approximately 150M POPs by 2020. Because Sprint's standalone 5G network will be rolled out based on 4G LTE network needs, that coverage will not be wholly contiguous. The limited ability to densely deploy our 2.5 GHz spectrum means that geographic coverage will remain a challenge, especially for the 60 million wireless customers who live in less populated exurban and rural areas. Simply stated, by combining Sprint's 2.5 GHz spectrum with T-Mobile's low-band and other spectrum resources, the proposed merger will enable the combined company to deliver a nationwide 5G network faster and with more breadth and depth than we could do on our own. This merger is about enabling the full potential of 5G on a faster timeframe and with broader geographic reach—to the benefit of U.S. consumers.

13. AT&T asserts that Sprint claims to be "the most improved [network] of any national carrier in terms of average download speeds." (AT&T Comments at 11.) The Q1 2018 Sprint earnings call transcript referenced in that petition, however, does not say this. In any event, I understand this to be a reference to Sprint's improved *year over year* download speed

according to PC Magazine. Of course, Sprint had the most room to improve on a nationwide basis given its existing challenges. This does not mean that Sprint has surpassed (or even caught up to) anyone else. Unfortunately, Sprint also received the lowest overall ranking in PC Magazine's "Fastest Mobile Networks 2018" list.

III. SPRINT'S CONTINUED COMPETITIVENESS

14. Opposing petitions assert that Sprint is the industry's "low-price leader" and that Sprint's innovative pricing enhances competition. (Public Knowledge Petition at 9; *see also* C Spire Petition at 12; Free Press Petition at 38.) But Sprint's promotional moves, like low introductory rates and free lines, have yielded only short-term improvements in net adds and have not resulted in sustainable growth. Moreover, because these aggressive prices have not resulted in strong customer retention, Sprint cannot afford to maintain them forever, particularly given its relative lack of free cash flow and other financial commitments.

15. Other opposing petitions assert that T-Mobile and Sprint compete with one another and often match each other's pricing and promotions. (*E.g.*, Dish Petition at 17-20; CWA Petition at 23-30.) In reality, all national wireless carriers compete and review competitive intelligence regarding each other's offerings. Rather, Sprint's competitive focus has been, and will remain, on AT&T and Verizon as national wireless competitors. This is why Sprint positioned its pricing plans as "half-off" Verizon or AT&T's rates.

16. Customers also have a number of choices when it comes to prepaid offerings. TracFone, for example, is the largest prepaid brand and has strong relationships with both AT&T and Verizon. Only a minimal portion of TracFone subscribers, however, utilize Sprint's network due to quality and performance challenges—particularly in rural areas—and we understand that TracFone [redacted]. Only around [redacted] TracFone subscribers use the Sprint network today, down from more than [redacted] just five years ago. In

addition to TracFone, AT&T competes aggressively with its Cricket brand, which has been very successful. Verizon has also been moving steadily into this space as indicated by its more aggressive merchandising and promotional activities in national retailers such as Best Buy and Walmart.

17. In any event, the lines between prepaid and postpaid service plans have been and remain increasingly blurred. For example, Boost recently launched the BoostUP! program to provide postpaid phone loans to Boost's existing prepaid customers as a way of fostering higher consumer satisfaction and reducing Boost's churn rate. Obtaining the offered loan does not require a credit check because the customer's own history of on-time payments is the only criterion used in deciding whether to allow the customer to participate in the plan. In less than a year, the number of Boost customers with postpaid BoostUP! loans has grown to [redacted], surpassing Boost's expectations. Today, most postpaid and prepaid offerings do not require an annual contract, and several postpaid plans, including those offered by Sprint, require payment in advance, but with a grace period allowing service continuity if payment is not received on time. Indeed, customer obligations now primarily revolve around device financing terms, not a commitment to a service period with a carrier. Even prepaid and postpaid rate plan pricing is converging. For example, a common family plan offer in the prepaid space is four lines for $100 per month. Last year, the Sprint postpaid brand began offering rate plans with free third, fourth or fifth lines. This essentially offered a three-, four- or five-line postpaid account for $100 per month. Thus, there is little effective difference between today's prepaid offerings and traditional postpaid offerings.

IV. ABSENT THE MERGER, THE GAP BETWEEN SPRINT AND AT&T AND VERIZON WILL CONTINUE TO WIDEN

18. It is important to understand that Sprint's many business challenges perpetuate

one another. In cutting costs over the last several years, Sprint has forgone network investments. Today, customers are less happy with the performance of Sprint's network and churn away from Sprint at comparatively high rates. These dissatisfied customers, in turn, perpetuate the perception challenges that Sprint faces by giving negative reviews of Sprint to their friends and acquaintances. To lure these customers back (or lure in new customers), Sprint has implemented aggressive promotions. But such promotions are limited by Sprint's relatively small advertising spend and limited distribution network. These promotions also pressure the company's cash flow and, thus, limit the amount the company can invest in its wireless network. This exacerbates poor network performance and drives further customer dissatisfaction.

19. AT&T and Verizon, by contrast, experience the very opposite sort of feedback loop: their networks—promoted with higher advertising budgets and sold through more and better located distribution centers—attract and retain customers, drive cash flow, and increase their ability to further invest in their networks. This allows AT&T and Verizon to attract and retain still further customers as their subscriber base gives positive reviews of their network to friends and acquaintances. Accordingly, Sprint will continue to be hard-pressed to generate sufficient scale and cash flow to catch up with AT&T and Verizon as a standalone entity.

20. As I explained in my initial Declaration, Sprint's limited cash flow has led Sprint to accumulate substantial debt (nearly $32 billion) to fund its network and operations. This large debt constrains Sprint's competitive options and ability to obtain alternative funding for further investment. Over $25 billion of that debt is slated to mature in the next five years, and Sprint's Q1 2018 interest coverage ratio—a measure of a company's ability to pay interest accruing on debt—was 3.07, which is considerably lower than AT&T (7.03), Verizon (9.38), and T-Mobile (10.39). Additional debt is also becoming more expensive with the Federal Reserve raising

interest rates in June 2018 and signaling further increases. This potentially limits Sprint's options for refinancing its existing debt as it comes due in the near future.

* * *

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed on September 14, 2018.

Signed: ______________________
Chief Commercial Officer
Sprint Corporation

APPENDIX F: DECLARATION OF COMPASS LEXECON
Mark Israel, Michael Katz, and Bryan Keating

September 17, 2018

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Executive Summary

Counsel for T-Mobile has asked us to provide our expert assessment of the unilateral effects analyses of the proposed merger of T-Mobile US, Inc. and Sprint Corporation submitted by Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas ("HBVZ").

HBVZ present both a simulation to predict the proposed merger's effects on mobile broadband retail pricing and a vertical Gross Upward Pricing Pressure Index ("vGUPPI") analysis to assess the effect of the merger on wholesale pricing incentives. Both models are seriously deficient, most importantly because they ignore the beneficial effects of the merger on marginal costs and product quality. Simply incorporating the marginal cost savings implied by Sprint's and T-Mobile's network planning and engineering analyses into HBVZ's merger simulation demonstrates that the proposed merger would promote competition and consumer welfare, even if one ignored consumer benefits from the merger's substantial network quality improvements and corrected none of the other problems with HBVZ's analysis.

To test the robustness of the conclusion that the proposed merger will promote competition and consumer welfare, we: (a) correct methodological and data errors in HBVZ's analyses; (b) complete HBVZ's analyses by including all efficiencies, including quality improvements; and (c) consolidate the analyses by integrating vGUPPIs into the merger simulation. In doing so, we make several assumptions that are conservative in the sense that they tend to underestimate the net competitive and consumer benefits of the proposed merger.

Our analysis begins in 2021, when the merger integration process will be substantially complete. Although our analysis is more conservative than HBVZ's, we still find that the merger's marginal cost savings and quality improvements will prevent any adverse unilateral competitive effects in all model specifications we examine. This analysis demonstrates that the proposed merger will strengthen competition and benefit consumers from 2021 through the foreseeable future.

I. INTRODUCTION AND OVERVIEW

1. T-Mobile US, Inc. ("T-Mobile") and Sprint Corporation ("Sprint") (collectively, the "Parties") have requested the consent of the Federal Communications Commission ("Commission") to combine to form "New T-Mobile."[1] Counsel for T-Mobile has asked us to provide our expert assessment[2] of the unilateral effects analyses submitted by Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas ("HBVZ").[3]

2. We have identified several serious shortcomings in HBVZ's merger simulation analysis of mobile broadband services and their upward pricing pressure analysis of wholesale services.[4] First and most important is that they do not consider the beneficial effects that the

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1 Description of Transaction, Public Interest Showing, and Related Demonstrations, *In the Matter of Applications of T-Mobile US, Inc., and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations*, WT Docket No. 18-197, June 18, 2018 (hereinafter, *T-Mobile/Sprint Public Interest Showing*). As part of their application, T-Mobile and Sprint submitted several declarations that we reference below: Declaration of Neville R. Ray (hereinafter, *Ray Declaration*); Declaration of Brandon "Dow" Draper (hereinafter, *Draper Declaration*); Declaration of John C. Saw (hereinafter, *Saw Declaration*); Joint Declaration of Professor Steven C. Salop and Dr. Yianis Sarafidis (hereinafter, *Salop-Sarafidis Declaration*); David S. Evans, "Economic Analysis of the Impact of the Proposed Merger of T-Mobile and Sprint on the Deployment of 5G Cellular Technologies and the Resulting Impact on Consumers, Enterprises, and the Economy" (hereinafter *Evans Declaration*).

2 Our qualifications are summarized in Appendix II to this declaration.

3 Declaration of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas, Exhibit B to Petition to Deny of DISH Network Corporation, *In the Matter of Applications of T-Mobile US, Inc., and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations*, WT Docket No. 18-197, August 27, 2018 (hereinafter, *HBVZ Declaration*), § III.

4 We also note that HBVZ present other analyses of unilateral effects. Specifically, HBVZ present analyses of concentration (based on the Herfindahl-Hirschman Index ("HHI")) and pricing pressure (based on the Gross Upward Pricing Pressure Index ("GUPPI")). (*HBVZ Declaration*, §§ III.B, III.C.1.) Because each of these indices is intended as a screening mechanism and not a full model of the merger, we focus on HBVZ's merger simulation analysis, which more fully analyzes the same economic incentives that the HHI and GUPPI analyses are designed to assess. (See, e.g., *HBVZ Declaration* at 39 ("The analysis of market

merger's efficiencies will have on both New T-Mobile's retail and wholesale pricing incentives and, thus, on competition and consumer welfare. Second, HBVZ's merger simulation analyses of pricing incentives contain data and methodological errors. Lastly, HBVZ (incompletely) analyze wholesale pricing separately from their retail mobile broadband simulation, rather than combining wholesale and retail effects in an integrated model. In the real world, wholesale and retail pricing are inextricably linked and must be considered together when assessing the bottom-line effect of the proposed merger on consumer welfare.

3. To address these shortcomings, we modify HBVZ's merger simulation analysis to: (1) account not only for any adverse unilateral competitive effects that would occur absent efficiencies, but also for the efficiencies that the merger will generate in the form of lower marginal costs and higher quality;[5] (2) correct several data and methodological errors in

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shares and concentration levels in the relevant product and geographic markets is *a useful starting point* for assessing the effect of a proposed merger." [emphasis added]); *HBVZ Declaration* at 43 ("The GUPPI does not take merger synergies into account."). See, also, U.S. Department of Justice and the Federal Trade Commission, *Horizontal Merger Guidelines*, August 19, 2010 (hereinafter, *Horizontal Merger Guidelines)*, §§ 5.3, 6.1.)

[5] HBVZ did not assess the impact of the transaction on the provision of wireless broadband services that are full substitutes for conventional fixed broadband services. (*HBVZ Declaration* at 7-8.) Although we do not address this topic, Dr. Harold Furchtgott-Roth has separately projected that the merger will generate substantial consumer benefits for consumers of such services. (Declaration of Dr. Harold Furchtgott-Roth, September 17, 2018 (hereinafter, *Furchtgott-Roth Declaration*)). It is our understanding that New T-Mobile will offer a full substitute for conventional fixed broadband services in areas where it has sufficient capacity to do so without materially raising marginal costs. (Reply Declaration of G. Michael Sievert, September 17, 2017, (hereinafter, *Sievert Reply Declaration*), ¶ 6.) Because we do not account for the merger-specific benefits due to such services, and provision of these services will not materially affect mobile broadband services, our approach understates the overall competitive and consumer welfare benefits of the merger.

HBVZ's analyses, and (3) consolidate the analyses by integrating wholesale pricing into our overall merger simulation.

4. Because it accounts for merger efficiencies, the modified analysis describes how the relevant wireless networks will evolve over time with and without the merger. The initial evolution of the New T-Mobile network will be driven by integration needs, as opposed to responding to changes in output levels.[6] Consequently, our merger assessment commences in 2021, by which time the integration of the Parties' wireless networks is anticipated to be largely complete, meaning that the available tools can be used to model the endogenous evolution of the New T-Mobile network.

A. Summary of Findings

5. Our central findings are as follows. The companies' plans indicate that New T-Mobile will build a far more capable wireless network than would either T-Mobile or Sprint acting on its own. By "more capable," we mean that New T-Mobile's planned network will allow the combined firm to achieve lower marginal costs of providing services and to offer higher quality services than would either merging party operating on its own. Incorporating these merger efficiencies in either HBVZ's original simulation analysis or our conservative alternative model indicates that the lower marginal costs and higher product quality will create downward pressure on New T-Mobile's quality-adjusted prices that will outweigh any upward price pressure from the loss of a competitor, thus benefiting consumers. New T-Mobile's lower quality-adjusted prices will also create competitive pressures on rival service

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6 Reply Declaration of Neville R. Ray, September 17, 2018, (hereinafter *Ray Reply Declaration*), ¶ 15.

providers to respond by reducing their prices and improving their services, further benefiting consumers. In short, the merger of Sprint and T-Mobile will strengthen mobile broadband competition.

6. More specifically, we find the following:

- *The proposed transaction is projected to generate significant marginal cost savings, which will strengthen the combined firm's incentive and ability to compete for users by offering lower quality-adjusted prices.* The Parties' network plans and T-Mobile's Network Build Model (described below) imply that New T-Mobile's network will have significantly lower marginal costs than would either company's network absent the merger. This is especially true with respect to standalone T-Mobile's network. Moreover, Parties project that the proposed merger will lead to reductions in non-network marginal costs. By significantly lowering non-network and network marginal costs, the proposed transaction will increase the incentive and ability of the merged firm to compete for new customers and to expand the volume of services sold to existing customers by lowering prices, increasing quality, or both. These practices will, in turn, increase competitive pressures on rival mobile broadband service providers.

- *The proposed transaction will generate significant quality improvements, which will benefit consumers and increase competitive pressures on rival service providers.* The Parties' network plans and their Network Build Model indicate that New T-Mobile's network will provide significantly higher quality services than would either company's network absent the merger. These quality improvements will come in the form of:

- *Faster Data Speeds.* New T-Mobile's network will offer users higher data throughput rates (colloquially, data speeds) than would the standalone network of either company.
- *Better Coverage.* New T-Mobile's network will offer users better signal strength and broader geographic access to 5G services than the standalone network of either company. This is particularly true relative to Sprint's standalone network.
- *Relaxation of Usage Restrictions.* Because the merger reduces New T-Mobile's marginal costs of carrying traffic, the merged company will be incented to allow users to consume greater amounts of data on a per-subscriber basis by relaxing usage restrictions such as data caps or limitations on throughput. These improvements can be viewed as an increase in output or, equivalently, as an improvement in the quality of a subscription.

All of these improvements will be valuable to consumers.

- *The HBVZ merger simulation analysis demonstrates that the merger is procompetitive once modified to account for efficiencies.* HBVZ merger simulation analysis ignores the efficiencies that will arise from the merger. Because it ignores the beneficial aspects of the merger for consumers, HBVZ's analysis, without further modification, would necessarily find that *any* merger of firms competing for the same customers harms competition and consumers and, thus, this analysis cannot support any conclusions about the net effect of the proposed transaction on competition and consumer welfare. Incorporating the merger-specific efficiencies projected by the Parties' network plans and their Network Build Model into the HBVZ merger simulation model leads to the conclusion that the merger will strengthen competition and raise consumer welfare. Specifically, all of HBVZ's merger simulations require [redacted] of efficiencies for the proposed merger to be procompetitive, and the Parties' projected

marginal cost savings alone exceed this threshold. Accounting for the quality benefits of the merger strengthens the conclusion that the proposed merger will benefit consumers.

- *Our alternative merger simulation analysis, which makes several more conservative assumptions than do HBVZ, also demonstrates that the merger is procompetitive and pro-consumer.* In addition to using more accurate data, we make several conservative assumptions relative to HBVZ, including using higher estimated diversion ratios between Sprint and T-Mobile, assuming a lower (in absolute value) industry elasticity, and accounting for incentives associated with wholesale pricing in an integrated framework with retail pricing incentives. Even taking this more conservative approach than HBVZ, we find that the merger promotes competition and benefits consumers. We run several sensitivity analyses and find that all of the variants of the alternative merger simulation require [redacted] of efficiencies for the proposed merger to be procompetitive. In all years except 2021, the Parties' projected marginal cost savings alone exceed this threshold. In 2021, the proposed merger is procompetitive as long as the average subscriber values the proposed merger's substantial projected quality improvements by [redacted]—a threshold that is surely cleared.

7. The remainder of this declaration explains these findings in greater depth and provides details of the facts and analysis that led to them.

B. DESCRIPTION OF HBVZ'S UNILATERAL EFFECTS ANALYSES

8. We begin by providing high-level summaries of HBVZ's merger simulation analysis of mobile broadband services and upward pricing pressure analysis of wholesale mobile

wireless services.[7] In Part I.C below, we provide more background on all the pieces of a proper merger simulation analysis for this case, including the pieces that HBVZ omit; here, because HBVZ's model is already in the record, we provide only a summary description of what they have done.

1. HBVZ's Merger Simulation Model

9. As is standard in merger simulation models, HBVZ start with assumptions about the shape of the demand curve, which affects the extent of substitution among the products offered by the merging parties, the upward pricing pressure created by that substitution and (when included) the downward pricing pressure created by efficiencies, and the extent to which each of these forces is translated into equilibrium prices. HBVZ make two alternative assumptions about the structure of demand for mobile wireless services. They assume it is either: (1) logit, which HBVZ sometimes refer to as the antitrust logit model or ALM, or (2) PC-AIDS.[8] These demand models differ primarily in the assumed curvature of the relationship between prices and quantities.[9] Specifically, HBVZ show that, because the ALM model assumes a flatter curvature than the PC-AIDS model, it generates lower estimates of

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7 We note at the outset that HBVZ did not provide worksheets, code, or other backup materials with their submission, and counsel has informed us that DISH refused to provide these materials when requested. Hence, there are various components of their analysis that we have had to reverse engineer to the best of our ability given the limited information that HBVZ were willing to provide.

8 *HBVZ Declaration* at 48.

9 Curvature refers to the extent to which the slope of a function changes at different points. A linear function has a constant slope everywhere; other functional forms allow the slope to change, meaning here that the effect of price on quantity demanded varies depending on the price (and quantity) level considered.

upward pricing pressure.[10] Below, we show that, for the same reason, the ALM model implies a lower pass-through rate of efficiencies than does the PC-AIDS model and that, once both upward pricing pressure *and* efficiencies are properly taken into account, the two demand models generate similar predictions about the consumer-welfare effects of the transaction.[11]

10. HBVZ also make several specific modeling assumptions about industry structure.[12] First, HBVZ separately model prepaid and postpaid segments, which means that they assume that price changes or other strategic decisions made by brands in one segment have no effect on the equilibrium decisions made by brands in the other segment. Second, within each segment, HBVZ treat each firm as a separate, differentiated product. In the postpaid segment, HBVZ model consumers as choosing from among five competitors: AT&T, Verizon, Sprint, T-Mobile, and U.S. Cellular. In the prepaid segment, HBVZ model six independent competitors: AT&T, Verizon, Sprint, T-Mobile, TracFone, and an aggregation of other mobile virtual network operators (MVNOs) that is treated as if it were a single firm ("Other MVNO").[13] Third, HBVZ include an "outside good" as a consumer option, which represents

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[10] *HBVZ Declaration* at 48.

[11] For a discussion of the implications of different demand systems for pass-through, see Luke Froeb, Steven Tschantz, and Gregory J. Werden (2005), "Pass-through Rates and the Price Effects of Mergers," *International Journal of Industrial Organization*, **23**(9-10): 703-715 ("We find that the demand conditions that cause a merger to result in large price increases absent synergies also cause the pass-through rate to be high.").

[12] *HBVZ Declaration* at 48-49.

[13] HBVZ note that mobile network operators (MNOs) supply network capacity to MVNOs on a wholesale basis and that the merger could therefore affect the input prices of MVNOs. However, they do not model these incentives in their merger simulation model. (*HBVZ Declaration*, n. 69.)

the choice to forego obtaining one of the options in the segment (postpaid or prepaid) being studied.[14]

11. Having specified a model of industry behavior, HBVZ calibrate their model to real-world outcomes. HBVZ do so using 2017 data from company annual reports on shares and average revenue per user (ARPU), the latter of which they use as a proxy for price.[15] HBVZ calculate marginal costs for each product using data from industry analysts and company financial reports.[16]

12. A component of HBVZ's marginal cost estimates is their estimate of network Marginal Capital Cost.[17] HBVZ make several highly simplifying assumptions in order to develop this estimate, including assuming values for: (1) the share of subscribers added by building towers; (2) the share of subscribers added by deploying radios; (3) the cost per tower; (4) the number of LTE channels; and (5) the cost of adding a radio.[18] HBVZ provide no sources to substantiate the numerical values that they assume. Moreover, and perhaps most important, HBVZ assume that the merger has no effect on the marginal capital costs of expanding the mobile operator's network, as well as no effect on non-network marginal costs. In other words, their analysis assumes that the proposed transaction will generate no marginal

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14 This does not necessarily mean that a household goes without mobile broadband service. Instead, for example, it could mean that a household chooses to go without an extra mobile broadband subscription on an extra device that it was considering adding.

15 *HBVZ Declaration at* 50.

16 See *HBVZ Declaration,* Appendix A for more details on how HBVZ calculate marginal costs for each brand.

17 *HBVZ Declaration*, Table 11 and Appendix A.

18 *HBVZ Declaration*, Table 11.

cost efficiencies. However, as we describe in Section IV.A below, T-Mobile's Network Build Model and the Parties' business plans and ordinary course data and assumptions imply that that the proposed merger will generate substantial network capex and opex savings, as well as non-network cost savings, which together generate substantial marginal cost reductions.

13. Limitations in the data available to HBVZ cause them to use different calibration approaches for postpaid and prepaid products for their ALM model:[19]

- *Postpaid Segment:* HBVZ collect or estimate data on ARPU, segment share, and margins for each of the five modeled brands. As a result, HBVZ have more data points than model parameters, making it unclear without additional investigation (not reported in their declaration) exactly how they pin down (identify) their model's parameters.[20] We have reverse engineered their Antitrust Logit merger simulation model, and it appears that HBVZ base their calibration of the subscriber price sensitivity parameter and the industry elasticity on the estimated marginal costs of AT&T and T-Mobile, and not the other brands.

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[19] *HBVZ Declaration*, nn. 68-69.

[20] *HBVZ Declaration*, n. 68:

> The system of equations derived from the model under standard assumptions is an over-identified system; there are more model equations than parameters to be calibrated. This is because for postpaid services we have all carriers' ARPU, incremental costs and subscriber counts, which leaves only the price sensitivity parameter and the market elasticity to be calibrated. Industry priors are employed to pin down the set of equations that will be used for the calibration. [Internal citations omitted.]

- *Prepaid Segment:* HBVZ lack ARPU data for AT&T and Verizon and lack marginal cost estimates for TracFone. HBVZ treat the ARPUs for AT&T and Verizon as unknown model parameters, which they calibrate based on the following: ARPUs for Sprint, T-Mobile, TracFone, and Other MVNO; estimated marginal costs for AT&T, Verizon, Sprint; and the subscriber count for each carrier's prepaid service.[21] HBVZ assume, without justification, that the prepaid industry elasticity is equal to their estimated postpaid industry elasticity.

14. HBVZ calibrate their PC-AIDS merger simulations using revenue shares derived from company financial reports and Sprint's marginal costs.[22] They import the industry elasticity calibrated from the postpaid logit model into their PC-AIDS models. For the prepaid model, they also use the prepaid ARPUs for AT&T and Verizon that are calibrated in the prepaid logit model as inputs.

15. As we will discuss below, HBVZ's simulation analyses suffer from several weaknesses. By far the biggest one is that it does not consider the beneficial effects that the merger's efficiencies will have on competition and consumer welfare. Other weaknesses arise from certain methodological choices made by HBVZ and their use of poor estimates of parameter values that are critical to their models' results.

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21 *HBVZ Declaration*, n. 69.

22 *HBVZ Declaration* at 52-53.

2. HBVZ's Gross Upward Pricing Pressure Index Calculation

16. In addition to their merger simulation model, HBVZ also calculate a Gross Upward Pricing Pressure Index ("vGUPPI") to "assess New T-Mobile's incentives to increase wholesale prices."[23] The vGUPPI attempts to account for the competitive implications of the fact that, today, each network both supplies wholesale network services to MVNOs and competes with those MVNOs for retail customers. The idea is that the merger potentially changes those wholesale pricing incentives by causing New T-Mobile to internalize the fact that a wholesale price increase to an MVNO may cause that MVNO to raise its retail price, generating diversion to Sprint's retail services in addition to T-Mobile's (the latter incentive is already reflected in pre-merger wholesale pricing). Today, T-Mobile obtains no benefit on sales diverted to Sprint, but post-merger those sales diverted to Sprint would go to the integrated New T-Mobile, so that New T-Mobile would internalize the benefit of such diverted sales. The vGUPPI attempts to evaluate the magnitude of the induced incentive to raise wholesale prices.

17. HBVZ calibrate their vGUPPI model using the following data. They assume diversion between TracFone and Sprint and between TracFone and T-Mobile is proportional to the share of prepaid subscribers.[24] They use the same retail prices and margins as they use in

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[23] *HBVZ Declaration* at 54.

[24] *HBVZ Declaration*, Table 25.

their merger simulation.[25] Finally, they derive Sprint's and T-Mobile's wholesale ARPU from their respective 2017 annual reports.[26]

18. HBVZ do not properly implement the vGUPPI.[27] Specifically, HBVZ do not properly account for the fact that Sprint and T-Mobile account for only a portion of each MVNO's traffic. In addition, HBVZ incorrectly implement the mathematical formula for the vGUPPI. HBVZ's wholesale pricing analysis also is not integrated into their retail mobile broadband simulation, which means that HBVZ cannot properly assess the bottom-line effects of any wholesale pricing changes on consumer welfare.

C. A Proper Merger Simulation Framework

19. As described above and further explained below, HBVZ's unilateral effects analyses suffer from serious deficiencies. The problem is not with the idea of using a merger simulation; merger simulation is an accepted method for making predictions about the effects of a proposed merger on competition and consumer welfare.[28] Rather, the problem is with

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25 *HBVZ Declaration*, Table 25.

26 *HBVZ Declaration*, Table 16.

The T-Mobile wholesale ARPU that HBVZ report in Table 16 does not match the T-Mobile wholesale ARPU that HBVZ use in their vGUPPI calculations in Table 25. It is unclear what accounts for the difference.

27 For additional discussion of problems with HBVZ's implementation of the vGUPPI, see Joint Supplemental Declaration of Professor Steven C. Salop and Dr. Yianis Sarafidis, September 17, 2018 (hereinafter, *Salop/Sarafidis Reply Declaration*), § V.A.

28 The Commission, the Department of Justice ("DOJ"), and other competition agencies frequently use this methodology to evaluate mergers, and such models have been used to evaluate competitive effects in recently litigated horizontal merger cases. (*Horizontal Merger Guidelines*, § 6.1. See, also, Memorandum Opinion, *United States of America v. H&R Block, Inc., et al.*, Civil Action No. 11-00948 (BAH), November 10, 2011 (hereinafter, *H&R Block Opinion*), § III.B.2.c; Memorandum Opinion, *Federal Trade Commission, et al., v. Sysco Corporation, et al.*, Civil No. 1:15-cv-00256 (APM), June 29, 2015 (hereinafter, *Sysco/US*

HBVZ's implementation of merger simulation. In what follows, we modify HBVZ's merger simulation analysis to correct major deficiencies from which it suffers. In particular, we: (a) correct methodological and data errors in HBVZ's analyses; (b) complete the analyses by including all efficiencies, including quality improvements; and (c) consolidate the analyses by integrating vGUPPIs into the merger simulation. Among other things, we show that, *even if one accepts all of the other assumptions of HBVZ's merger simulation analysis, simply correcting it to account for the proposed merger's projected efficiencies leads to the conclusion that the proposed merger will strengthen competition and benefit consumers.*

20. Unlike HBVZ's analysis, our more complete merger simulation analysis accounts for all three of the primary effects that economic theory and marketplace evidence indicate that the merger will have:[29]

- The merger will change the ownership structure such that T-Mobile will jointly own both Sprint and T-Mobile and, therefore, will internalize the value of sales diverted between the two firms (that otherwise would have been viewed as lost sales by each separate firm);

Foods Opinion), § II.C.2.; Memorandum Opinion and Order, *In the Matter of Applications of AT&T Inc. and DIRECTV for Consent to Assign or Transfer Control of Licenses and Authorizations*, MB Docket 14-90, rel. July 28, 2015 (hereinafter, *AT&T/DIRECTV Order*), § IX.A and Appendix C; Memorandum Opinion, *United States of America, et al., v. Aetna Inc., et al.,* Civil Action No. 16-1494 (JDB), January 23, 2017 (hereinafter, *Aetna/Humana Opinion*), § I.A.4.)

[29] Because it does not account for the second and third effects, HBVZ's merger simulation analysis does not provide a valid prediction of the effects of the proposed merger. HBVZ's vGUPPI analysis is similarly invalid.

- the merger will lower the marginal costs of serving additional customers facing the combined firm relative to those facing the standalone firms, creating incentives to cut prices and expand output; and
- the merger will improve the quality of service that the combined firm will offer relative to what the standalone firms would offer.

All else equal, the first effect—the only one HBVZ consider—will tend to create incentives to raise quality-adjusted prices (and therefore lower consumer welfare), while the second and third effects will tend to create incentives to lower quality-adjusted prices (and therefore raise consumer welfare).

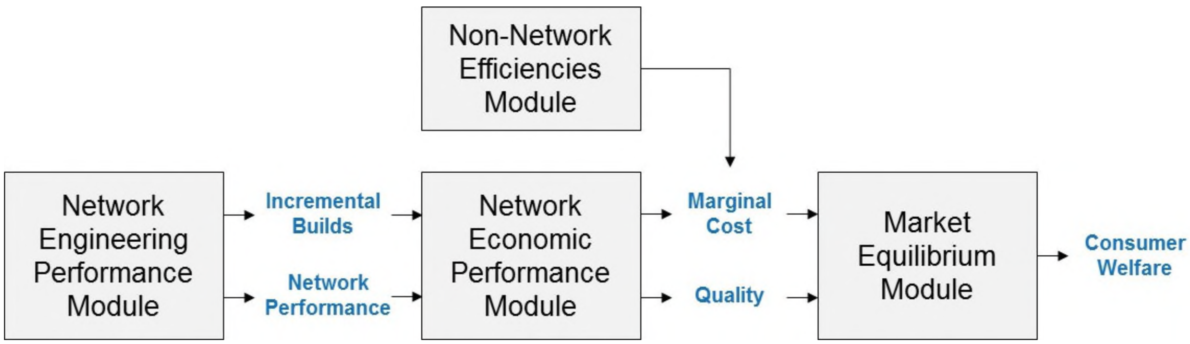
21. Properly done, merger simulation provides a framework within which the net effects of these three forces on the combined company's incentives can be determined. It is important to recognize that, contrary to popular misunderstanding, a merger simulation does not calculate a price increase from a merger and then "offset" it with efficiencies. Rather, the simulation appropriately determines a merger's competitive effects by evaluating the combined effects of the economic forces identified above on the merged company's incentives to raise or lower its quality-adjusted prices relative to those prices that would have prevailed absent the merger.

22. As described further below, both HBVZ's merger simulation models and our alternative merger simulation model also incorporate competitor reactions via price responses. The models allow AT&T, Verizon, and other competitors to respond to the merger by raising or lowering their prices. The fact that, when one accounts for merger efficiencies, both HBVZ's merger simulation models and our alternative merger simulation model predict that

AT&T and Verizon will lower their prices in response to the merger indicates that the merger will strengthen competition.

23. Figure 1 provides a schematic description of the elements of the full merger simulation framework that we employ.

Figure 1: Merger Simulation Schematic



24. The *Network Engineering Performance Module*, which we describe in greater detail in Section III below, is a tool that models the required network investments, determines the associated network performance, and serves as a basis for quantifying the network efficiencies that arise from combining the Parties' networks. Specifically, for each of three networks (i.e., standalone Sprint, standalone T-Mobile, and New T-Mobile), the module calculates: (a) the number and type of incremental investments (e.g., spectrum overlays and cell splits) necessary to achieve the desired network performance metrics, and (b) measures of network performance delivered to users expressed in engineering terms (e.g., megabits per second (Mbps) of throughput).[30] Comparing the output of the Network Engineering Performance

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30 As we describe in more detail below, the Network Engineering Performance Module does not capture all meaningful elements of network quality and merger-specific quality improvements.

Module for New T-Mobile's network with the outputs of the module for the standalone networks provides a measure of the efficiencies gained from integrating the networks. We refer to these improvements in performance as "network efficiencies."

25. Although network efficiencies constitute the bulk of the expected efficiencies in this merger, the Parties also expect to realize non-network, merger-specific efficiencies. The *Non-Network Efficiencies Module,* which we describe in Section IV.B below, analyzes merger-specific efficiencies unrelated to the network. As shown in Figure 1 above, these efficiencies are also inputs into the Market Equilibrium Module.

26. The *Network Economic Performance Module,* which we describe in greater detail in Sections IV.A and VI below, translates engineering estimates of network builds and performance into projected marginal cost curves and projected consumer valuations of network quality for each of the three networks. These projections are compared across networks to quantify the marginal cost savings and consumer valuation of the quality improvements due to the merger.

27. The marginal cost and quality valuations are fed into the *Market Equilibrium Module,* which we describe in Section II, to predict the consumer welfare levels with and without the proposed merger. The predicted consumer-welfare effects of the proposed merger are found by comparing the predicted consumer welfare level with the merger to the predicted consumer welfare level without the merger. The model's finding that the proposed merger will benefit consumers is based on an integrated and internally consistent framework that incorporates

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For example, it does not measure latency and does not fully capture improvements in coverage and consistency.

efficiencies from marginal cost and quality improvements, as well as the effect of the loss of a competitor, to arrive at an estimate of the proposed merger's competitive effects.

28. Before describing the components of our analysis further, it is useful to describe how HBVZ's analyses fit within the framework described in Figure 1 above. HBVZ's logit and PC-AIDS models are alternative versions of the Market Equilibrium Module. Although HBVZ develop estimates of existing marginal costs, they do so based on minimal modeling and make no attempt to estimate any effects of the proposed merger on marginal costs.[31] They also fail to estimate quality effects. In other words, their analyses lack a Network Engineering Performance Module, an Economic Performance Module, and a Non-Network Efficiencies Module, or reliable substitutes for those modules. Lastly, their vGUPPI analysis is conducted as a standalone analysis and is not incorporated into the Market Equilibrium Module of their simulations, meaning it cannot properly contribute to analyzing the merger's bottom-line effect on consumer welfare, which is the relevant question for economic merger analysis.

II. MARKET EQUILIBRIUM

29. Starting at the final stage, the Market Equilibrium Module, is useful because it illuminates how the outputs of the other modules are used to predict the effects of the proposed merger. This module consists of an economic model of the industry that is a calibrated to industry conditions (e.g., prices, shares, and margins) and then used to predict

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[31] *HBVZ Declaration*, § III.C. See especially *HBVZ Declaration* at 54 (using their merger simulation model to make predictions about post-merger price increases with no consideration of potential efficiencies).

consumer-welfare levels with and without the merger. In Part A, we describe how our alternative Market Equilibrium model: (a) corrects data and methodological errors in HBVZ's analyses; (b) completes the analyses by incorporating efficiencies; and (c) consolidates the analyses by integrating the vGUPPI analysis into the overall merger simulation. In Part B, we then describe the implications of both of HBVZ's and our models for predicting the net consumer-welfare effects due to any adverse unilateral competitive effects and the merger's efficiencies. As part of this discussion, we demonstrate that our alternative approach is based on a more conservative set of assumptions than is HBVZ's model, which has the effect of increasing the upward pricing pressure predicted by our model relative to HBVZ's model.[32]

A. OUR ALTERNATIVE MARKET EQUILIBRIUM MODEL

30. In this part we first describe how our alternative market equilibrium model modifies HBVZ's approach. We then describe how the model is calibrated.

1. Model Description

31. As does HBVZ's model, our alternative merger market equilibrium model assumes firms choose prices to maximize profits, taking into account the anticipated reactions of rival firms (the "Bertrand-Nash" assumption).[33] For our assumption about the shape of demand, we also use a type of logit model (nested logit) that is similar to HBVZ's ALM model in many respects. An important feature of logit demand is that diversion ratios are assumed to

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[32] In Section VI below, we show that, even under these more conservative assumptions, the merger is procompetitive once projected efficiencies are incorporated.

[33] We describe the technical details of our model in more detail in Part A of Appendix I.

be proportional to market shares (at least for products within the same nest in a nested logit),[34] making the model easy to implement and the assumption about diversion ratios simple, transparent, and well-understood and frequently-used by economists. We consider it an advantage that we demonstrate that the merger is procompetitive using a simple, standard, commonly used demand model.

32. Starting from this baseline, our alternative model makes several changes to HBVZ's ALM model, which together have the effect of making our model more conservative than HBVZ's model.

33. First, we include all postpaid and prepaid brands in one model to allow for substitution between prepaid and postpaid brands. We used a nested version of the logit model to allow for the fact that, although there is substitution between postpaid and prepaid products, postpaid products may be closer substitutes for other postpaid products and prepaid products closer substitutes for other prepaid products. The nested logit model accomplishes this by allowing diversion among products in a given nest to potentially be scaled up relative to what shares would imply, with diversion to products in other nests is scaled down.

34. Second, our nested logit approach more generally allows for richer substitution patterns than does the ALM model. Specifically, we do not force diversion among all products included in the model to be proportional to share. Instead, diversion in our model is

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[34] In the simple logit model, diversion is assumed to be proportional to shares. In a nested logit model, diversion *within nests* is assumed to be proportional to shares. Diversion across nests is allowed to be less than proportional, but even in this case, the diversion ratios between a product in one nest and all products in another nest are scaled down uniformly, such that the relative diversion ratios are still proportional to relative shares.

proportional to share only for products within the same nest. Products in different nests are potentially more distant substitutes, with diversion rates that are lower than those among products in the same nest. Our model has the following nesting structure, which, among other things, conservatively allows for higher diversion between Sprint and T-Mobile products than between either Sprint or T-Mobile products and products in other nests:

- There is a high-level choice among five nests: postpaid brands controlled by T-Mobile and Sprint; postpaid brands controlled by all other operators; prepaid brands controlled by mobile network operators (MNOs, including AT&T, Verizon, Sprint, and T-Mobile); prepaid brands controlled by MVNOs; and an outside good.
- We allow the outside good to have its own nest to reflect that this is a fundamentally different product from the mobile broadband options.
- We group T-Mobile and Sprint postpaid products into their own nest as a parsimonious way to allow for the possibility that Sprint and T-Mobile postpaid products may be closer substitutes for one another than for other brands. We also allow prepaid brands run by MNOs to be closer substitutes for one another than for MVNO brands (and, as discussed below, calibrate the nesting parameter for this all-MNO prepaid nest to match the diversion ratio between Sprint and T-Mobile in particular). Allowing for greater-than-proportional diversion between Sprint and T-Mobile is an important dimension on which our approach is conservative relative to HBVZ's, which assumes diversions are proportional to shares.

35. A third modification to HBVZ's model concerns treatment of the "outside good" (i.e., the extent to which people will react to changes in quality-adjusted prices by changing the

number of mobile wireless subscriptions that they purchase).[35] As do HBVZ, we account for the degree of substitution between the products at issue and the outside good, but we allow for less substitution with the outside good than do HBVZ, which, all else equal, increases the incentive for the Parties to raise prices post-merger.[36] As do HBVZ, we measure the degree of substitution with the outside good through the industry elasticity of demand, which measures the percentage change in total industry demand in response to a one-percent change in every firm's price. Roughly speaking, a low industry demand elasticity indicates that only a small percentage of consumers reduce or eliminate their purchases of a good in response to a general price increase. The lower is the industry elasticity, the higher are the diversion ratios between suppliers, as fewer consumers opt out of purchasing the good altogether in response to a price increase, relative to those who switch to a different supplier of the good. Conversely, with a relatively high industry demand elasticity, a price increase by a single firm will cause relatively more subscribers to forego purchasing the product (e.g., forego mobile wireless service on an extra device, such as an iPad). In our analysis, we consider a range of industry elasticities that are consistent with those estimated for mobile wireless service in the empirical academic literature and previously adopted by the Commission.[37] In our baseline

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35 As explained above, diversion to the outside good does not mean a person stops using mobile broadband service altogether. Rather, it means she foregoes a mobile broadband subscription that she otherwise would have taken, perhaps choosing to go without a subscription for an iPad, for example.

36 The interpretation of the outside good is somewhat different between HBVZ's model and our modification of it. Specifically, prepaid products are part of the outside good for HBVZ's postpaid segment, and postpaid products are part of the outside good for their prepaid segment.

37 In its evaluation of the AT&T/T-Mobile merger, the Commission Staff considered a range of industry elasticities from 0.0 (assuming no substitution to the outside good) to -0.51, with the

model, we use an industry elasticity of -0.3, which is lower in absolute value than the estimate of -0.55 that HBVZ use, and thus, all else equal, will lead the model to predict larger post-merger price increases. We also consider a highly conservative sensitivity case with an industry elasticity of -0.1, as well a case with industry elasticity of -0.5.

36. Fourth, although HBVZ compute vGUPPIs and argue that the merger will create incentives to raise wholesale prices to MVNOs, they do not integrate their analysis of horizontal (merger simulation) and vertical (vGUPPI) pricing incentives.[38] More generally there are several flaws with their vGUPPI approach. First, HBVZ do not account for upstream network efficiencies when considering wholesale pricing incentives. Reductions in network marginal costs will put downward pressure on wholesale prices, and HBVZ ignore this incentive. Second, HBVZ do not account for the effect of efficiencies, and the induced changes in downstream quality adjusted prices, on MVNO's downstream pricing incentives. To the extent that efficiencies reduce the quality-adjusted prices of retail rivals to MVNOs, such reductions will also put downward pressure on MVNO retail prices even if the MVNO's input costs increase. To properly answer the question of whether the merger affects consumer

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latter estimate drawn from the economic literature. (Staff Analysis and Findings, *In the Matter of Applications of AT&T Inc. and Deutsche Telekom AG for Consent to Assign or Transfer Control of Licenses and Authorizations*, WT Docket 11-65, rel. November 29, 2011 (hereinafter *AT&T/T-Mobile Commission Staff Report*), Appendix C, ¶ 15.)

HBVZ use an industry elasticity of -0.55. (*HBVZ Declaration,* n. 67.)

In our analysis below, we use an industry elasticity of -0.3 in our baseline model and consider industry elasticities ranging between -0.1 and -0.5.

[38] *HBVZ Declaration,* n. 69.

welfare through wholesale pricing, both effects must be considered. Third, HBVZ made certain technical errors in implementing their vGUPPI calculations.[39]

37. To implement an integrated model of MNO and MVNO competition, we model demand and competitive interactions at the brand level, accounting for underlying ownership and wholesale relationships.[40] As do HBVZ, we treat MVNOs such as TracFone as distinct downstream retail competitors. However, in contrast to HBVZ, we account for the MNO wholesale pricing incentives that arise from the fact that MNOs sell wireless services to MVNO's for resale in retail markets.[41] Specifically, we estimate merger-related changes in MVNO input costs using a vGUPPI that corrects for errors in HBVZ's implementation and also accounts for network marginal cost efficiencies. In doing so, we account for the fact that MNOs will internalize the profits they earn on sales of wholesale network services to MVNOs and any merger-induced change in those incentives. Critically, we embed these effects in an overall model of market equilibrium, thus jointly determining the bottom-line effects on MNO and MVNO pricing and consumer welfare.[42]

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39 *Salop/Sarafidis Reply Declaration*, ¶ 47.

40 See Part B of Appendix I for further details on this modeling.

41 HBVZ separately consider the implications of the relationship between MNOs and MVNOs and the effects of the merger on those relationships outside the framework of their merger simulation.

42 We note that TracFone, the largest MVNO, has concluded that the merger will benefit MVNOs and their customers. (See Comments of TracFone Wireless, Inc., September 13, 2018, at 2 ("TracFone expects that the strong 5G network to be built by the New T-Mobile, with the additional coverage, speed and capacity can only improve the wholesale market for MVNOs and thus TracFone's customers going forward.").)

2. Model Calibration

38. Although we generally rely on the same types of data as do HBVZ, we make several modifications to their calibration, which we describe briefly below and further in Part C of Appendix I below.

39. Our calibration exercise consists of finding values for the value of the following parameters, which together fully pin down our Nested Logit model, such that it determines each brand's share and margin, and diversion ratios between the brands:

- *product-specific "quality parameters"* that capture non-price attributes of each product, such as network quality (i.e., how attractive each product is to each customer, holding price fixed);
- a *price-sensitivity parameter* that specifies how strongly consumers react to price changes and helps to determine firms' equilibrium profit margins; and
- *nesting parameters* that measure the degree of substitutability between products within the same nest and helps determine diversion ratios between carriers.

40. We calibrate the model by choosing values for these parameters such that the values for the following variables generated by the model match the corresponding values observed in our data sources: (i) shares of all specified products, (ii) the average Sprint and T-Mobile margin, and (iii) the average diversion ratio between Sprint and T-Mobile. The intuition behind the calibration is as follows:

- The model chooses product-specific quality parameters such that the predicted shares match observed shares (given values for the other parameters);

- the model chooses the price sensitivity parameter such that the predicted average profit-maximizing Sprint and T-Mobile margins matches the observed margins;[43] and
- the model chooses a nesting parameter common to the two postpaid nests, and a separate nesting parameter common to the two prepaid nests, such that the predicted average diversion ratio between Sprint postpaid and T-Mobile postpaid products and the predicted average diversion ratio between Sprint prepaid and T-Mobile prepaid products match the corresponding average diversion ratios observed in the data.

41. Notably, unlike HBVZ, we explicitly deal with the forward-looking nature of the exercise by using projections of subscriber shares and margins in the relevant time periods (post-integration) to calibrate our model.[44] To understand why this is important, recall that merger analysis compares the predicted industry equilibrium for a world in which the merger is consummated with the predicted equilibrium in a no-merger "baseline" world in which the merger does not occur. In a static industry, the no-merger baseline is often assumed to be the current (pre-merger) state of the industry (HBVZ take this approach). Given the dynamic nature of this industry, however, one must draw inferences about the merger's effects in future time periods. To deal with this, rather than use 2017 share and ARPU data, we calibrate our nested logit model using projected future values of the key variables drawn from the Parties' ordinary course documents and business plans, which utilize data from the Parties' own internal modeling as well as that of third-party industry analysts. This approach

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43 This profit-maximizing condition is a variant of the Lerner condition (which holds that a firm's own-price elasticity equals the inverse of the firm's margin) for multi-product firms.

44 Throughout, we use subscribers synonymously with lines.

allows us to incorporate the industry's views about expected future industry trends, thus ensuring that the model is consistent with the views that the Parties and other industry participants hold about the non-merger baseline in future years. In particular, incorporating the Parties' future plans as drawn from their business documents incorporates T-Mobile's and Sprint's standalone plans with regard to 5G and thus addresses the concerns of critics that claimed merger benefits do not credit these standalone plans.[45]

42. Also, unlike HBVZ, who base margins on aggregated data derived from the Parties' financial reports, we use the Parties' ordinary course customer lifetime value (CLV) models to compute margins. The margins computed from these CLV models are conceptually similar to the margins computed by HBVZ, but they incorporate more detailed data from the Parties that are contained in the CLV models but not publicly available. This approach yields lower margins than those HBVZ calculate. For example, whereas HBVZ calculate margins of [redacted] percent and [redacted] percent for Sprint and T-Mobile respectively, we find corresponding values of [redacted] percent for Sprint and [redacted] percent for T-Mobile, with the precise values varying by year.[46]

43. Finally, unlike HBVZ —who use diversion ratios proportional to shares—we calibrate our nested logit model (which allows substitution between the Parties' brands that is more than proportional to share) using information on switching rates from survey data that T-

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45 See, e.g., Petition to Deny of DISH Network Corporation, *In the Matter of Applications of T-Mobile US, Inc., and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations*, WT Docket No. 18-197, August 27, 2018 (hereinafter, *DISH PTD*), §§ III, IV.A.

46 See Table 26 below.

Mobile uses in the ordinary course of business. We describe alternative sources of switching data in Part C.3 of Appendix I, and we test the sensitivity of our conclusions to alternative diversion ratios.

B. THRESHOLD EFFICIENCIES

44. We use the Market Equilibrium Model (either HBVZ's or our alternative version) to compute the break-even efficiencies: the level of efficiencies that, given the impact of the loss of competition between the Parties, would still result in the transaction's having a neutral effect on consumer welfare. The break-even value of efficiencies serves as a threshold for evaluating the merger: If the efficiencies are greater than the threshold, then the merger strengthens competition and benefits consumers. The break-even value of efficiencies also serves as a summary measure of what it means to be conservative. The fact that our alternative merger simulation generates higher threshold efficiencies than do the HBVZ merger simulation models indicates that the alternative assumptions that we make are collectively more conservative than are HBVZ's assumptions in terms of their implications for whether the merger will lead to higher retail prices.

1. Efficiency Thresholds Based on the HBVZ Market Equilibrium Models

45. Table 1 reports the threshold value of efficiencies calculated based on HBVZ's model. These threshold efficiencies are defined such that, if New T-Mobile realizes efficiencies at least this large *with respect to each of the standalone companies,* then the merger will benefit consumers. This threshold value applies to the sum of the improvement in marginal costs and consumers' dollar valuation of increased product quality. As we explain below, the efficiencies that New T-Mobile must realize for the proposed merger to be

procompetitive can be smaller with respect to one standalone company, say Sprint, if they are larger with respect to the other, say T-Mobile. We present a single threshold value (assuming common efficiencies across the firms) in our tables solely to simplify the presentation.

46. Table 1 shows the critical efficiency values based on HBVZ's ALM and PC-AIDS models, separately for their prepaid and postpaid segments, respectively.[47] For comparability with the results from our alternative model—which accounts for projected industry changes over time—we show results by year, even though HBVZ's model is entirely static and accounts for no such changes. For the prepaid segment, the threshold efficiency values range from [redacted] based on HBVZ's ALM demand model to [redacted] based on HBVZ's PC-AIDS demand model. For the postpaid segment, the threshold efficiencies all fall inside this range using either model.[48, 49] Put simply, these figures imply that, *as long as the combination of marginal cost savings and*

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47 As noted above, because HBVZ did not provide backup materials with their declaration, we have had to reverse engineer their results based on the information contained in the declaration. We are able to replicate HBVZ's predicted post-merger prices within 0.2 percent in HBVZ's ALM prepaid and postpaid models and HBVZ's PC-AIDS postpaid model. We have been able to replicate HBVZ's predicted post-merger prices within 2.0 percent in HBVZ's PC-AIDS prepaid model. The results that we report below are based on our reverse-engineered version of HBVZ's merger simulation models.

48 For the purposes of this comparison, we compute the efficiencies relative to the subscriber share-weighted average of T-Mobile's and Sprint's standalone ARPUs. The necessary average efficiency level could be achieved through higher efficiencies for one firm and smaller efficiencies for the other. We explore such combinations in more detail below.

49 HBVZ's ALM merger simulation projects nominal price increases, absent any efficiencies, of \$2.33 and \$2.17, respectively, for Sprint postpaid and T-Mobile postpaid. (*HBVZ Declaration*, Table 21.) HBVZ's ALM merger simulation projects nominal price increases, absent any efficiencies, of \$2.76 and \$1.09, respectively, for Sprint prepaid and T-Mobile prepaid. (*HBVZ Declaration,* Table 22.)

quality improvements exceed [redacted]*, the merger is procompetitive and consumer-welfare enhancing.*

Table 1: Critical Efficiencies Based on HBVZ Models

[redacted]

47. We also note that the critical efficiencies do not vary much between the ALM and PCAIDS models. This fact is consistent with the principle that the assumed shape of the demand curve similarly affects both the predicted pass through of upward pricing pressure and the predicted pass through of efficiencies. Because the shape of the demand curve affects the strength of effects running in opposite directions, there tend not to be large differences between the models. In HBVZ's postpaid segment, the estimated critical efficiency thresholds of the PC AIDS and ALM models are within five cents of one another.[50] In HBVZ's prepaid segment, the estimated critical efficiency thresholds of the two models are within 87 cents of one another.[51] In all cases, critical efficiencies are [redacted].

50 In contrast, HBVZ report estimated price increases, not accounting for efficiencies, that differ by [redacted] for Sprint and T-Mobile. (*HBVZ Declaration*, Tables 21 and 23.)

51 In contrast, HBVZ report estimated price increases, not accounting for efficiencies, that differ by [redacted] for Sprint and T-Mobile. (*HBVZ Declaration*, Tables 22 and 24.)

2. Efficiency Thresholds Based on Our Alternative Market Equilibrium Model

48. Table 2 shows the critical efficiency value for 2021-2024 using our alternative model.[52] In this more conservative merger simulation, a combination of marginal cost and quality efficiencies worth at least [redacted] would be sufficient to make the merger procompetitive and benefit consumers. These values are quite similar from 2021 through 2024; the small differences reflect projected changes in shares, prices, and margins over time.

[52] In the base specification, we assume that the average T-Mobile and Sprint margin predicted by the merger simulation model matches the average T-Mobile and Sprint margin derived from the CLV models described in Part C.2 of Appendix I, that industry elasticity is -0.3, that the nesting parameter is calibrated to switching rates from the Harris Mobile Insights data, that 75 percent of vertical upward pricing pressure is passed through, and that there is no input substitution by MVNOs.

Table 2: Alternative Critical Efficiencies (2021-2024)

[redacted]

49. We also consider several robustness checks to the value of breakeven efficiencies by altering the assumptions underlying the model in Row 1.

- *Diversion Ratios:* Rows 2 through 4 consider alternative diversion ratios based on assuming either diversion rates derived from survey data, diversion proportional to share of gross adds, or diversion proportional to share of subscribers (meaning a logit model with one nest for all inside goods and one for the outside good). The estimated break-even efficiencies in 2021 range from [redacted] across these different diversion rate estimates. In 2024, the corresponding range is [redacted].
- *Industry Elasticity:* Rows 5 and 6 consider alternative industry elasticity assumptions (-0.1 or -0.5). Critical efficiencies in 2021 are [redacted] with an industry

elasticity equal to -0.1 (corresponding to little substitution with the outside good), and [redacted] when using the upper end of the industry elasticity range that the Commission previously used (-0.5, corresponding to greater substitution with the outside good).[53] The corresponding values in 2024 are [redacted].

- *Vertical Upward Pricing Pressure Assumptions:* Rows 7 through 9 consider different assumptions about the effect of vertical upward pricing pressure on wholesale prices to MVNOs. When the pass-through rate is 50 percent, the critical efficiencies range from [redacted]. When vertical upward pricing pressure is fully passed through, critical efficiencies range from [redacted] Finally, if the calculation of vertical upward pricing pressure accounts for potential input substitution on the part of the MVNOs, the critical efficiencies range from [redacted].

In sum, for the baseline versions of our alternative model, critical efficiencies are all under [redacted], and for a wide range of alternative versions, they are centered around [redacted], ranging from approximately [redacted].

50. An important property of the efficiency threshold approach is that there is a trade-off between the efficiencies that must be realized by the two Parties for the proposed merger to be consumer-welfare neutral; the larger are the realized efficiencies with respect to Sprint, the lower are the threshold efficiencies required with respect to T-Mobile, and vice versa. Figure 2 illustrates this trade-off by showing the "frontier" of Sprint and T-Mobile efficiencies

53 See note 37 above.

necessary to make the merger competitively neutral in 2024.[54] Any combination of Sprint and T-Mobile efficiencies that falls to the right of the frontier means the merger is consumer welfare enhancing. As discussed above, using our conservative alternative to HBVZ, if both Sprint and T-Mobile achieve efficiencies of [redacted] in 2024, then the merger would be welfare neutral, but efficiencies of approximately [redacted] for Sprint (and zero for T-Mobile), or [redacted] for T-Mobile (and zero for Sprint) would also achieve this result, as would any other combination of values on the frontier.

54 At several points in this declaration, we present figures solely for 2024 to illustrate a point. In other cases, we present figures for 2021 and 2024 because 2022 and 2023 represent intermediate cases. We provide a full set of figures in our backup materials.

Figure 2: Trade-Off between Sprint and T-Mobile Efficiencies (2024)[55]

[redacted]

3. Our Approach to Modeling the Market Equilibrium is More Conservative than is HBVZ's Approach

51. Comparison of the results in Table 1 and Table 2 reveals that our alternative model generates larger break-even efficiencies than do HBVZ's merger simulation models. For example, the break-even efficiencies that HBVZ's models imply range from [redacted]. In contrast, our baseline break-even efficiencies range from [redacted]. The fact that the break-even efficiencies are larger in our alternative

55 In this figure, we represent critical efficiencies as a weighted average of values for prepaid and postpaid products.

model proves that the combination of alternative assumptions that we make relative to HBVZ are conservative from the perspective of evaluating the merger.

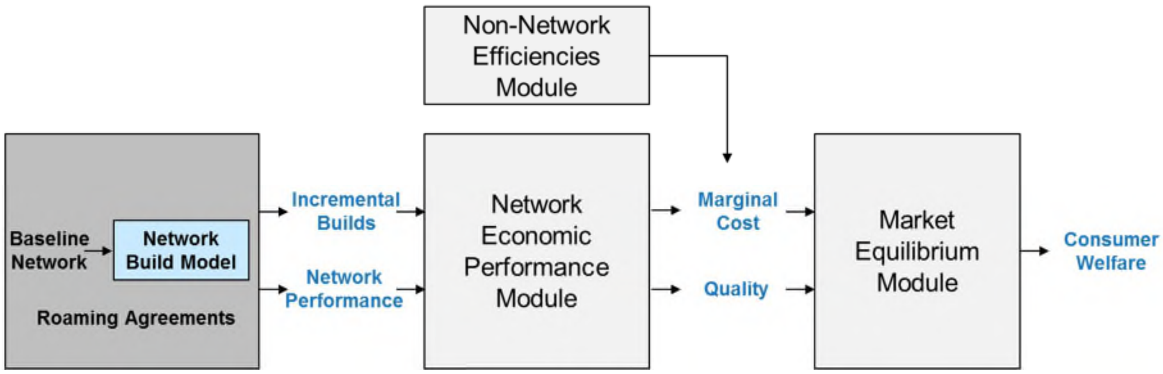
III. NETWORK ENGINEERING PERFORMANCE

52. Efficiencies arising from the integration of the Sprint and T-Mobile networks generate the bulk of the marginal cost savings and quality improvements projected to be realized due to the merger. The Network Engineering Performance Module generates projections of network investment and performance. These projections are, in turn, used by the Economic Performance Module to quantify the network marginal cost savings and quality improvements that will result from the merger. In this section, we describe the Network Engineering Performance Module.

A. OVERVIEW OF THE NETWORK ENGINEERING PERFORMANCE MODULE

53. Figure 3 provides an overview of the Network Engineering Performance Module and its place in the overall merger-assessment framework. The module starts from a baseline network consisting of spectrum deployed on specific sites (there is a separate baseline network for each of the standalone and New T-Mobile networks). Then, for any given traffic forecast, the Network Build Model determines the type and number of incremental builds necessary to accommodate the traffic while satisfying satisfy the relevant network performance planning criteria. Only these incremental builds are considered in the marginal cost calculations that we describe in Section IV.A below. The Network Build Model also computes a user experience throughput measure (in Mbps) that results from the addition of the incremental builds to the initial Baseline Network.

Figure 3: Network Engineering Performance Module as Part of Overall Framework



54. We first describe the Network Build Model and then describe the baseline networks that we use for our analysis.

1. Network Build Model

55. Figure 4 provides a schematic of the Network Build Model, which was developed by T-Mobile in consultation with Sprint.[56] The model has the following inputs: (i) a baseline network plan, and (ii) a traffic forecast, which consists of a projection of the overall traffic level, a forecast of the split of traffic between 5G-capable devices and LTE-only devices, and a forecast of the distribution of traffic across time-of-day and geography. For any given baseline network and traffic forecast, the model identifies congested sectors based on network performance planning criteria.[57] The model is based on a set of "solutions" (e.g., cell splits)

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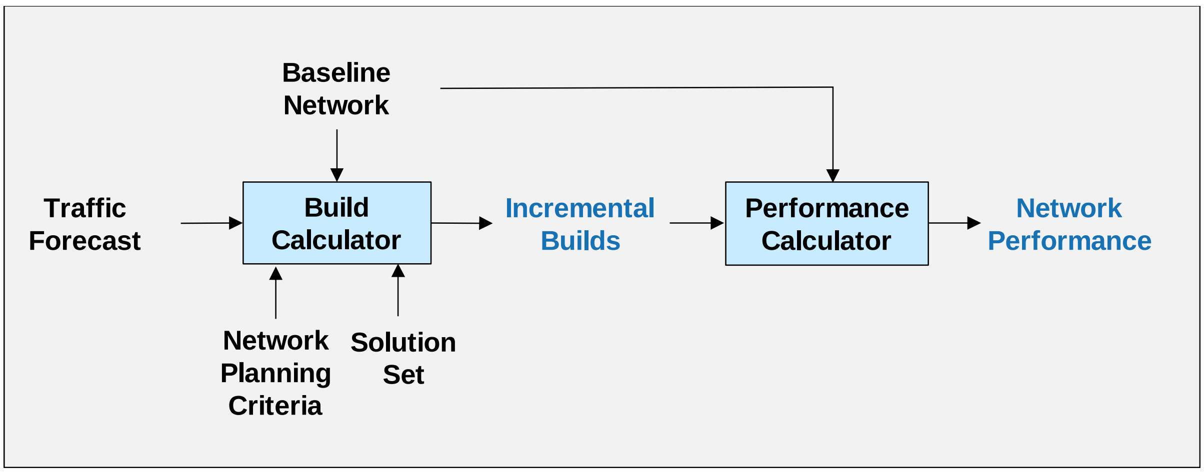
56 T-Mobile submitted the code and documentation for the Network Build Model to the Commission on September 5, 2018. Here, we provide an overview of its approach and functionality. We base our analysis on the revised Network Build Model that T-Mobile submitted to the Commission on September 17, 2018.

57 Where appropriate, the model implements different planning criteria for Sprint and T-Mobile, but in all cases it uses the same criteria for standalone T-Mobile and New T-Mobile. The Parties' respective Chief Technology Officers have stated that the Network Build Model provides a reasonable representation of how each company would operate and invest in its

for alleviating congestion that are placed in a hierarchy from most to least cost-effective.[58] The model then implements these solutions by following the cost hierarchy until the congestion is resolved or until the model runs out of available solutions. For example, practical and engineering constraints place a limit on the number of cell splits that can be performed at a given site in a given period of time.

Figure 4: Schematic of Network Build Model



56. These network solutions have two important implications for the economic modeling. First, as described in Section IV.A below, there are costs associated with each solution, and

respective network. (*Ray Reply Declaration,* ¶ 2, §§ II.A (describing T-Mobile's ordinary-course-of-business 4G LTE engineering model), and II.B (describing the 5G engineering model that T-Mobile developed based on the fundamental concepts of the existing 4G LTE model); Reply Declaration of John C. Saw, September 17, 2018 (hereinafter, *Saw Reply Declaration*), ¶ 15.)

The code and documentation for the Network Build Model were submitted to the Commission on September 5, 2018 provide additional detail on the relevant planning criteria. T-Mobile submitted a revised version of the Network Build Model to the Commission on September 17, 2018. See also, *Ray Reply Declaration*, §§ II.A-B.

[58] Again, where appropriate, the model uses different solution sets for Sprint and T-Mobile.

these costs represent the marginal costs of handling incremental network traffic while meeting the planning criteria ("marginal network costs"). Second, using the network defined by the baseline network plus all solutions applied by the Build Calculator, the Performance Calculator determines network performance in each sector, where performance is measured as user experience throughput (measured in Mbps). This network performance is driven, at least in part, by network loading, which the Network Build Model calculates for each sector, incorporating both the baseline network and all of the implemented solutions. Network loading for the 5G network is measured as the ratio of carried traffic to offered traffic; network loading for the LTE network is measured as users per 5 MHz of spectrum deployed.[59] In general, higher network loading generates lower performance and lower network loading generates higher performance, all else being equal.

57. As described by T-Mobile's Chief Technology Officer, Neville Ray, T-Mobile created and ran the Network Build Model for the years 2021 through 2024.[60] He explains that the evolution of the New T-Mobile network prior to 2021 will be driven by requirements associated with integrating the Sprint and T-Mobile networks, as opposed to responding to changes in traffic levels.[61] In particular, he states that the 2021 post-integration network would not be altered even if traffic were significantly below the forecasted levels.[62] Consequently, the Network Build Model, which is fundamentally a model of incremental

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59 Offered traffic is a measure of network capacity. (*Ray Declaration,* ¶¶ 17, 55, 57 (describing the capacity of the standalone network based on offered traffic).)

60 *Ray Reply Declaration*, ¶ 17.

61 *Ray Reply Declaration*, ¶ 15.

62 *Ray Reply Declaration*, ¶ 15.

capacity investments motivated by incremental traffic, does not provide an appropriate tool for predicting New T-Mobile's network investments during the integration period. We thus commence our merger assessment at the end of 2021, by which time the integration of the Parties' wireless networks is anticipated to be largely complete and the Network Build Model becomes an appropriate tool for determining network investments.

2. Baseline Networks

58. Our analysis builds on the baseline networks planned by each company. Both Sprint and T-Mobile have developed plans detailing cell site locations and spectrum deployments for the standalone companies over 2021-2024.[63] These plans also include spectrum migration plans that detail the transition of spectrum from LTE to 5G networks.[64] In addition, T-Mobile has developed a baseline network plan for New T-Mobile. The New T-Mobile plan involves re-farming spectrum to its 5G network more quickly than does either the standalone T-Mobile or standalone Sprint plan.[65] The New T-Mobile mobile plan also involves a greater number of 5G cell sites than does either the standalone T-Mobile or standalone Sprint plan.[66]

59. In the economic modeling that we describe in Section IV.A below, we use the planned baseline networks for standalone Sprint and standalone T-Mobile for the entire 2021-2024 period. This approach means that, in the economic modeling described below, we treat any investments planned for the standalone networks over this period as sunk costs, and count as

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63 *Saw Declaration*, ¶¶ 17-22; *Ray Declaration*, ¶¶ 16-20, 40-42; *Ray Reply Declaration*, ¶¶ 14, 16, 33.

64 *Ray Reply Declaration*, Table 1.

65 *Ray Reply Declaration*, Table 1.

66 *Ray Reply Declaration*, Table 7.

marginal costs only the incremental builds above this baseline that are required to meet the network performance planning criteria as traffic grows. By contrast, for New T-Mobile, we treat only the baseline network builds through 2021 as sunk. For all later years, we apply the Network Build Model to the 2021 baseline network, meaning that we treat *all* builds after 2021 for New T-Mobile as marginal costs.[67] Table 3 illustrates the fact that using the 2021 baseline network in 2024 results in more incremental builds and, thus, higher network marginal costs than does using the 2024 baseline network in 2024.

Table 3: The Effect of the Baseline Network Choice on Incremental Solutions Required by New T-Mobile's Network (2024)

[redacted]

60. The implication of our different treatments of the standalone networks and the New T-Mobile network on this dimension is that we are being conservative in our assessment of the proposed merger's benefits: If we applied the same approach to the standalone networks that we apply to New T-Mobile's network, we would project higher marginal costs for the standalone networks, which would increase the magnitude of the proposed merger's marginal

[67] In doing so, we assume that the 5G spectrum described in the refarming plan above is available to the New T-Mobile, but that the costs to deploy the spectrum are incurred only if warranted by the network traffic and the necessity of satisfying New T-Mobile's network planning criteria.

cost savings. In addition, by including all planned builds through 2024 for the standalone networks as part of the baseline, but only including planned builds for New T-Mobile for 2021 as part of the baseline, we are giving the standalone networks—but not New T-Mobile—the benefit of the quality improvements provided by these builds, meaning that our approach is conservative from a network performance and service-quality point of view as well.

B. THE MERGER WILL DRAMATICALLY IMPROVE NETWORK PERFORMANCE

61. In this section, we explain how the network modeling demonstrates that, as a result of the merger efficiencies, the New T-Mobile network would realize substantially lower marginal costs and offer vastly improved product quality along several dimensions relative to the standalone networks.

62. To assess how network performance varies and how network investments are triggered as traffic grows, we run the Network Build Model over a range of increasing traffic levels, using increments equal to ten percent of the baseline traffic associated with 5G-capable devices assumed in the network model.[68]

1. Reduced Necessary Capacity Builds

63. As a result of efficiencies achieved by combining the Sprint and T-Mobile networks, the New T-Mobile network will have capacity substantially greater than the sum of the standalone networks' capacities. One consequence of this increased capacity is that, for any

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[68] Because the model implements "solutions" to expand the network relative to the exogenously specified baseline network, the required network builds at any given assumed traffic level do not depend on the assumed *baseline traffic* level in the model, but rather reflect the required incremental builds to supplement the *baseline network* so as to serve the specified traffic level in a way that meets the network performance planning criteria.

given level of traffic, the New T-Mobile network is less likely than the standalone networks to experience congestion and, thus, less likely to trigger costly builds and/or suffer quality degradation. As a result, the New T-Mobile network will have both higher quality and lower marginal costs than the standalone networks.

64. Table 4 summarizes the number and type of congestion solutions that the model implements for each network to accommodate its baseline projected traffic level in 2024. Reflecting standalone T-Mobile's more limited spectrum holdings, especially those that can be dedicated to 5G, the model indicates that the standalone T-Mobile network would require substantially more builds to solve for congestion than would the New T-Mobile network.[69] The standalone Sprint network would also require more builds than the New T-Mobile network.

Table 4: Incremental Network Builds (2024)

[redacted]

[69] To calculate incremental builds for New T-Mobile, we assume that New T-Mobile maintains usage restrictions and holds the mix of LTE-only and 5G-capable devices fixed at levels projected for the standalone networks.

2. Reduced Roaming Costs

65. As we describe further in Section III.B.3 below, standalone Sprint's network has substantial coverage limitations. Sprint's LTE network currently covers 302 million POPS and 1.0 million square miles.[70] By contrast, Verizon's LTE network covers 322 million POPS and 2.4 million square miles.[71] To address its coverage limitations, Sprint has signed roaming agreements with other carriers—including T-Mobile, Verizon, AT&T, and U.S. Cellular—to provide coverage outside of the Sprint radio network's footprint.[72] Some of Sprint's roaming partners (e.g., [redacted] offer only 3G roaming coverage, while others (e.g., [redacted]) offer LTE roaming coverage.[73, 74]

66. Under these roaming arrangements, Sprint typically pays a per unit fee for the data its customers use while roaming on a partner network. These roaming fees can be substantial. For example, in 1Q FY2018, Sprint estimated that that it would pay an average of [redacted] to its roaming partners for domestic data roaming.[75] Because of these costs, Sprint often

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70 Sprint, "Rural Strategy," March 7, 2018, SPR-FCC-01276622, at 2.

71 Verizon Wireless, "Highest network quality in the U.S.," *available at* https://www.verizonwireless.com/featured/better-matters/, *site visited* September 10, 2018.

72 *Saw Declaration*, ¶ 14.

73 In FY2017, approximately [redacted] percent of Sprint's domestic data roaming was on LTE networks and, by 2020, Sprint expects more than [redacted] percent of its domestic data roaming will occur on LTE networks. (Sprint, "Roaming MQ1 Forecast," March 5, 2018, IKK Exhibit 1, at 10.)

74 Sprint signed an LTE roaming agreement with T-Mobile specifically in conjunction with this transaction, which imposes certain limits on Sprint's usage of T-Mobile's network. (*Saw Declaration*, ¶ 34.) It is our understanding from counsel that there are legal arguments against considering the Sprint-T-Mobile roaming agreement as part of the non-merger but-for world. In our analysis below, we consider Sprint's roaming costs with and without the T-Mobile roaming agreement in place.

75 Sprint, "Roaming MQ1 Forecast," March 5, 2018, IKK Exhibit 1, at 4.

limits the quality and amount of roaming coverage it offers to its customers. For example, Sprint currently limits data throughput to [redacted] on Verizon's network, [redacted] on AT&T's network, and [redacted] on other networks (e.g., rural roaming partners).[76] In sum, Sprint's roaming agreements allow it to provide nationwide coverage, but that coverage is high cost and low quality outside of the Sprint footprint.

67. Table 5 reports Sprint's projected domestic roaming costs with and without the T-Mobile roaming agreement.[77] We assume that Sprint will incur no domestic data roaming costs once it gains access to the New T-Mobile network (including the low-band 600 MHz spectrum that T-Mobile is deploying) post-merger.[78] The elimination of roaming costs will reduce its marginal costs by [redacted] per postpaid subscriber per month in 2021, increasing slightly to [redacted] per postpaid subscriber per month in 2024.[79] In addition, as described in

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76 Sprint, "T-Mobile Domestic Data Roaming Impact," June 6, 2018, SPR-FCC-03783385, at 6. See also *Saw Declaration*, ¶ 14.

77 In the ordinary course of business, we understand that Sprint uses its average roaming cost per postpaid customer in its CLV calculations. We adopt the same approach here.

We also understand that Sprint does not forecast roaming costs out as far as the modeling period in the ordinary course of business, but has provided estimates for FY18-FY24. (See Sprint, Domestic Data Roaming Costs, IKK Exhibit 2 in our backup materials.)

78 By the end of 2018, T-Mobile expects to cover 325 million POPs with its LTE network. It owns licenses to 600 MHz spectrum covering approximately 328 million POPs. (T-Mobile News Release, "T-Mobile Delivers its Best Q2 Ever," August 1, 2018, *available at* https://www.t-mobile.com/news/best-q2-ever.)

Although there would be some costs associated with carrying the traffic on the New T-Mobile network, such costs would be small because (1) New T-Mobile experiences marginal network costs of just [redacted] (see Part D of Appendix I), and (2) roaming traffic accounts for [redacted] of Sprint's overall traffic.

79 Our analysis assumes the roaming agreement with T-Mobile would expire four years following any abandonment of this merger. ("Domestic LTE Roaming Data Services Agreement by and between T-Mobile USA, Inc., Sprint Spectrum L.P., and Sprint Corporation," April 28, 2018, TMUS-FCC-02508420, § 14(a).)

greater detail below, post-merger, Sprint's customers will gain access to the vastly superior New T-Mobile network, which will have full nationwide coverage.

Table 5: Sprint Domestic Roaming Costs (2019-2024)

[redacted]

3. Improved Product Quality

68. In addition to reducing the costs associated with serving any given level of traffic, the efficiencies derived from combining the Sprint and T-Mobile networks increase product quality along several dimensions, including, among others, improvements in throughput, consistency of experience and reduced usage restrictions. In discussing, merger-specific quality improvements, it is important to note that the Network Build Model is, fundamentally, a capacity model designed to assess network performance within the footprint of the network. It is not designed to measure coverage limitations and thus does not fully capture Sprint's disadvantages in this regard. We discuss this point further below.

(a) Increased Throughput

69. We begin by examining user throughput. Figure 5 shows the average 5G user experience throughput on the various networks in 2021 after the model implements

solutions.[80] In this section, we focus on 5G user experience throughput because it is our understanding that 5G services and the 5G network will be the focus of pricing and strategic business decisions by 2021 and that the overwhelming majority of new customers in 2021 and beyond are likely to be customers with 5G-capable devices.[81] However, when we quantify consumer valuation on improved network quality in Section VI.C, below, we account for both 5G and LTE throughput.

70. In this and several subsequent figures, we plot 5G user experience throughput against the sum of standalone 5G-capable device traffic, adjusted for the split of traffic between Sprint and T-Mobile. For example, if Sprint accounts for x percent of combined 5G-capable device traffic g and T-Mobile accounts for $1-x$ percent of total 5G-capable device traffic, at point g on the x-axis, we plot the Sprint throughputs associated with 5G-capable device traffic equal to xg and T-Mobile throughputs associated with 5G-capable device traffic equal to $(1-x)g$. This approach recognizes that network performance is a function of total traffic and allows us to compare the standalone and New T-Mobile networks on an apples-to-apples basis.

71. The New T-Mobile 5G network yields substantial improvements in throughput relative to the standalone 5G networks. For example, at total 5G-capable device traffic of approximately [redacted] (equivalent to the expected sum of Sprint and T-

80 The specific measure of user experience throughput that we utilize is the average downlink throughput for a given average level of network traffic. The throughput levels reported by the Network Build Model are calibrated to Ookla speed-test data.

81 Reply Declaration of Peter Ewens, September 17, 2018 (hereinafter, *Ewens Reply Declaration*), ¶ 36; Reply Declaration of Brandon “Dow” Draper, September 17, 2018, (hereinafter *Draper Reply Declaration*), ¶ 12.

Mobile traffic in 2021), the average network-wide 5G throughput is approximately [redacted] on the standalone Sprint network and approximately [redacted] on the standalone T-Mobile network. By contrast, average 5G throughput is approximately [redacted] on the New T-Mobile network, nearly double standalone Sprint's throughput and nearly quadruple standalone T-Mobile's throughput.

Figure 5: User Experience Throughput (2021)

[redacted]

72. Figure 6 shows the average user experience throughput on the various networks in 2024 after the model implements solutions. The New T-Mobile network yields substantial improvements in user experience throughput in the 5G networks compared to the standalone networks. For example, at total 5G-capable device traffic of approximately [redacted]

(equivalent to the expected sum of Sprint and T-Mobile traffic in 2024), the average network-wide 5G throughput in the New T-Mobile network is approximately [redacted] while the average network-wide 5G throughput is approximately [redacted] in the Sprint network and [redacted] in the standalone T-Mobile. In other words, by 2024, the throughput differential is projected to have grown to the point where New T-Mobile has throughput more than 2.5-times that of standalone Sprint and more than quadruple that of standalone T-Mobile.

Figure 6: User Experience Throughput (2024)

[redacted]

(b) Improved Consistency

73. Sprint's standalone plans indicate that its 5G network will offer limited coverage. For example its plan of record includes sites that will only cover approximately [redacted] POPs

in 2021.[82] Moreover, Sprint plans to focus its 5G deployment on major cities.[83] An implication of this deployment plan is that Sprint customers would frequently be forced to “leak” to Sprint’s LTE network or onto the networks of Sprint’s roaming partners with the associated losses in network quality.

74. Figure 7 shows the distribution of 5G user-experience throughput for each network in 2021. Because Sprint can deploy 5G on its 2.5 GHz spectrum, it will be able to offer reasonably high-quality 5G where it deploys 5G, but that deployment will cover [redacted] of total POPs. In contrast, T-Mobile’s standalone 5G network, which would be deployed largely using its 600 MHz spectrum, offers a relatively consistent user experience covering most POPs, but at lower throughput. New T-Mobile’s 5G network is better than the standalones on both dimensions, offering higher throughputs than either standalone network over a much broader geographic area than the standalone Sprint network.

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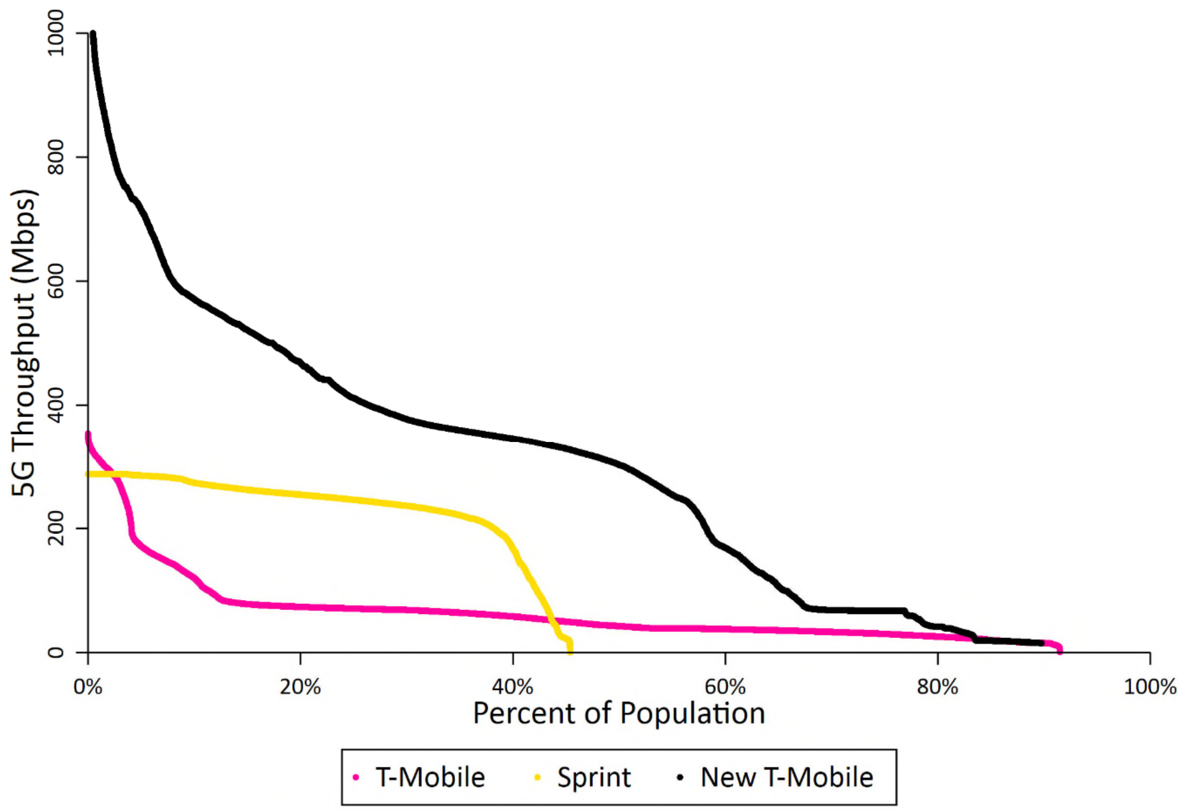
82 *Saw Reply Declaration,* ¶ 6.

83 See also, *Saw Reply Declaration,* ¶ 8 (“5G deployment will be limited to areas in and around major cities”).

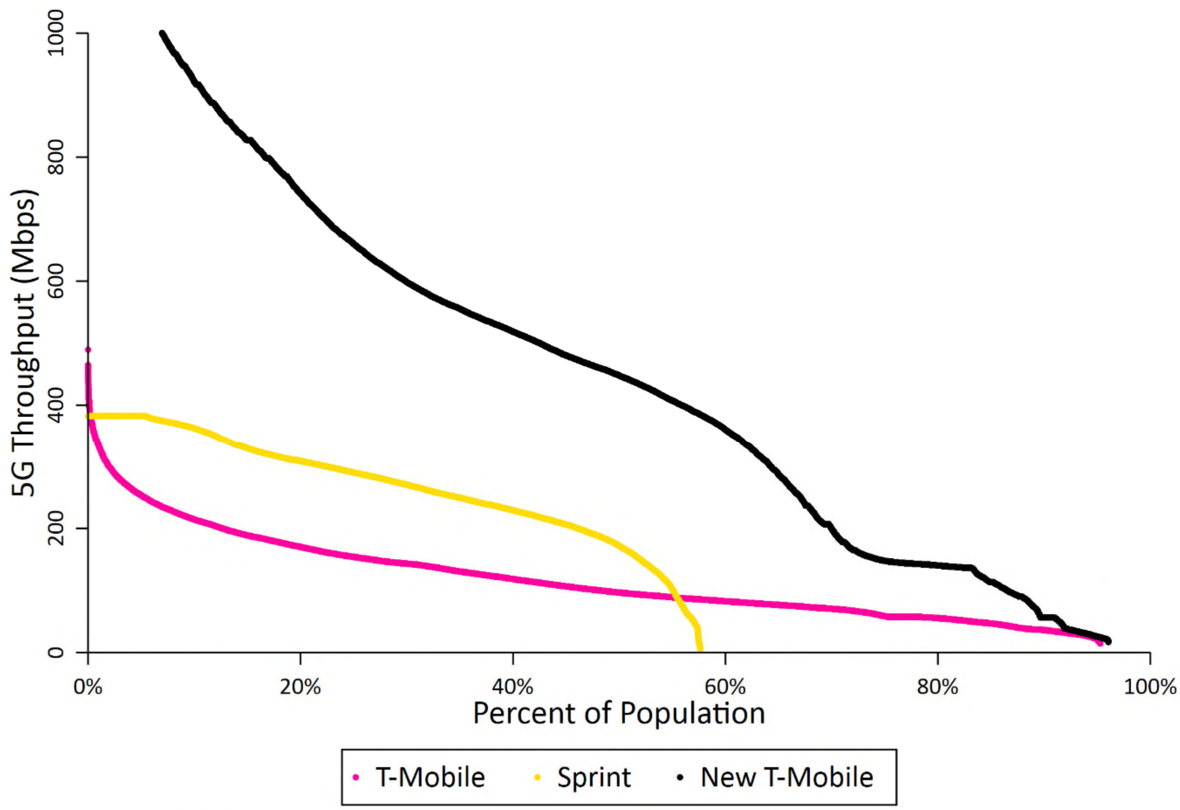
Figure 7: 5G User-Experience Throughput by Covered POPs (2021)



Source: Calculations based on Network Build Model results.

75. Figure 8 demonstrates a similar pattern holds in 2024. Although Sprint projects that it would expand its 5G coverage relative to 2021, its coverage will remain limited relative to New T-Mobile's. Even in 2024, Sprint expects its 5G network to cover at most 60 percent of the population. And New T-Mobile's network continues to dominate the standalone networks on both dimensions, with higher throughput than the standalone networks over a larger set of subscribers the standalone Sprint network.

Figure 8: 5G User-Experience Throughput by Covered POPs (2024)



Source: Calculations based on Network Build Model results.

76. Finally, the fact, discussed above, that Sprint will severely limit the deployment of its 5G network for many years (because the cost of expansion would exceed the benefits to Sprint given its small customer base) has implications beyond just the throughput levels that the Network Engineering Performance Module measures.[84] In particular, the fact that standalone Sprint customers will have to rely on LTE far more often than will New T-Mobile customers deprives the Sprint customers of the full benefit of the lower latency and lower

84 Sprint customers would also have access to roaming services in many areas, but as discussed in Section III.B.2, these services are generally inferior to 5G service and to Sprint's own LTE service.

power requirements for certain devices. Our analysis does not quantify these additional benefits of expanded access to 5G for Sprint's customers; doing so would lead to even greater merger benefits.

(c) Relaxed Usage Restrictions

77. Sprint's and T-Mobile's current subscriber plans impose various restrictions on data usage.[85] In addition, both Sprint and T-Mobile deprioritize data for certain users during periods of congestion.[86] We understand that Sprint and T-Mobile utilize these tools to manage congestion on their networks.[87] In our base-case analysis, we assume that New T-Mobile will utilize these tools to the same degree in order to achieve the same usage levels as would the standalone networks. However, given the significantly lower marginal costs that

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85 For example, the "T-Mobile ONE" plan imposes throughput constraints such as 480p video streaming and mobile hotspot (tethering) data usage at 3G speeds. The "T-Mobile ONE Plus" plan, which costs $10 more per month than the "T-Mobile ONE" plan, offers ten GB of LTE mobile hotspot data usage and unlimited HD streaming. (T-Mobile, "T-Mobile ONE for Phones," ***available at*** https://support.t-mobile.com/docs/DOC-36931, *site visited* September 10, 2018.) Similarly, Sprint's "Unlimited Basic" plan includes a 500 MB allowance for LTE mobile hotspot data usage and streams video at 480p, music at up to 500 kbps, and gaming at up to 2 Mbps. Sprint's "Unlimited Plus" plan, which costs an extra $10 per line, per month, includes a 15 GB allowance for LTE mobile hotspot data usage and streams video at 1080p, music at up to 1.5 Mbps, and gaming at up to 8 Mbps. (Sprint, "Unlimited Plus," ***available at*** https://www.sprint.com/en/shop/plans/unlimited-cell-phone-plan.html, *site visited* September 10, 2018.)

86 See, e.g., Sprint, "Open Internet Information," *available at* https://www.sprint.com/en/legal/open-internet-information.html, *site visited* September 13, 2018; T-Mobile, "Open Internet," ***available at*** https://www.t-mobile.com/responsibility/consumer-info/policies/internet-service, *site visited* September 13, 2018.

87 See, e.g., Sprint, "Open Internet Information," *available at* https://www.sprint.com/en/legal/open-internet-information.html, *site visited* September 13, 2018; T-Mobile, "Open Internet," ***available at*** https://www.t-mobile.com/responsibility/consumer-info/policies/internet-service, *site visited* September 13, 2018.

New T-Mobile is projected to have, economic logic predicts that New T-Mobile would relax usage restraints, which would facilitate greater average data usage by its subscribers than by those of the standalone networks. The relaxation of usage restraints and the additional data consumption per subscriber would constitute service quality improvements that would benefit consumers. In our alternative-case analysis, we assume New T-Mobile will fully relax usage restrictions, and we demonstrate that this would further increase consumer valuation of the proposed merger's projected quality improvements.

78. Both Sprint and T-Mobile have developed traffic forecasts for LTE and 5G devices.[88] T-Mobile's traffic forecast model is based on time use surveys and engineering estimates of throughput for different use cases.[89] Specifically, the model considers the amount of time customers with 5G-capable mobile devices are expected to engage in video streaming, web browsing, augmented reality, virtual reality, gaming, IoT, audio streaming, and social media. It then uses engineering estimates to calculate the network traffic associated with each use case and sums these traffic forecasts to arrive at a total estimate of usage per subscriber per month. These usage estimates can be thought of as estimates of unconstrained demand for data, i.e., the amount of data that mobile broadband subscribers would consume in the absence of usage restrictions.[90] As shown in Figure 9, T-Mobile's estimates of unconstrained

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88 SPR-DOJ-04338918 (IKK Exhibit 8) contains Sprint's traffic forecasts. TMOPA_04641354 contains T-Mobile's traffic forecast model.

89 *Ray Reply Declaration*, ¶¶ 22-24.

90 We understand that this forecast assumes some restrictions on usage of the mobile network for in-home broadband substitution or replacement, without which usage could increase to as much as 400-500 GB/subscriber/month.

mobile broadband 5G usage increase from approximately [redacted] GB/subscriber/month in 2021 to approximately [redacted] GB/subscriber/month in 2024.

Figure 9: Sprint and T-Mobile Data Usage Forecasts

[redacted]

79. Sprint's ordinary course traffic forecasts take a different approach. Rather than estimate usage based on a detailed accounting of expected time use and use cases, Sprint projects usage based on growth relative to current usage based on historical growth rates.[91] This approach implicitly reflects both existing usage restrictions as well as network restrictions. For example, the amount of 5G data that a Sprint user could consume is limited

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[91] SPR-DOJ-04338918, IKK Exhibit 8, p. 5.

by the coverage of Sprint's 5G network. Sprint's forecasts thus differ in a fundamental way from T-Mobile's forecasts. Rather than reflect estimates of unconstrained data demand, they provide an estimate of the amount of data Sprint customers would actually consume given the limitations of the standalone Sprint Network. As shown in Figure 9, Sprint estimates that mobile broadband 5G usage on its standalone network would increase from approximately [redacted] GB/subscriber/month in 2021 to approximately [redacted] GB/subscriber per month in 2024.[92] Reflecting the limitations of Sprint's network, the implicit growth rate of [redacted] percent per year is [redacted] than both the estimates from T-Mobile's traffic forecast model (29.8 percent per year) and those of third parties such as Cisco (30 percent per year) and Ericsson (40 percent per year).[93]

80. The marginal cost curves that we describe in Section IV.A demonstrate that the standalone networks, especially T-Mobile's, would incur high marginal costs per subscriber at the estimated unconstrained usage levels. At an average usage level of [redacted] GB/subscriber/month, the T-Mobile network model predicts that the marginal network cost per subscriber would be more than [redacted]/subscriber/month. It is our understanding that, as a standalone company, T-Mobile would impose certain restrictions on usage in order to mitigate

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92 SPR-DOJ-04338918, IKK Exhibit 8, p. 9.

93 See TMOPA_04641354; Cisco, "VNI Mobile Forecast Highlights, 2016-2021, *available at* https://www.cisco.com/assets/sol/sp/vni/forecast_highlights_mobile/#~Country (Country = United States), *site visited* September 13, 2018; Ericsson, "Ericsson Mobility Report," June 2018, *available at* https://www.ericsson.com/assets/local/mobility-report/documents/2018/ericsson-mobility-report-june-2018.pdf, *site visited* September 13, 2018, at 15 (projecting North American data traffic to increase from 2.5 EB/month in 2017 to 19 EB/month in 2023).

these high costs.[94] Table 6 demonstrates that, in order to satisfy the financial constraints on its ability to deviate from expected network expenditures forecast in its long-range plans (LRPs), T-Mobile would have to constrain usage below levels that would prevail absent those restrictions.[95] In contrast, we understand that New T-Mobile would be able to serve full traffic demand within its financial constraints.[96]

Table 6: Comparison of Unconstrained and Constrained Traffic in the Standalone T-Mobile Network

[redacted]

81. In our alternative scenario in which New T-Mobile relaxes usage restraints, we measure marginal costs and network quality for each network accounting for the different degrees to which different networks are predicted to impose usage limitations (if at all):

- we measure Sprint's marginal costs and network quality at the usage levels in Sprint's ordinary course documents;

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94 *Ewens Reply Declaration*, ¶ 34.

95 *Ewens Reply Declaration*, ¶ 33.

96 *Ewens Reply Declaration*, ¶ 36.

- we measure T-Mobile's marginal costs and network quality at the constrained usage levels described above; and
- we measure New T-Mobile's marginal costs and network quality at the unconstrained usage levels described above.

For this scenario, we account for the value to consumers of relaxing these usage restrictions using the method described in Section VI.C.2 below.

(d) Faster migration to 5G

82. As shown in Table 7 below, New T-Mobile also plans to migrate subscribers to 5G service faster than would the standalone companies.[97] Consumers who would be on LTE in the absence of the merger, but 5G with the merger, will benefits from the increased throughput and other advantages of 5G over LTE discussed above.

Table 7: Standalone vs. New T-Mobile 5G Migration

[redacted]

83. In our baseline scenario, in which we assume New T-Mobile maintains the usage levels of the standalone networks, we also assume that it also maintains the LTE/5G migration paths that the standalone companies would adopt. Doing so allows us to model an all-else-

[97] *Ray Declaration*, ¶ 40 ("Based on past experiences with device penetration, we have estimated that New T-Mobile will be able to drive 5G capable device penetration rates up by 10 percent, year over year (e.g., if standalone T-Mobile would have 50 percent of customers with 5G devices, New T-Mobile would have 55 percent).").

equal case in which New T-Mobile serves exactly the same traffic as would the standalone networks in total, and we ask whether New T-Mobile can do so at sufficiently lower cost and higher quality to make the merger procompetitive. However, in our alternative scenario, in which we account for New T-Mobile's ability to relax usage restrictions given its lower cost 5G network, we also account for its associated ability to accelerate the migration path to 5G.

IV. MARGINAL COST EFFICIENCIES

84. In this section, we analyze both network and non-network marginal cost savings. We focus on the *marginal* cost savings because those are the types of costs recognized by the Commission and federal antitrust agencies[98] as most likely to be passed through to consumers.[99] The specific degree to which marginal cost savings are projected to be passed through to consumers is determined by the Market Equilibrium Model.

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98 *Horizontal Merger Guidelines*, § 10.

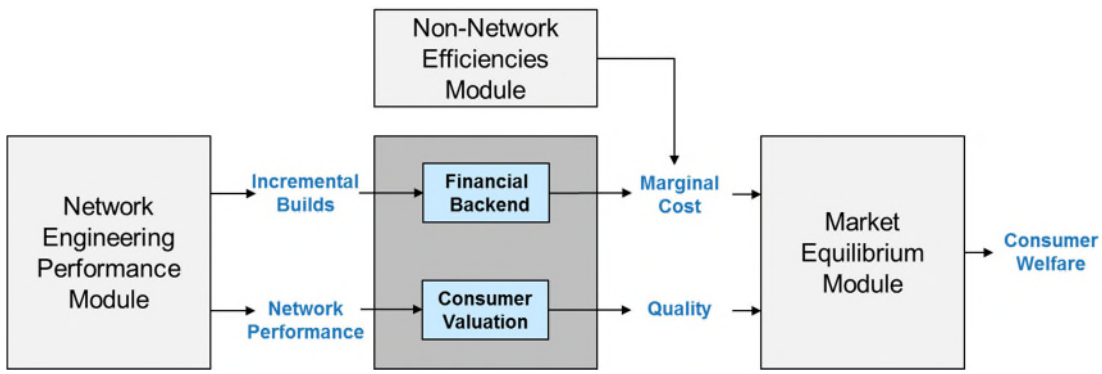
99 It is a well-established principle taught in freshman economics courses that even a monopolist—which New T-Mobile manifestly would not be—has incentives to pass through marginal cost decreases to consumers in whole or in part. (See, e.g., Jeremy I. Bulow and Paul Pfleiderer (1983) "A Note on the Effect of Cost Changes on Prices," *Journal of Political Economy*, **91**(1): 182-85; Paul L. Yde and Michael G. Vita (1996), "Merger Efficiencies: Reconsidering the 'Passing-On' Requirement," *Antitrust Law Journal*, **64**(3): 735-47; Paul Yde and Michael Vita (2006), "Merger Efficiencies: The 'Passing-On' Fallacy," *Antitrust* **20**():59-65, at 62-63; or virtually any microeconomics textbook.) Intuitively, a firm has incentives to pass on portions of marginal cost reductions to consumers in the form of lower prices because doing so generates additional sales that would have been unprofitable at the previous cost level but are now profitable at the new, lower-cost level.

It should also be observed that the conclusion that marginal cost savings will be passed through to consumers is based on the same logic that finds upward pricing pressure from a merger. Under that theory, the upward pricing pressure from a merger is equivalent to that associated with an increase in marginal cost, namely, the "cannibalization cost" associated with sales diverted from the merger partner. (See, e.g., Joseph Farrell and Carl Shapiro (2010), "Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition," *The B.E. Journal of Theoretical Economics*, **10**(1): 1-39.) Hence, any argument that marginal cost changes are not passed-through also logically implies that the upward pricing pressure from the proposed merger will not lead to higher prices.

A. NETWORK MARGINAL COST SAVINGS

85. We first describe how we convert the engineering performance measures into marginal cost measures that we feed into the Market Equilibrium Module, as one piece of our calculation of the merger's effects on consumer welfare. We do so by using a Financial Backend Model that converts incremental capacity builds into marginal costs. Figure 10 illustrates the process, including the quality component that we discuss in more detail below.

Figure 10: Network Economic Performance Module



86. When a network attracts a new subscriber, that subscriber consumes data and places additional load on the network. In order to satisfy network performance criteria, the network operator must deploy additional spectrum and equipment to create incremental capacity to handle the additional load. In the present section, we describe how these incremental deployments translate into the marginal cost of additional subscribers.

87. At a very high level, the structure of our approach is as follows. We first use the Network Engineering Performance Module and a Financial Backend Model to compute the

total incremental costs associated with any given level of traffic.[100] We then trace out a total incremental cost curve from which we derive the marginal cost associated with any given level of traffic, which is expressed as a marginal cost per gigabyte of consumption. Lastly, because mobile broadband service is sold on a subscription basis, we convert the marginal cost per gigabyte into a marginal cost per subscriber, accounting for expected number of gigabytes consumed by each subscriber.

88. As discussed, it is our understanding that 5G services will be the focus of pricing decisions by 2021 and that the overwhelming majority of new customers in 2021 and beyond are likely to be customers with 5G-capable devices.[101] Hence, we model marginal costs associated with incremental traffic generated by customers with 5G-capable devices as the relevant costs for the Parties' pricing decisions. Although we focus on 5G *devices*, we account for the costs that such devices place on both the 5G and LTE *networks* because some traffic from 5G devices may "leak" to LTE networks.

89. Before describing our approach to estimating marginal costs, we note that HBVZ also estimated marginal costs, but their results are inaccurate due to their reliance on poor proxies for the relevant data and their lack of a detailed engineering model.[102]

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[100] These "total costs" refer to costs for builds above and beyond the baseline network, but do not include the cost to build the baseline network itself. We thus refer to them as total incremental costs, rather than simply total costs, because they do not account for the sunk costs of the underlying baseline networks.

[101] See note 81 above and the associated text.

[102] *HBVZ Declaration* at 31-32 and Appendix A.

HBVZ find that, "[o]n a monthly basis, the marginal capital cost portion of the amortized incremental cost of a single subscriber ranges from $1 to $2 across the four MNOs." (*HBVZ*

1. Network Total Incremental Costs

90. We first calculate total incremental network costs by applying a Financial Backend Model to results produced by the Network Build Model. As described in Section III.B.1 above, for any given level of traffic, the Network Build Model determines the solutions beyond the baseline network necessary to satisfy network performance criteria while handling that traffic level. The Financial Backend Model multiplies the unit cost associated with each type of solution (e.g., spectrum overlay or cell split) times the number of incremental solutions of that type and then sums across the different solution types to determine the total incremental costs associated with any given level of traffic.

91. Table 8 below reports the unit costs associated with the different solutions. Each unit cost comprises capital expenditures (capex) and operating expenditures (opex). These unit costs are drawn directly from the Parties' ordinary course cost estimates.[103] We define the cost of a solution per year as the opex plus the levelized annual value of the capex, accounting for the lifetime of the capital and the firm's discount rate.[104] Similar to Sprint's and T-Mobile's ordinary course of business calculations, we amortize capex over the lifespan of the capital investment using Sprint's and T-Mobile's weighted average costs of capital as the

Declaration, n. 42.) In contrast, we estimate the true marginal network costs to be approximately [redacted]/subscriber/month for T-Mobile and [redacted]/subscriber/month for Sprint, of which capex account for approximately half. (See Section IV.A.)

103 Data provided by Sprint and T-Mobile through counsel.

104 We amortize the capex in order to account for the fact that it represents a durable investment in assets that are productive for several years. The amortization allocates the costs of the capex over the useful life of the investment. Both Sprint and T-Mobile perform similar calculations in the ordinary course of business. (See, e.g., TMUS-FCC-00708893.) HBVZ perform a similar calculation. (*HBVZ Declaration,* Appendix A.)

discount rates.[105] For the standalone firms, in order to reflect the pricing incentives they would face absent the merger, we use each firm's ordinary course assumptions. For Sprint, we assume a lifespan of [redacted] years and a discount rate of [redacted] percent.[106] For T-Mobile, we assume a lifespan of [redacted] years and a discount rate of [redacted] percent.[107] For New T-Mobile, we use five years and a discount rate of 8.0 percent.[108]

Table 8: Unit Costs for Network Build Solutions

[redacted]

92. Figure 11 shows the total incremental cost curves for each of the three networks in 2021 as a function of total network traffic.[109] Standalone T-Mobile generally experiences the highest costs, reflecting the fact that its more limited spectrum portfolio will require it to

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105 See, e.g., T-Mobile, Standard Cost Model [tab 'Totals – updated'], TMUS-FCC-02478892; TMUS-FCC-00708893, p. 10.

106 Data provided by Sprint through counsel.

107 Data provided by T-Mobile through counsel.

108 Data provided by T-Mobile through counsel.

109 Note that, similar to our treatment of throughput described in Section III.B.3(a) above, we plot total incremental costs against the sum of standalone 5G-capable device traffic, adjusted for the split of traffic between Sprint and T-Mobile.

expend more to build out its network to handle incremental traffic. In contrast, the standalone Sprint and New T-Mobile cost curves are lower and flatter. For example, at total traffic of [redacted] (equivalent to expected total Sprint and T-Mobile traffic in 2021), T-Mobile's incremental total costs above its baseline plan are [redacted] Sprint's incremental total costs above its baseline plan are [redacted], and New T-Mobile's incremental total costs above its baseline plan are $30 million/month.

Figure 11: Total Incremental Costs (2021)

[redacted]

93. Figure 12 shows the total incremental cost curves for each of the three networks in 2024. These curves are similar to those observed in 2021, although the degree to which Sprint's costs are higher than New-T Mobile's is greater over the relevant range of traffic levels. For example, at total traffic level of [redacted] (equivalent to expected total Sprint

and T-Mobile traffic in 2024), T-Mobile's total incremental costs are [redacted], Sprint's total incremental costs are [redacted], and New T-Mobile's total incremental costs are $60 million/month.

Figure 12: Total Incremental Costs (2024)

[redacted]

2. Network Marginal Costs

94. We use the information regarding the total incremental costs associated with different traffic levels to determine marginal costs per unit of traffic. Specifically, we calculate the marginal cost curve as the increase in total incremental costs for a small increase in

GB/subscriber/month, measured at each point on the curve. For example, the marginal cost (expressed in \$/GB) associated with a one-unit increment (increase) in traffic is:[110, 111]

$$\frac{TotalCost_j - TotalCost_{j-1}}{Traffic_j - Traffic_{j-1}}$$

where j indexes each traffic increment.[112]

95. When interpreting these marginal costs, it is important to recognize that a conventional marginal cost curve measures costs for a given product (i.e., it holds quality constant). In calculating marginal network costs, the model uses T-Mobile's ordinary-course build rules, which do not necessarily hold network quality constant.[113] When the model implements solutions to handle incremental traffic, it generally does not fully match the quality level that prevailed with less traffic and thus quality generally falls as traffic goes up even after solutions have been applied. Ideally, the impact of this declining quality would be counted as part of marginal cost, but implementing such a calculation is intractable. Our approach of ignoring these quality-degradation effects when computing marginal cost tends to understate

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110 In this case, we define a unit to be equal to ten percent of baseline traffic.

111 These costs can be computed for each incremental unit or over multiple traffic increments starting from some baseline traffic number. For clarity, we refer to the former as "marginal costs" and the latter as "average incremental costs." Average incremental costs depend on the assumed baseline traffic estimate because it affects the traffic levels over which incremental costs are estimated. Although T-Mobile estimates incremental costs in both ways in the ordinary course, we understand that it primarily relies on marginal costs estimated [redacted]. (See, e.g., T-Mobile, Standard Cost Model [tab 'Totals – updated'], TMUS-FCC-02478892; TMUS-FCC-00708893, p. 10.)

112 T-Mobile and Sprint perform similar calculation in the ordinary course of business. (See, e.g., TMUS-FCC-00708893, p. 10.)

113 See Section III.A.1 above.

the competitive and consumer benefits of the proposed merger because New T-Mobile has much higher throughput levels than does either of the standalone networks, and the marginal consumer value of incremental throughput generally declines as the level of throughput rises, which means that the marginal decreases in New T-Mobile's throughput have smaller associated dollar values.[114]

96. Because mobile broadband services generally are sold on a monthly subscription basis, the most relevant measure of marginal cost for pricing purposes is the marginal cost *per subscriber per month.* We calculate this marginal cost by multiplying the marginal cost per gigabyte by the average number of gigabytes per month per subscriber.[115] The Network Engineering Performance Module implies that that the merger will generate very substantial efficiencies in the form of lower marginal network costs.

(a) Per-Subscriber Network Marginal Costs if New T-Mobile Maintains Usage Restrictions

97. Figure 13 graphs the marginal network cost per month per subscriber, as a function of the number of subscribers, for each of the three networks in 2021, under the scenario in which New T-Mobile maintains the standalone usage restrictions and LTE/5G device mix. The marginal cost curve for each network is centered around the baseline number of subscribers with 5G-capable devices that the network is projected to serve in this scenario. At [redacted] 5G subscribers using an average of [redacted] (the projected baseline values for standalone T-Mobile), T-Mobile's marginal network costs are approximately

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114 For a comparison of throughput levels, see, e.g., Figure 5 and Figure 6 above. For a discussion of the marginal value of additional throughput, see Section VI.C below.

115 We present estimates of the marginal cost per gigabyte in Part D of Appendix I.

[redacted]. At [redacted] 5G subscribers using an average of [redacted] (the projected baseline values for standalone Sprint), Sprint's marginal network costs are approximately [redacted]. Finally, at [redacted] 5G subscribers (the sum of the projected baseline numbers of Sprint and T-Mobile 5G subscribers), New T-Mobile's marginal network costs range from [redacted] for standalone Sprint subscribers to [redacted] for standalone T-Mobile subscribers.[116]

Figure 13: Marginal Network Cost per Subscriber/Month as a Function of the Number of 5G Subscribers if New T-Mobile Maintains Usage Restrictions (2021)

[redacted]

[116] These values differ because we assume different usage levels for legacy Sprint and T-Mobile subscribers. For expositional simplicity, Figure 13 presents New T-Mobile costs based on a blended usage rate.

98. Figure 14 graphs the marginal network cost per month per subscriber for each of the three networks in 2024 as a function of total traffic (again for the scenario in which New T-Mobile maintains the standalone usage restrictions and LTE/5G mix). At [redacted] 5G subscribers using an average of [redacted] (the expected values for standalone T-Mobile), T-Mobile's marginal network costs are approximately [redacted]. At [redacted] 5G subscribers using an average of [redacted] (the expected values for standalone Sprint), Sprint's marginal network costs are approximately [redacted]. Finally, at 98.8 million 5G subscribers (the sum of Sprint and T-Mobile 5G subscribers), New T-Mobile's marginal network costs range from [redacted] for standalone Sprint subscribers to [redacted] for standalone T-Mobile subscribers.[117]

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[117] For expositional simplicity, Figure 14 presents New T-Mobile costs based on a blended usage rate.

Figure 14: Marginal Network Cost per Subscriber/Month as a Function of the Number of Subscribers if New T-Mobile Maintains Usage Restrictions (2024)

[redacted]

(b) Per-Subscriber Network Marginal Costs if New T-Mobile Relaxes Usage Restrictions

99. As described above, economic logic indicates that New T-Mobile would relax usage restrictions in comparison with the standalone companies. Figure 15 and Figure 16 show the marginal costs per subscriber when New T-Mobile fully removes usage restrictions and implements its accelerated migration to 5G while the standalone companies continue to apply their baseline restrictions and LTE/5G device mix, as described in Section III.B.3(c) above. Figure 15 graphs the marginal network cost per month per subscriber for each of the three

networks in 2021.[118] The costs for standalone Sprint and T-Mobile are the same as described above. Reflecting greater usage, New T-Mobile's costs increase from [redacted] for Sprint subscribers and [redacted] for T-Mobile subscribers to [redacted] for both Sprint and T-Mobile subscribers.[119] Note that, in this case, the New T-Mobile figure is a single value, reflecting the unconstrained usage level, rather than two numbers, one for Sprint's standalone usage and one for T-Mobile's standalone usage.

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118 The Network Build Model is a function of total traffic and results do not depend on whether traffic increases because usage per subscriber increases, holding the number of subscribers constant, or vice versa. In the graphs presented here, we hold the number of subscribers constant at levels projected by Build 8.0 of the financial model.

119 In this case, we assume that all New T-Mobile 5G subscribers use the average of [redacted] predicted by T-Mobile's traffic forecast model.

Figure 15: Marginal Network Cost per Subscriber/Month as a Function of Number of Subscribers if New T-Mobile Relaxes Usage Restrictions (2021)

[redacted]

100. Figure 16 shows the marginal network cost per subscriber per month, in the scenario in which New T-Mobile relaxes usage restrictions, for each of the three networks in 2024. Again, the costs for standalone Sprint and T-Mobile are the same as described above (because the scenario only differs in terms of New T-Mobile's usage restrictions and migration path to 5G). Reflecting greater usage, New T-Mobile's costs increase from [redacted] for Sprint subscribers and [redacted] for T-Mobile subscribers to [redacted] for all subscribers.[120]

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[120] In this case, we assume that all New T-Mobile 5G subscribers use the average of [redacted] predicted by T-Mobile's traffic forecast model.

Figure 16: Marginal Network Cost per Subscriber/Month as a Function of Number of Subscribers if New T-Mobile Relaxes Usage Restrictions (2024)

[redacted]

101. We observe that, if the standalone networks were to attempt to fully relax usage restrictions, then the cost differentials would be even greater, especially in 2024. For example, at [redacted] in 2024, New T-Mobile's marginal network cost would be [redacted]. By contrast, standalone T-Mobile's marginal network costs would be approximately [redacted] while standalone Sprint's marginal network costs would be approximately [redacted]. The fact these costs are so high relative to New T-Mobile's costs provides further evidence of the benefits of combining the networks.

B. NON-NETWORK MARGINAL COST SAVINGS

102. The Parties expect to achieve run-rate non-network cost savings of approximately $2.4 billion per year by 2024.[121] These savings include cost reductions in sales, service and marketing (including retail distribution, advertising, customer care, equipment costs, repair, and logistics) and back office (including information technology, billing and other G&A). Although the majority of these cost saving constitute fixed cost savings, certain savings, including dealer commissions, device purchases, and device repair insurance, vary with the number of customers that New T-Mobile attracts. In total, these variable costs account for approximately one third of the total estimated non-network cost savings. Because these costs vary with the number of subscribers, the combined firm will experience lower marginal costs, which it will have an incentive to pass through to consumers (at least in part) in the form of lower prices.

103. Table 9 summarizes the estimated non-network efficiencies, separately by category (reductions in dealer commissions, device costs, and insurance costs associated with device repair) and in total.[122] The marginal cost savings per postpaid customer ranges from [redacted] per

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[121] Financial Model Build 8.0, TMOPA_08060379_00000001.

[122] New T-Mobile's financial plan estimates that customer care costs will be higher for the merged firm relative to the standalone firms. This cost increase is largely due to the fact that T-Mobile incurs higher customer care costs than does Sprint, in part because T-Mobile relies on more live-handled (versus automated) calls and also uses a higher percentage of on-shore call-center workers (See, "New T-Mobile Business Plan – Detailed Assumptions and Methodology," August 2018, TMUS-FCC-02503297, at 11.) It is our understanding that the New T-Mobile plans to continue with T-Mobile's customer care practices. (*Id.* at 10) Doing so would make sense only if the value to consumers exceeded the incremental costs of providing this improved service. An implication is that the *quality-adjusted* costs will remain constant or decline. To be conservative, we assume no net change in customer care costs due to the merger.

month in 2021 to [redacted] per month in 2024; the marginal cost savings per prepaid customer ranges from [redacted] per month in 2021 to [redacted] per month in 2024.

Table 9: Non-network Marginal Cost Savings ($/subscriber/month)

[redacted]

104. Table 10 presents the dealer commission efficiencies. We understand that these savings arise from the benefits of dealer scale. New T-Mobile will consolidate Sprint and T-Mobile dealer locations, resulting in fewer total locations but higher traffic in each location, thereby allowing dealers to reduce the average cost of serving a customer.[123] The Parties expect to save between [redacted] and [redacted] annually. New T-Mobile will achieve dealer commission on new customers. To calculate average savings per subscriber per month, we divide total cost savings by the projected number of gross additions multiplied by the expected customer lifetime.[124] Savings per subscriber per month range from [redacted] to [redacted].

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123 New T-Mobile will close [redacted] dealer locations, saving monthly commissions of [redacted] per location, for annual savings of approximately [redacted]. In addition, increased traffic at other dealers will increase dealer profitability, allowing new T-Mobile to reduce dealer commission rates by [redacted] percent on the [redacted] of annual commissions, resulting in annual savings of approximately [redacted]. These numbers account for the fact that New T-Mobile plans to open approximately 600 new stores in rural locations with higher-than-average costs.

124 We allocate total savings between the postpaid and prepaid segments using a "%weight" that is determined by the product of the gross adds for each segment (as obtained from T-Mobile's Build 8 Model) and a "Commissions Weight" (as obtained from T-Mobile's financials and

Table 10: Calculation of Dealer Commission Efficiencies

[redacted]

105. Table 11 presents the projected device efficiencies. The Parties expect greater scale will allow them to obtain a [redacted] percent discount on [redacted] of annual purchases of Android devices resulting in savings of approximately [redacted] per year.[125] As do dealer commissions, these savings apply to new customers. To calculate average savings per subscriber per month, we divide total cost savings by the projected number of gross additions multiplied by the expected customer lifetime. Savings per subscriber per month range from [redacted] to [redacted].

Table 11: Calculation of Device Efficiencies

[redacted]

reflecting the fraction of commissions that are paid on postpaid subscribers versus prepaid subscribers).

125 We understand that the Parties do not anticipate similar savings on iPhones.

106. Sprint and T-Mobile offer their customers insurance that covers the costs of device repairs. The Parties project that, by realizing economies of scale, the merger will reduce insurance program costs by [redacted] percent.[126] The resulting savings are projected to be [redacted] in 2021 and result in a marginal cost reduction of [redacted] per month per postpaid subscriber and [redacted] per month per prepaid subscriber.

V. HBVZ'S MARKET EQUILIBRIUM MODELS INDICATE THAT THE PROPOSED MERGER WOULD PROMOTE COMPETITION AND CONSUMER WELFARE BASED ON THE MARGINAL COST SAVINGS ALONE

107. As described in Sections III.B.3 and IV.A above, the proposed merger is projected to raise the quality of the Parties' products while lowering their marginal costs. In this section, we demonstrate that HBVZ's market equilibrium models imply that the proposed merger would be procompetitive once we incorporate the projected marginal cost savings into them. In other words, their models show the proposed merger would promote competition and consumer welfare even if (counterfactually) it did not generate *any* quality improvements.

108. We compute the marginal cost savings separately for HBVZ's two versions of the Industry Performance Module. For each version, we consider two alternative post-merger scenarios (as described briefly in Sections III.B.3(c) and III.B.3(d) above):

- In our baseline scenario, we start from the point at which New T-Mobile serves the sum of the standalone traffic, meaning that it imposes the same usage restrictions as

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126 "New T-Mobile Business Plan – Detailed Assumptions and Methodology," August 2018, TMUS-FCC-02503297, at 14.

would the standalone networks and maintains the same LTE/5G split as they would as well, albeit while offering higher network quality in terms of speed and coverage.

- In our alternative scenario, we start from the point at which New T-Mobile serves the sum of the standalone networks' subscribers, but incurs higher costs on its 5G network both due to relaxed usage restrictions and faster migration of subscribers to 5G-capable devices. In this case, New T-Mobile offers a higher quality product (greater usage and a higher percentage of subscribers on 5G) at a higher cost.

These two scenarios offer alternative views on the degree to which New T-Mobile would pass through merger efficiencies in the form of lower costs versus higher product quality.

109. We consider both scenarios for the sake of completeness. However, as a general matter, New T-Mobile would have an incentive to relax usage restrictions and accelerate migration to 5G (the second scenario) *only* if consumers value the additional product quality by more than the associated cost. Because New T-Mobile will pass much of the resulting increase in economic surplus on to consumers, this means that, whenever the second scenario arise in practice, consumers will be better off than if New T-Mobile had chosen the first scenario. It follows that, if the proposed merger is procompetitive under the first scenario—as we show that it is—then it must also be procompetitive under the second scenario if that is the one chosen by New T-Mobile.[127]

[127] It should be noted that, even if (counterfactually) the merger were not consumer-welfare enhancing under the first scenario, it could still be consumer-welfare enhancing under the second scenario because of the consumer benefits of relaxed usage restrictions and accelerated transition to 5G.

A. HBVZ'S MODELS INDICATE THAT THE MERGER'S MARGINAL COST SAVINGS ALONE WOULD OUTWEIGH ANY ADVERSE UNILATERAL COMPETITIVE EFFECTS IF NEW T-MOBILE MAINTAINS USAGE RESTRICTIONS AND THE LTE/5G MIX

110. Table 12 summarizes the marginal cost savings described in Section IV above under our baseline scenario. These savings range from [redacted] to [redacted].

Table 12: Summary of Marginal Cost Savings:
New T-Mobile Maintains Usage Restrictions and LTE/5G Mix

[redacted]

111. Table 13 compares these marginal cost savings with the total efficiencies (i.e., marginal cost savings and quality improvements) necessary to render the proposed merger competitively neutral under HBVZ's market equilibrium models. Specifically, Table 13 reports the results of subtracting the marginal cost savings stated in Table 12 from the values of the overall efficiency thresholds stated in Table 1. As can be seen from Table 13, the

differences are all negative numbers, which indicates that projected marginal cost savings exceed the efficiencies thresholds.[128] In other words, HBVZ's industry equilibrium models imply that the proposed merger would benefit consumers even if (counterfactually) they did not have to place any value at all on the proposed merger's projected quality improvements—the marginal cost savings alone are sufficient to offset the loss of a competitor.

Table 13: Critical Quality Efficiencies Based on HBVZ's Models: New T-Mobile Maintains Usage Restrictions

[redacted]

B. HBVZ'S MODELS INDICATE THAT THE MERGER'S MARGINAL COST SAVINGS ALONE WOULD OUTWEIGH ANY ADVERSE UNILATERAL COMPETITIVE EFFECTS IF NEW T-MOBILE RELAXED USAGE RESTRICTIONS AND ACCELERATED 5G MIGRATION

112. Table 14 summarizes the marginal cost savings described in Section IV above under the assumption that New T-Mobile serves the sum of the standalone subscribers but does so while allowing its subscribers to consume unconstrained usage levels and accelerates the migration to 5G-capable devices. These marginal cost savings range from

128 Technically, this statement is correct only if the quality effects are non-negative. As discussed in Sections III.B.3 above and VI.C below, the merger is projected to generate substantial quality improvements.

[redacted] to [redacted]. Although these marginal cost savings are lower than the scenario in which we hold usage fixed at the non-merger levels, the change in costs is accompanied by greater quality improvements in the form of relaxed usage restrictions and faster 5G migration. Thus, ignoring the quality improvements is even more conservative in this case.

Table 14: Summary of Marginal Cost Savings:
New T-Mobile Relaxes Usage Restrictions

[redacted]

113. Table 15 reports by how much the proposed merger will have to improve quality to be procompetitive under HBVZ's market equilibrium models.[129] The fact that all the numbers in

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[129] The entries in Table 15 are calculated by subtracting the estimated marginal cost savings reported in Table 14 from the critical efficiencies reported in Table 1.

the table are negative again demonstrates that, using HBVZ's merger simulation, marginal cost savings alone are sufficient to more than offset the loss of a competitor.

Table 15: Critical Quality Efficiencies Based on HBVZ's Models: New T-Mobile Relaxes Usage Restrictions

[redacted]

VI. QUALITY IMPROVEMENTS ARE MORE THAN SUFFICIENT FOR THE MERGER TO INCREASE CONSUMER WELFARE, EVEN APPLYING OUR MORE CONSERVATIVE MARKET EQUILIBRIUM MODEL

114. In the previous section, we showed that the marginal cost savings from the merger are so large that, even without accounting for quality improvements, the merger is procompetitive in all years using HBVZ's market equilibrium models. In the present section, we apply our more conservative model of market equilibrium and reach the same bottom-line conclusion: the merger will promote competition and consumer welfare.

115. More specifically, we show that:

- [redacted] In our baseline specification, in which New T-Mobile maintains the usage restrictions and the LTE/5G mix of the standalone firms, the proposed merger is shown to be procompetitive and consumer-welfare enhancing in 2022-2024 based on marginal cost savings alone (i.e., even without accounting for quality improvements). In 2021, the

merger is shown to be procompetitive and consumer-welfare enhancing in our baseline model as long as consumers value the quality improvements from the merger by [redacted] Even in the most conservative model we run, the merger is procompetitive and consumer-welfare enhancing as long as consumers value the proposed merger's projected quality improvements by [redacted]

- In the alternative specification in which we allow new T-Mobile to relax usage restrictions and enable consumers to switch to 5G faster, the proposed merger is procompetitive and consumer-welfare enhancing in 2022 and 2023 even if (counterfactually) consumers place no value on its quality improvements. In this specification, using our baseline model, the merger is procompetitive and consumer-welfare enhancing if its quality improvements are worth at least [redacted] per month to consumers in 2021 and [redacted] per month in 2024. Even under the most conservative model specification we run, the merger is procompetitive and consumer-welfare enhancing if consumer value the quality improvements by at least [redacted] per subscriber per month in 2021 and at least [redacted] in 2024. And in this case, it is critical to remember that, in addition to faster throughput and the other merger benefits, consumers also benefit from faster migration to 5G and from relaxed usage restrictions. Relaxing the usage restrictions leads to increases in the projected average usage across Sprint and T-Mobile 5G subscribers of roughly [redacted] percent in 2021 and [redacted] percent in 2024. Such large increases in usage seem likely to generate significant consumer value.

- Even conservative estimates of consumer valuation on the network quality improvements created by the merger easily exceed these critical levels. And a variety of more qualitative evidence bolsters the conclusion that consumers place high value on network quality improvements. These results demonstrate that the merger is consumer-welfare enhancing in all the years we evaluate.

116. Before turning to the details of our analysis, we stress that consumers will almost surely value network speed and quality more highly in the future than they do today. As David Evans explained at length in his Declaration, the history of the mobile wireless industry demonstrates that, as wireless speeds increase and the application ecosystem evolves to keep up, consumer demand for faster and better networks increases, meaning that consumer willingness to pay for (and thus benefit from) improved network quality—particularly at the high end of what networks can offer—increases substantially.[130] A critical implication of this fact is that *any attempt to utilize unadjusted estimates of the amounts by which consumers currently value network speed and quality to assess how consumers will value the proposed merger's quality benefits will almost surely understate those benefits.* Because of the difficulties in applying estimates based on current and past data to predict future valuations, we are continuing to explore alternative ways to estimate future valuations of network quality, including increased throughput, relaxed usage constraints, and other dimensions of quality. However, even the conservative approach that we take below finds that the proposed merger will enhance consumer welfare in all scenarios.

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130 *Evans Declaration*, § II.

117. The remainder of this section proceeds as follows. In Part A, we identify the quality thresholds necessary for the merger to be procompetitive under our conservative alternative model. In Part B, we present evidence from a variety of sources indicating that consumers generally place high values on the dimensions of quality that the proposed merger will improve. Lastly, in Part C, we use an article recently published in the academic literature to quantify the value consumers place on higher throughput, and we show that the merger is procompetitive and consumer-welfare enhancing in all years and scenarios, even utilizing this conservative estimate of the value of only some of the merger's quality improvements.

A. QUALITY EFFICIENCY THRESHOLDS BASED ON OUR ALTERNATIVE MARKET EQUILIBRIUM MODEL

118. In this section, we use our alternative market equilibrium model and the marginal cost savings described above to derive quality thresholds for the scenarios in which New T-Mobile does, and does not, maintain the standalone usage restrictions and the LTE/5G device mix.

1. Threshold Consumer Valuations of Quality Improvements if New T-Mobile Maintains Usage Restrictions and the LTE/5G Traffic Mix

119. For the first case, in which New T-Mobile maintains the standalone networks' usage restrictions and LTE/5G traffic mix, Table 16 reports the amount by which quality must rise to make the merger procompetitive given the marginal cost savings reported in Table 12 above. Row 1 demonstrates that, even with the conservative assumptions underlying our industry equilibrium model, marginal costs savings alone are sufficient to offset the loss of a competitor in all years except 2021 (negative numbers in the table indicate that realized marginal cost efficiencies exceed the break-even values). Even in 2021, the quality threshold is only [redacted] in our baseline model, rising to [redacted]

[redacted] in the most conservative specification in which the industry elasticity is assumed to be only -0.1, which increases the diversion ratio to all inside goods.[131] In Parts B and C, below, we present evidence from a variety of sources indicating that consumer valuation of the proposed merger's projected quality improvements will easily exceed these thresholds, even using conservative valuations based on historical data.

Table 16: Alternative Critical Quality Efficiencies; New T-Mobile Maintains Usage Restrictions

[redacted]

2. Threshold Consumer Valuations of Quality Improvements if New T-Mobile Relaxes Usage Restrictions and Accelerates 5G Migration

120. We next turn to the case in which New T-Mobile capitalizes on lower costs and increased 5G capacity by relaxing usage restrictions and accelerating the transition of

[131] As described in Section II.B above, we also consider several robustness checks, which are reported in the remaining rows of Table 16.

subscribers to 5G. In Table 17, we consider how much incremental quality is necessary to make the merger procompetitive given the higher marginal costs for New T-Mobile (but also corresponding higher quality benefits) associated with fully relaxed usage restrictions and thus unconstrained usage levels, as well as faster transition to 5G. Row 1 demonstrates that, for our baseline model, even using more conservative assumptions in the merger simulations, marginal costs savings alone are sufficient to offset the loss of a competitor in 2022-2023. In 2021, all that is required is consumer valuation of quality improvements of at least [redacted]; in 2024, all that is required is consumer valuation of quality improvements of at least [redacted].[132] Even using the most conservative specification (industry elasticity of -0.1), average consumer valuation of increased quality of at least [redacted] in 2021 and [redacted] in 2024 is sufficient. As noted above, in this case, these valuations cover all the sources of valuation in the first case, plus the likely substantial benefits of relaxed usage constraints, as well as faster 5G transition. In Sections VI.B and VI.C below, we present evidence from a variety of sources indicating that consumer valuation of the quality improvements from the merger will easily exceed these thresholds.

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132 As described in Section II.B above, we also consider several robustness checks, which are reported in the remaining rows of Table 17.

Table 17: Alternative Critical Quality Efficiencies; New T-Mobile Relaxes Usage Restrictions

[redacted]

121. As also described above, the more valuable are the quality improvements for the consumers of one firm, the lower is the threshold for quality improvements enjoyed by consumers of the other firm. As one illustration of this, Figure 17 illustrates the tradeoff in quality-valuation thresholds for our baseline model in 2024, using the case in which the merged firm fully relaxes usage constraints and accelerates the transition to 5G. Consistent with the table, a valuation of [redacted] for the customers of each firm is sufficient, but so is a valuation of [redacted] for T-Mobile subscribers with none for Sprint subscribers (covering a case in which subscribers who do not value quality choose Sprint) and a valuation of [redacted] for Sprint subscribers and none for T-Mobile subscribers. We will use figures of this form again below to show that the merger is procompetitive and welfare enhancing in all years and even in our most conservative specifications.

Figure 17: Frontier of Critical Quality Improvements if New T-Mobile Relaxes Usage Restrictions (2024)

[redacted]

B. EVIDENCE FROM A VARIETY OF SOURCES INDICATES THAT CONSUMERS PLACE SUBSTANTIAL VALUE ON MULTIPLE DIMENSIONS OF NETWORK QUALITY

122. In this part, we present evidence from a variety of sources that consumers place high value on the types of quality improvements that will be generated by the merger. Then, in Part C, we provide a conservative quantification of the consumer valuation of the specific quality improvements from the merger. Together, this evidence demonstrates that consumer valuations of the projected quality improvements generated by the merger will easily exceed critical values in those years/specifications in which our, more conservative (than HBVZ), market equilibrium model needs more than just marginal cost savings to yield positive

consumer welfare effects. And we stress again that all of this evidence is drawn from current and historical data, before the application ecosystem has evolved to make full use of higher speeds, and thus it provides only conservative measures of the consumer benefits created by the merger-induced improvements in network quality.

1. Evidence from Consumer Surveys

123. Consumer surveys conducted in the ordinary course of business by both Sprint and T-Mobile reveal high consumer valuation of quality improvements of the general type associated with the merger. Both Sprint and T-Mobile conduct surveys of new and deactivating customers to discern information about what aspects of service quality are important to them. Although these surveys do not allow one to estimate a precise dollar value of specific dimensions of network quality, they demonstrate that consumers place substantial value on network quality.

124. Table 18 summarizes the responses given by Sprint customers regarding the reasons for dropping their service. For Sprint consumers who deactivate voluntarily, network quality is cited as the reason by [redacted] percent.[133] Indeed, network quality is given as a reason for departure more frequently than the cost of monthly service or poor customer service. These results reveal substantial room to enhance the welfare of Sprint customers via improvements in network quality and reveal that such improvements might be more important to consumers than modest changes in the level of their monthly bill.

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[133] SPR-FCC-01292280, p. 4.

Table 18: Primary Reason for Deactivation of Service Among Sprint Subscribers

[redacted]

125. Similarly, among T-Mobile postpaid customers who deactivated in Q1 2018, [redacted] percent cited coverage as a major reason for deactivation, and monthly plan cost is cited as a major reason for deactivation by only [redacted] percent of respondents.[134] And in a survey of new T-Mobile customers experiencing one or more issues with T-Mobile, the two most common issues were "coverage or reception problems" ([redacted] percent) and "data speed / performance issues" ([redacted] percent).[135] Further, T-Mobile acknowledged that "coverage remains a leading pain point and a driver of dissatisfaction among our new customers" and "poor network

134 T-Mobile, Postpaid Deactivation Tracker Q1 '18 Results, April 2018, TMOPA_07187966_00000001, p. 5.

135 T-Mobile, New Customer Research – Brand, Consumer and Market Insights, April 2018, TMUS-FCC-01887354, p. 25.

satisfaction cannot be easily overcome by T-Mobile benefits, features and price/value."[136] Again, these results reveal scope for substantial welfare enhancement via network quality improvements and that such improvements might be more important to consumers than modest changes in the level of their monthly bill

126. More generally in the industry, many customers also cite network quality as an important factor in their initial carrier decision. In a 2014 McKinsey & Company survey, customers were asked to choose the three most important factors in their carrier selection. Four of the five most frequently chosen options were aspects of network quality.[137]

127. Academic research, as well as studies conducted by or for the Parties, further bolster the conclusion that consumers' product choices respond to network quality, which demonstrates that they value it. For example, Sprint, working with the third-party consulting firm Delta Partners, has developed a comprehensive measure of network quality: Quality of Experience (QoE). QoE measures each subscriber's individual mobile wireless experience based on her use of the network. Delta Partners' research finds that Sprint customers with below-average QoE churn away from Sprint at substantially higher rates—as much as [redacted] percent in some areas—relative to consumers with above-average QoE.[138] Sprint customers also respond to changes in QoE: Customers experiencing deteriorating QoE are [redacted]

136 T-Mobile, New Customer Research – Brand, Consumer and Market Insights, April 2018, TMUS-FCC-01887354, p. 17.

137 "Everywhere, all the time, really fast: The importance of network quality" (December 2015) McKinsey & Company (McKinsey_Everywhere, all the time, really fast_ …pdf).

138 Delta Partners, "Managing Network Quality of Experience (QOE) from a Commercial Perspective," September 20, 2017, IKK Exhibit 3, at 28.

percent more likely to churn than customers experiencing improving QoE.[139] Several academic studies have also shown that network quality is an important determinant of customer satisfaction and choice of broadband and telephony service in a wide variety of contexts.[140] The fact that customers make choices based on network quality reveals that they place significant value on it.

128. In accordance with the importance consumers place on quality, carriers focus their marketing campaigns around various measures of network quality.[141] Along with traditional marketing and advertising, carriers produce press releases touting good performance in recent network quality reports.[142]

129. Ordinary course evidence reveals that it is not just postpaid customers who place high value on network quality; prepaid customers do as well. Sprint recently conducted a survey to

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139 Delta Partners, "Managing Network Quality of Experience (QOE) from a Commercial Perspective," September 20, 2017, IKK Exhibit 3, at 30.

140 See, e.g., Teresa Garín-Muñoz, Covadonga Gijón, Teodosio Pérez-Amara, and Rafael López (2013),"Customer Satisfactin of Mobile-Internet-Users: An Empirical Approximation for the Case of Spain," *Journal of Reviews of Global Economics*, **2**(): 442-454; Takanori Idaa, Shin Kinoshita, and Masayuki Sato (2008), "Conjoint analysis of demand for IP telephony: the case of Japan," *Applied Economics*, **40**(): 1279-1287; Ingy Shafei and Hazem Tabaa (2016), "Factors affecting customer loyalty for mobile telecommunication industry," *EuroMed Journal of Business*, **11**(3): 347-361.

141 Twentieth Report, *In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, WT Docket No. 17-69, rel. September 27, 2017 (hereinafter, *20th Annual Report*), ¶ 66.

142 See, for example, Verizon News Release, "RootMetrics ranks Verizon's network #1 in the nation for a record ninth time in a row," February 7, 2018, *available at* https://www.verizon.com/about/news/rootmetrics-ranks-verizons-network-1-nation-record-ninth-time-row, *site visited* September 10, 2108; T-Mobile News Release, "Customers Have Spoken: T-Mobile's Network is Tops – AGAIN," January 21, 2018, *available at* https://www.t-mobile.com/news/opensignal-2018, *site visited* September 10, 2018.

examine the tradeoffs made by current prepaid customers when choosing a carrier. This survey explicitly asked customers about the importance of various factors in choosing a prepaid plan. Coverage "in places you go most" was rated as very important by [redacted] percent of customers, second only to price ([redacted] percent).[143] The carrier's overall reputation for network coverage was also chosen by [redacted] percent of respondents as a very important factor. This value of quality is consistent with trends in usage patterns observed by Sprint and T-Mobile: On average, prepaid customers use approximately the same amount of data per subscriber as postpaid customers, likely because prepaid customers are more likely to use mobile broadband as a substitute for wired broadband—a use case that places a premium on network quality.[144]

2. Evidence from Network Operators' Pricing Decisions

130. The fact that mobile wireless network operators charge substantially higher prices for higher quality plans further confirms that many consumers place high value on network quality today. This follows because network operators' pricing decisions reflect their estimates of consumers' valuation of product quality: the more highly consumers value a dimension of network quality, the more firms will optimally charge for that dimension of quality. Hence, although firms' pricing decisions alone cannot be used to determine consumer willingness to pay for specific aspects of product quality, they do provide useful

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143 Sprint, Prepaid Brand Conjoint Research, IKK Exhibit 4, at 31.

144 SPR-DOJ-04338918, IKK Exhibit 8; T-Mobile Response to FCC Information Request 32.

guidance regarding what network operators believe customers will pay for greater network quality.

131. Although network plans are complex and multidimensional, we can still learn from the prices of plans that differ on certain quality dimensions but are otherwise similar.[145] To this end, Table 19 compares prices and attributes across several postpaid plans offered by Sprint, T-Mobile, Verizon, and AT&T. We observe that:

- The "T-Mobile ONE" plan imposes throughput constraints such as 480p video streaming (supporting SD) and mobile hotspot (tethering) data usage at 3G speeds.[146] In contrast, the "T-Mobile ONE Plus" plan offers ten GB of LTE mobile hotspot data usage for tethering and unlimited HD streaming (effectively meaning greater video throughput) for an extra $10-$15 per line.[147]

- Similarly, Sprint's "Unlimited Basic" plan includes a 500 MB allowance for LTE mobile hotspot data usage and streams video at 480p, music at up to 500 kbps, and gaming at up to 2 Mbps.[148] In contrast, Sprint's "Unlimited Plus" plan includes a 15

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145 T-Mobile internal documents describe the various features of prepaid and postpaid plans offered by mobile carriers, but a summary of plans focuses on a subset of plan characteristics, the amount of data, the number of lines, and the speed of video streaming. ("Pricing and Propositions, T-Mobile and Competitive View, Cheat Sheet," July 2017, TMUS-FCC-01094091.)

146 T-Mobile, "T-Mobile ONE™ for Phones," *available at* https://support.t-mobile.com/docs/DOC-36931, *site visited* September 10, 2018.

147 T-Mobile, "T-Mobile ONE™ for Phones," *available at* https://support.t-mobile.com/docs/DOC-36931, *site visited* September 10, 2018.

148 Sprint, "Unlimited Plus," *available at* https://www.sprint.com/en/shop/plans/unlimited-cell-phone-plan.html, *site visited* September 10, 2018.

GB allowance for LTE mobile hotspot data usage and streams video at 1080p (HD), music at up to 1.5 Mbps, and gaming at up to 8 Mbps, for an extra $10 per-line.[149]

- AT&T and Verizon also charge between $8 and $15 more per line for similar improvements, including greater mobile hotspot tethering usage limits and HD video throughput.

Table 19: Plan Prices and Attributes

Carrier	Plan Name	Key Features	Per Line Price 1 Line	2 Lines	3 Lines	4 Lines
AT&T	Unlimited & More	SD Video	$70	$63	$48	$40
	Unlimited & More Premium	HD Video; 15 GB LTE Hotspot	$80	$75	$57	$48
Sprint	Unlimited Basic	SD Video	$60	$50	$40	$35
	Unlimited Plus	HD Video; 15 GB LTE Hotspot	$70	$60	$50	$45
T-Mobile	ONE	SD Video	$70	$60	$47	$35
	ONE PLUS	HD Video; 20GB of LTE Hotspot	$85	$70	$57	$45
Verizon	Go Unlimited	SD Video	$75	$65	$50	$40
	Beyond Unlimited	HD Video; 15 GB LTE Hotspot	$85	$80	$60	$50

Source: TMUS-FCC-01014607; company websites

132. In sum, although there are other differences between each pair of plans offered by a carrier,[150] the price differences are roughly $10 per line when moving from a plan with throughput only sufficient to allow SD streaming (and limited tethering) to one with throughput that allows HD streaming (and greater tethering). Because there are other feature differences between the plans and because not all consumers take the more expensive plans, one cannot say that the valuation of the higher throughput and relaxed usage (tethering)

149 Sprint, "Unlimited Plus," *available at* https://www.sprint.com/en/shop/plans/unlimited-cell-phone-plan.html, *site visited* September 10, 2018.

150 By comparing prices within each carrier's plans, we hold constant differences across carriers, such as network breadth, that may affect prices.

restrictions is $10, but these variations do show that network operators view many customers as placing considerable value on these quality improvements.

C. CONSUMER VALUATION OF INCREASED THROUGHPUT AND RELAXED USAGE RESTRICTIONS

133. To develop one quantitative estimate of the quality benefits of the proposed merger, we turn to estimates of the valuations of increased throughput and relaxed usage restrictions in the academic literature.[151] Most relevant for present purposes is a paper by former DOJ Deputy Assistant Attorney General for Economic Analysis Aviv Nevo and coauthors, who analyze, among other questions, customers' willingness to pay (WTP) for increased throughput.[152]

134. Before turning to the specifics of our quantification, we note that the quantification of valuations of quality improvements developed from *Nevo et al.* is likely quite conservative for at least three reasons. First, *Nevo et al.*'s results are based on data from 2012 and, thus, likely do not capture the continuing increase in consumer valuation of higher network speeds even as of today, let alone for 2021-2024. This problem is partially ameliorated by the fact that the paper analyzed wired broadband networks, which have much higher levels of speed and per-subscriber usage than do mobile wireless networks today. As a result, valuations based on

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151 Beyond the specific article on which we rely for our quantification, we note that the academic papers that have studied the topic have generally found high consumer valuation on various aspects of network quality, including throughput, coverage, and usage limits. (See, e.g., Yu-Sin Liu, Jeffrey Prince, and Scott Wallsten (2018), "Distinguishing Bandwidth and Latency in Households' Willingness-to-Pay for Broadband Internet Speed," unpublished manuscript; Kyle Wilson (2018), "Does Public Competition Crowd Out Private Investment? Evidence from Municipal Provision of Internet Access," unpublished manuscript.)

152 Aviv Nevo, John L. Turner, and Jonathan W. Williams (2016), "Usage-Based Pricing and Demand for Residential Broadband," *Econometrica*, **84**(2): 411-443 (hereinafter, *Nevo et al.*).

wireline networks may capture some of the increased benefits on speed on future wireless networks. But given that *Nevo et al.*'s findings are based on data that are now several years old, and given the huge increases in network performance associated with 5G, these estimates are still likely to underestimate the valuation that consumers in future years, with a more developed application ecosystem, will place on the proposed merger's throughput increases.

135. Second, our approach does not fully capture the benefits that the merger will generate for subscribers with 5G-capable devices. For example, the quantification does not account for the fact that Sprint customers will have broader geographic access to other benefits of 5G, such as lower latency and better device power performance. Nor does our quantification account for improvements in signal strength or reductions in time spent roaming by Sprint customers in particular.

136. Third, our quantification focuses primarily on consumer valuation of throughput, rather than valuation of other quality improvements, such as relaxed usage restrictions. As noted above, the size of the usage increases in our alternative scenario that allows for relaxed usage restrictions by New T-Mobile are very large. For example, usage is nearly [redacted] for New T-Mobile as for the standalone firms in 2024. We are continuing to investigate ways to use the estimates in *Nevo et al.* or other approaches to value the relaxation of usage restrictions. Here, we simply note that, given the extent to which the standalone firms are projected to constrain usage below the projected unconstrained levels, consumers' valuations of relaxing these restrictions are likely to be large.

1. Consumer Valuations of Quality Improvements if New T-Mobile Maintains Standalone Usage Restrictions and LTE/5G Traffic Mix

137. As described above, our baseline scenario compares a case in which New T-Mobile does not relax the usage restrictions imposed by the standalone firms or change the mix of LTE/5G traffic relative to the standalone firms. To compute consumer valuation on increased throughput in this case, we first compute the weighted average throughput for each sector—weighting the 5G and LTE throughputs by the traffic on each sector—for each of the standalone networks and new T-Mobile. We then use the *Nevo et al.* results to determine the consumer valuation of this weighted average throughput at each sector.[153] We weight the resulting sector-level valuations up to the network level by using the sector traffic levels as weights. Finally, we compute consumer valuation of the merger-induced improvements in network quality by taking the difference between the valuation of the New T-Mobile network and that of each standalone network.

138. As a first approach to determining the relevant consumer valuations, we apply the quality-valuation parameters from *Nevo et al.* with no adjustments for likely differences

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153 In running the model from *Nevo et al.*, we assume consumers do not face explicit usage constraints. This approach simplifies the model substantially by removing the dynamic aspect of the usage decision, which means that the consumer's expected optimal usage and expected valuation are characterized by closed-form expressions. In the unadjusted runs, we select the most common consumer type from *Nevo et al.* for each parameter, as described in the article's supplemental appendix on page 11, and compute the valuations using the closed form solution. In the adjusted runs, we start from these most common consumer types, but we then re-calibrate the model so that the usage predicted by the model matches that in the Network Build Model for the New T-Mobile network. We do so by finding the value of μ, the main parameter governing the consumer's average value of content, such that the *Nevo et al.* model predicts expected monthly usage on the New T-Mobile network equal to that in the Network Build Model. For example, our calibrated values of μ for the case where New T-Mobile relaxes usage restrictions are [redacted] in 2021, [redacted] in 2022, [redacted] in 2023, and [redacted] in 2024. The increasing values reflect increasing usage over time. Additional details can be found in our backup materials.

between mobile broadband consumers in 2021-2024 and the consumers in *Nevo et al.*'s sample (clearly a highly conservative approach). The results are presented in Table 20. As can be seen from the bottom two rows of the table, this method yields valuations per subscriber per month that are well over [redacted] for T-Mobile subscribers in every year, and over [redacted] for Sprint subscribers in every year but 2021— when the value is [redacted] per sub-per month.

Table 20: Valuation of Throughput Improvements:
No Usage or Mix Change, Unadjusted *Nevo et al.* Estimates

[redacted]

139. Using our baseline model, these valuations for consumers of both firms are well above the threshold quality levels (reported in Table 17 above) for all years and all model specifications, which indicates that the proposed merger is procompetitive and consumer-welfare enhancing.

140. Shifting all the way to the most conservative case—which has a quality valuation threshold of [redacted] per subscriber per month in 2021, but negative thresholds in 2022-2024—the T-Mobile quality valuation is far above the threshold, while the Sprint quality valuation is slightly below it. For this extreme case in 2021, we plot the critical quality

frontier, showing all combinations of T-Mobile and Sprint valuations that imply the proposed merger is procompetitive and consumer-welfare enhancing. As seen in Figure 18, the actual consumer valuations implied by the unadjusted *Nevo et al.* values are well above the critical quality frontier, implying that the merger is procompetitive even in this most conservative case.

Figure 18: Unadjusted *Nevo et al.* WTP Compared to Critical Quality Frontier: No Usage or Mix Change (2021)

[redacted]

141. As a second approach to using *Nevo et al.* to determine the relevant consumer valuations, we do a version of the calculation that adjusts for the fact that the throughput and usage levels in our data are different from those in *Nevo et al.* In particular:

- Before applying the *Nevo et al.* valuations, we rescale the throughputs observed in our data so that the weighted average throughput experienced by standalone T-Mobile and Sprint customers in our data match the mean throughput in *Nevo et al.* This rescaling is equivalent to interpreting the *Nevo et al.* quality valuations as capturing the value placed on percentage improvements relative to the mean, rather than absolute throughput improvements. For example, if the average throughput is 25 Mbps for one set of consumers at one point in time and 50 Mbps for another set of consumers at another point in time, then our assumption is that the value of doubling throughput from 25 Mbps to 50 Mbps in the first case has the same value as doubling throughput from 50 Mbps to 100 Mbps in the second case.

- We change the parameter in the *Nevo et al.* model that determines data usage per subscriber per month so that the data usage implied by the model matches the usage in our simulation analysis (the constrained usage for both the standalone firms and New T-Mobile in this scenario). We allow this parameter to differ for T-Mobile and Sprint so that we match the projected usage for each brand.[154]

142. The results for this case are presented in Table 21. Starting in 2022, this method yields valuations over [redacted] per subscriber per month and growing for Sprint customers and over [redacted] for T-Mobile customers. In 2021, when the average throughput gaps between the

[154] We must specify a throughput level to do this calibration. We use throughput at the combined firm, which yields slightly lower valuations than if we were to use throughputs at the standalone firms.

networks are smaller, valuations are somewhat lower: [redacted] for T-Mobile customers and [redacted] for Sprint customers.

Table 21: Valuation of Throughput Improvements:
No Usage or Mix Change, Adjusted *Nevo et al.* Estimates

[redacted]

143. Once again, using our baseline model, these valuations *for consumers of both firms* are well above the threshold quality levels for all years and all model specifications (most of which are negative), meaning that the average consumer valuation of quality improvements must be above the critical threshold, and thus the merger is procompetitive and welfare enhancing.

144. Shifting all the way to the most conservative case—which has a quality valuation threshold of [redacted] per subscriber per month in 2021, but negative thresholds in 2022-2024—the T-Mobile quality valuations are far above the relevant thresholds, while the Sprint quality valuation is below the threshold in 2021. Once again, we plot the critical quality

frontier for this extreme case in 2021, showing all combination of T-Mobile and Sprint valuations that mean the merger is procompetitive and consumer-welfare enhancing. As seen in Figure 19, the consumer valuations implied by the adjusted *Nevo et al.* values are far above the critical quality frontier, implying that the merger is procompetitive even in this most conservative case.

Figure 19: Adjusted *Nevo et al.* WTP Compared to Critical Quality Frontier: No Usage or Mix Change (2021)

[redacted]

2. Consumer Valuations of Quality Improvements if New T-Mobile Relaxes Usage Restrictions and Accelerates Migration to 5G

145. We next consider an alternative scenario in which New T-Mobile uses its reduced 5G network costs and expanded 5G capacity as a way to relax the usage restrictions and

accelerate customer migration from LTE to 5G. In this case, marginal cost savings are slightly lower (because New T-Mobile has to incur greater costs to serve the additional traffic on its 5G network triggered by relaxing usage restrictions and accelerating user migration), so the critical network valuations are slightly higher, as shown above. However, the quality improvements are larger: They incorporate not just throughput improvements but also relaxed usage restrictions and greater numbers of consumers enjoying the benefits of 5G, which together likely generate substantial consumer valuation, as explained above.

146. First, consider the throughput increases. We again apply the two methods (unadjusted and adjusted *Nevo et al.* estimates) described above. Applying the unadjusted *Nevo et al.* results yields the results in Table 22. The valuations in this case are generally slightly higher than those in the first scenario, shown above.

Table 22: Valuation of Throughput Improvements:
Increased Usage and Accelerated Migration, Unadjusted *Nevo et al.* Estimates

[redacted]

147. Next consider the adjusted version of *Nevo et al.* In this case, our adjustment of the average throughput level to match that in *Nevo et al.*'s data stays the same as described for our base scenario, above. However, we adjust *Nevo et al.*'s usage parameter to match the

unconstrained usage level (rather than the constrained level) in each year for each standalone network.[155] This allows for the fact that the higher usage levels in this case allow consumers to enjoy New T-Mobile's increased throughput over a greater amount of data usage. Table 23 shows the results. Not surprisingly, the valuations go up significantly relative to the unadjusted case, due to the benefit of increased throughput over a greater amount of usage. By 2024, for example, consumer valuation of the throughput improvements is more than [redacted] per subscriber per month for T-Mobile subscribers, and more than [redacted] per subscriber per month for Sprint subscribers.

Table 23: Valuation of Throughput Improvements:
Increased Usage and Accelerated Migration, Adjusted *Nevo et al.* Estimates

[redacted]

155 As before, we do this calibration at the throughput of the combined firm, which yields lower valuations than if we were to calibrate this value at the throughput of the standalone firms.

148. Notably, for both the unadjusted and adjusted *Nevo et al.* results in this scenario, the value of increased throughput for customers of both firms is greater than the critical value for all years, even for the most conservative version of our model. This means that the average value of the increased throughput is necessarily greater than the critical level for all years for all model specifications.

149. In summary, in this expanded usage/faster-migration-to-5G case, the proposed merger is necessarily procompetitive and consumer-welfare enhancing even before considering the value on the increased usage (other than indirectly through its effect on the value of higher throughput) or the value of faster migration to 5G. And this result follows even though the valuation of those unaccounted-for dimensions of quality improvement are likely to be substantial. Table 24 below shows the projected usage levels in the restricted-usage case (matching the standalone firms) and the expanded-usage case. The increases in usage are substantial. For example, for the two years in which any quality improvements are ever required for the merger to be procompetitive—2021 and 2024—the average usage increases are roughly [redacted] percent and [redacted] percent, respectively. If consumers would pay even [redacted] percent more for those substantial usage increases, the additional value would be more than [redacted], pushing the quality improvement that much farther beyond the critical threshold.[156] Notably, the total monthly cost of this alternative case (in levelized capex and opex) is less than [redacted] per subscriber in all years, making it highly likely that New T-Mobile will pursue this case with its large consumer benefits.

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[156] As noted above, we continue to work on developing quantitative estimates of the value on this expanded usage.

Table 24: Usage by Network and Year

[redacted]

150. In sum, once one accounts for the proposed merger's projected quality improvements, it is clearly procompetitive and consumer-welfare enhancing in all years and for all specifications of our market equilibrium model. In 2022 and 2023, the merger's projected marginal cost savings alone are enough to render the merger procompetitive. In 2021 and 2024, only small quality improvements are required in addition to the marginal cost savings to render the merger procompetitive, and, in some model specifications, the marginal cost savings alone are sufficient for the merger to be procompetitive. Consumers' valuation of the merger's projected quality improvements will easily surpass the quality thresholds even when failing to account for some important dimensions of quality improvements. Moreover, these results hold even using estimates for quality based on historical data, which very likely substantially understate the benefits consumers will realize from improved network quality over this time period.

151. Finally, our findings on the relative qualities of the standalone and New T-Mobile networks demonstrate that substantial consumer benefits from the merger are likely to persist, or even grow, in the years after 2024. Several factors support this conclusion:

- The gap between the usage per subscriber that the standalone firms can support—based on projections of standalone usage trends by Sprint and projections based on financial constraints by T-Mobile—and the unconstrained consumer demand for usage

is increasing over time, as seen in Table 24. In 2021, the unconstrained demand is projected to be roughly [redacted] percent of the constrained usage served by the standalone firms; by 2024 the unconstrained demand is projected to be roughly double the constrained usage served by the standalone firms. And even as the unconstrained demand grows dramatically from 2022-2024, the usage that standalone T-Mobile can support—given its financial constraints—is roughly flat. In contrast, as explained above, New T-Mobile can support the unconstrained usage within its financial constraints and doing so would likely generate large consumer benefits.

- Even in the scenario in which New T-Mobile serves the unconstrained usage per subscriber, while the standalone networks fall further behind, the relative throughput gap between New T-Mobile and the standalone firms grows from 2021 to 2024. As seen in Table 22, in the scenario in which New T-Mobile relaxes usage constraints, the relative throughput of the combined network goes from [redacted]-times standalone T-Mobile in 2021 to [redacted]-times standalone T-Mobile in 2024, and from [redacted]times standalone Sprint in 2021 to [redacted]-times standalone Sprint in 2024. These comparisons provide further evidence that the gap between the networks will grow over the time period we have studied.

- The Sprint 5G coverage gap relative to new T-Mobile is also very unlikely to go away given the fact, explained above, that standalone Sprint cannot profitably invest in closing the coverage gap given its current scale.

- Finally, as explained above, consumer valuation of these elements of network quality will surely increase over time, as the application ecosystem expands to make fuller use of the capabilities of 5G networks.

In sum, the combination of persistent large gaps in permitted usage, network throughput, and coverage, coupled with growing consumer valuation of network quality, implies persistent, or even growing, consumer benefits from the network enhancements created by the merger.

VII. CONCLUSION

152. In this declaration, we have applied a rigorous analytical framework that uses standard merger-analytic economic tools to assess the effects of the proposed merger from 2021 onward, accounting both for the loss of Sprint as an independent network operator and for the marginal cost savings and network quality improvements projected by the Parties' business plans and Network Build Model. This analysis clearly demonstrates that the projected combination of lower marginal costs and higher network quality would prevent any adverse unilateral competitive effects. In short, the merger will strengthen competition and benefit consumers.

APPENDIX I: TECHNICAL APPENDIX

A. Formal Description of the Market Equilibrium Model

153. As described in Section II.A, we use a nested logit model to model consumer demand for wireless products. Formally, we assume that are J wireless products together with an outside good on the market that can be assigned to G exhaustive and mutually exclusive nests. In this model, consumer i who chooses wireless product j in nest g receives the following indirect utility

$$u_{ij} = \delta_j - \alpha p_j + \left(\zeta_{ig} + (1 - \sigma_g)\epsilon_{ij}\right)$$

where

- δ_j is the product-specific quality parameter that captures non-price attributes of wireless product j;
- α is the price-sensitive parameter that measures consumers' marginal utility of income and how strongly consumers react to changes in price of wireless product j, p_j;
- σ_g is a nesting parameter that measure the degree of substitutability between wireless products within nest g; and
- ϵ_{ij} is an extreme value random variable, and for consumer i, the variable ζ_{ig} is common to all products in nest g and has a distribution function that depends on σ_g, with $0 \leq \sigma_g < 1$. Collectively, the term $\zeta_{ig} + (1 - \sigma_g)\epsilon_{ij}$ is the "error-term" in the model that characterizes the idiosyncratic taste of each consumer.

We assign the $J + 1$ products into the following five nests: (i) postpaid brands controlled by T-Mobile and Sprint; (ii) postpaid brands controlled by all other operators; (iii) prepaid brands

controlled by mobile network operators (MNOs); (iv) prepaid brands controlled by MVNOs; and (v) an outside good.

154. We assume that there is a nesting parameter σ_1 that is common for the two postpaid nests and that there is another nesting parameter σ_2 that is common for the two prepaid nests. Without loss of generality, we can normalize the product-specific quality parameter and the nesting parameter for the outside good to be 0. Under these assumptions, the nested logit demand model can be fully characterized by the $J + 3$ parameters $(\delta_1, \delta_2, \dots, \delta_J, \alpha, \sigma_1, \sigma_2)$, and the market share of wireless product j in nest g can be expressed as

$$s_j(p) = \frac{\exp\left(\frac{\delta_j - \alpha p_j}{1 - \sigma_g}\right)\left(\sum_{k \in g} \exp\left(\frac{\delta_k - \alpha p_k}{1 - \sigma_g}\right)\right)^{-\sigma_g}}{\sum_{g'=0}^{G}\left(\sum_{l \in g'} \exp\left(\frac{\delta_l - \alpha p_l}{1 - \sigma_{g'}}\right)\right)^{1-\sigma_{g'}}}$$

155. Similar to HBVZ, we use a differentiated Bertrand model to analyze carriers' pricing decisions. Unlike HBVZ, however, our model explicitly allows for upstream wholesale pricing incentive to affect downstream retail pricing decisions. Specifically, we assume that the expected profit of carrier f takes the following form

$$\pi_f(p) = \sum_{j \in J_f} (p_j - c_j) s_j(p) + \sum_{l \in L_f} M_l^U s_l(p)$$

where

- J_f is the set of downstream retail wireless products controlled by carrier f;
- L_f is the set of downstream retail MVNO products (if any) operating on carrier f's network;
- c_j is the downstream marginal cost to serve an additional subscriber of product j; and

- M_l^U is the upstream wholesale markup that carrier f receives on each subscriber of MVNO product l.

156. Given the prices set by other carriers and its upstream wholesale margin, carrier f chooses a price p_j for each $j \in J_f$ to maximize its expected profit. The optimal price p_j must satisfy the following profit maximizing first-order necessary condition:

$$\frac{\partial \pi_f(p)}{\partial p_j} = s_j(p) + \sum_{k \in J_f} (p_k - c_k) \frac{\partial s_k(p)}{\partial p_j} + \sum_{l \in L_f} M_l^U \frac{\partial s_l(p)}{\partial p_j} = 0$$

The Nash equilibrium of this model is a vector of prices $p = (p_1, p_2, \dots, p_J)$ such that the above first-order condition is satisfied for each of the J products. This system of J equations can be written in matrix notation as

$$s(p) + H \cdot (p - c) + F \cdot M^U = 0$$

where H is a $J \times J$ matrix whose ij^{th} component is equal to $\partial s_j(p)/\partial p_i$ if both product i and product j are controlled by the same carrier and it is equal to 0 otherwise, and F is a $J \times J$ matrix whose ij^{th} component is equal to $\partial s_j(p)/\partial p_i$ if product j is an MVNO product operating on the network of the carrier that controls product i and it is equal to 0 otherwise.

157. The parameters of the market equilibrium model are calibrated as follows:

- The J product-specific quality parameters $(\delta_1, \delta_2, \dots, \delta_J)$ are chosen such that the model predicted market shares match the observed market shares;

- The price sensitive parameter α is chosen such that the predicted average margin across all Sprint and T-Mobile products matches their average margin observed in the data;

- The postpaid nesting parameter σ_1 and the prepaid nesting parameter σ_2 are chosen such that the predicted average diversion ratio between Sprint postpaid and T-Mobile postpaid products and the predicted average diversion ratio between Sprint prepaid and T-Mobile prepaid products match the corresponding average diversion ratios observed in the data;[157]
- Finally, the share of the outside good is chosen such that the predicted industry elasticity of demand matches our assumed values of industry elasticity (see Section II.A.1 for a discussion of industry elasticities).

158. Once these parameters are calibrated, the market equilibrium model provides an analytical mapping between the observed prices and shares and the unknown marginal costs c = $(c_1, c_2, \ldots, c_J)$. To see this, note that the system of equations characterizing the equilibrium can be rearranged as

$$c = p - H^{-1} \cdot (s(p) + F \cdot M^U)$$

and we use this expression to recover the downstream marginal costs that are consistent with observed data and the market equilibrium model.

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157 We compute the diversion ratio from Sprint postpaid to T-Mobile postpaid as the fraction of all Sprint postpaid subscribers diverted to any T-Mobile postpaid product as a result of an increase in the prices of all Sprint postpaid products by the same percentage. That is, let A be the set of Sprint postpaid products and let B be the set of T-Mobile postpaid products. The diversion ratio from Sprint postpaid to T-Mobile postpaid is calculated as

$$Div_{AB} = -\frac{\sum_{j\in B}\sum_{k\in A}\frac{\partial}{\partial p_k}\left(\frac{s_j}{1-s_0}\right)}{\sum_{j\in A}\sum_{k\in A}\frac{\partial}{\partial p_k}\left(\frac{s_j}{1-s_0}\right)} = -\frac{\sum_{j\in B}\sum_{k\in A}\left(\frac{\partial s_j}{\partial p_k}\right)+\sum_{j\in B}\sum_{k\in A}\frac{s_j}{1-s_0}\left(\frac{\partial s_0}{\partial p_k}\right)}{\sum_{j\in A}\sum_{k\in A}\left(\frac{\partial s_j}{\partial p_k}\right)+\sum_{j\in A}\sum_{k\in A}\frac{s_j}{1-s_0}\left(\frac{\partial s_0}{\partial p_k}\right)}.$$

The diversion ratio in the other direction, as well as the diversion ratios for prepaid products, are calculated similarly.

B. Formal Description of Our Treatment of MVNO Pricing Incentives

159. We rely on KPMG StreamShare data to obtain estimates of current MVNO subscriber counts.[158] KPMG StreamShare data provide estimates of subscriber counts for TracFone and for an agglomeration of MVNOs that purchase wholesale network service from Sprint that is collectively referred to as "Sprint Resellers" in the data. We model TracFone as a multi-product firm that controls three distinct retail products that are dependent on the wholesale network services provided by AT&T, Verizon, and T-Mobile, respectively.[159] We divide the subscribers of TracFone based on a T-Mobile document estimating the relative shares of traffic on the three networks: [redacted] percent to Verizon, [redacted] percent to AT&T, and [redacted] percent to T-Mobile.[160] We model Sprint Resellers as a single firm and conservatively assume that Sprint Resellers do not have an option to substitute away from Sprint in the event that Sprint raises its wholesale price post-merger.

160. Our alternative Market Equilibrium Model integrates our analyses of horizontal and vertical pricing incentives in three ways. First, as discussed in Section II.A.1 above and Part

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158 KPMG Streamshare Data, IKK Exhibit 5.

159 These are modeled as wholly owned TracFone products and are only associated with the MNOs through their wholesale agreements.

In the data, we refer to these products as AT&T TracFone, Verizon TracFone, and T-Mobile TracFone. In practice, TracFone maintains several consumer brands that largely correspond to the network on which they run. For example, we understand that Straight Talk and Total Wireless run mainly on the Verizon network; Net 10 runs mainly on the AT&T network; and GoSmart, Walmart Family Mobile, and Simple Mobile run exclusively on the T-Mobile network. (T-Mobile, "TracFone Payload Contribution," May 30, 2018, TMOPA_02814121_00000001; *HBVZ Declaration* §VII.A.)

160 T-Mobile, "TracFone Payload Contribution," May 30, 2018, TMOPA_02814121_00000001.

A of Appendix I below, MNOs internalize their wholesale margins when setting their retail prices: an MNO realizes that when raising its retail price, some of the departing subscribers will divert to an MVNO served by its network and the MNO will capture the associated wholesale margin. Second, we correct for several technical errors that HBVZ made in their vGUPPI calculations and implement the vGUPPI calculations for T-Mobile TracFone and Sprint Resellers using inputs that are consistent with our alternative Market Equilibrium Model.[161] We then apply a pass-through rate to the calculated vertical upward pricing pressure (vUPP), and increase the marginal costs of the affected MVNOs post-merger by the resulting amount. Third, our model allows MNOs to pass through a share of the merger-specific network marginal cost savings, which is a function of the strength of competition that they face. Unlike HBVZ, our model recognizes that network marginal cost efficiencies will put downward pressure on wholesale prices.

161. To compute the vGUPPIu, we first calibrate our alternative Market Equilibrium Model in the absence of the merger. Each of the components of the vGUPPIu is an input into the model, or can be directly inferred from the calibrated model. We define the vGUPPIu, under the assumption of no input substitution, as:[162]

$$vGUPPIu \text{ without input substitution} = DR_{UD} \times M_D \times P_D \,/\, W_R$$

Using T-Mobile TracFone as an example, DR_{UD} is the diversion ratio from T-Mobile TracFone to Sprint controlled products and wholesale partners, M_D is the percentage margin

161 See Section II.A.1 of this Declaration.

162 *See* Serge Moresi & Steven C. Salop (2013) "vGUPPI: Scoring Unilateral Pricing Incentives in Vertical Mergers," *Antitrust Law Journal*, **79**(1): 185-214.

Sprint makes on each of those products, and P_D is the price Sprint charges per subscriber of each of those products. Thus, $DR_{UD} \times M_D \times P_D$ is the value of sales diverted to Sprint from T-Mobile TracFone. Because Sprint is a multi-product firm, we compute this value as the sum of diverted profit margins across all—both retail and wholesale—Sprint products. The last term, W_R, is the wholesale input price T-Mobile charges TracFone. We repeat this calculation for Sprint Resellers with respect to profit margin recapture among T-Mobile retail and wholesale products.

162. Following HBVZ, we also calculate a version of vGUPPIu that allows for input substitution by TracFone (as noted above, we conservatively assume that Sprint Resellers do not have the option to substitute away from Sprint). In response to an increase in the T-Mobile wholesale price, TracFone can adjust retail prices to shift consumers away from the T-Mobile network and toward the AT&T and Verizon networks, which affects the extent of vertical upward pricing pressure. This version of vGUPPIu is defined as:

$$vGUPPIu \text{ with input substitution} = \frac{vGUPPIu \text{ without input substitution}}{1 + M_R \times E_{SR} \,/\, E_P}$$

where M_R is T-Mobile TracFone's retail margin, E_{SR} is the percentage change in T-Mobile TracFone's share of total TracFone subscribers in response to a percentage change in the wholesale price, and E_P is the percentage change in T-Mobile TracFone's retail price in response to a percentage change in the wholesale price. The T-Mobile TracFone retail margin can be inferred directly from the calibrated model. We estimate E_{SR} and E_P in our model by artificially increasing the input price to T-Mobile TracFone, simulate the new equilibrium,

and then compare the product shares and retail prices in the new equilibrium to those observed in the data.

163. In the alternative merger simulation model, we assume the vUPP implied by the vGUPPI is passed through to the MVNO at some rate ([redacted] percent in our baseline case). We also model the effect of merger efficiencies on the pricing incentives of MVNOs and MNOs. If the merger causes network marginal costs to fall, the MNOs will have an incentive to pass through some share of those marginal cost savings to MVNOs via lower wholesale prices. The network model implies reductions in network marginal cost savings per GB, which we multiply by the standalone usage rate per subscriber for each of the affected MVNOs to get a per-subscriber wholesale marginal cost reduction. We assume this efficiency is passed through at the same rate as the vGUPPI.

164. The MVNO's marginal cost increases by the vUPP less efficiencies, times the pass-through rate. On net, the MVNO's marginal cost may increase or decrease. Therefore, the merger may put upward or downward pressure on MVNO retail prices, which we explicitly model. At the same time, the MNO's wholesale dollar margin increases by the vUPP times the pass-through rate, plus the wholesale marginal cost efficiency multiplied by one minus the pass-through rate. This makes an MVNO subscriber on the MNO's network more valuable to the MNO, creating an incentive for the MNO to raise its retail prices post-merger. These various wholesale and retail pricing incentives are explicitly accounted for in the alternative merger simulation model, and the net effect on consumers is computed in the post-merger equilibrium.

C. MERGER SIMULATION CALIBRATION DATA

165. Calibrating the key parameter of the Market Equilibrium Model requires the following key data points:

- Pre-merger shares
- Pre-merger prices
- Pre-merger margins
- Diversion ratios
- Industry elasticities.

As described further below, we calibrate the model using projected future values of these parameters drawn from the Parties' ordinary course documents and business plans.

166. By using projections of the post-integration shares and margins to calibrate our model, our merger analysis compares the predicted industry equilibrium for a world in which the merger is consummated with the predicted equilibrium in a world in which the merger does not occur. This approach allows us to incorporate the industry's views about expected future industry trends, thus ensuring the model is consistent with the views that the Parties and other industry participants hold about the non-merger baseline in future years.

1. Shares and Prices

167. Table 25 reports shares and prices for each mobile wireless brand that we model. We derive these values from the Parties' ordinary course standalone business plans. Specifically, we derive these values using the information contained in Build 8.0 of the Parties transaction

model.[163] This model incorporates information from the Parties ordinary course standalone business plans and other competitive analysis.[164] It therefore reflects the best estimates of what the industry would look like in future years in the absence of the merger.

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163 It is our understanding that Build 8.0 reflects the Board-approved plan, while Build 9.0 explores additional revenue opportunities. For the variables for which we rely on the financial model, Builds 8.0 and 9.0 are identical. We therefore cite to Build 8.0 throughout this declaration.

164 To compute these shares, we use the estimated present and future subscriber counts contained in the Build 8.0 model for the Parties' own brands and those in the T-Mobile Competitive Intelligence database (TMUS-DOJ-00045329) for brands owned by AT&T, Verizon, and US Cellular. We also rely on KPMG StreamShare data to obtain estimates of present MVNO subscriber counts. (See IKK Exhibit 5 in our backup materials.) We apply the projected industry growth rates in Build 8.0 to the present total subscriber base to estimate the growth of the total subscriber base, which then allows us to impute future subscriber counts for brands for which we do not have estimates.

Table 25: Shares and ARPU[165]

[redacted]

168. We use average revenue per user (ARPU) as a proxy for price in the model. Although ARPU is not literally the price that any specific user pays, it represents the revenue that mobile wireless plans derive from selling services to customers. Moreover, the Parties use

165 We include Virgin in the Sprint Prepaid category and Cricket in the AT&T Prepaid category. We also note that we generally use lower shares for MVNOs than do HBVZ, which makes our analysis conservative on that dimension. Specifically, HBVZ assume that there are 43 million MVNO subscribers in 2017. (*HBVZ Declaration*, Table 13.) By contrast, the data we use to calculate shares reports 33 million MVNO subscribers in 2018 and 30 million in 2021. (See backup materials for details.) These share estimates may understate future competition from cable providers.

ARPU in their CLV models (described further in Part C.2 of Appendix I) from which we calculate margins, as we describe in the next section. Thus, the model uses consistent assumptions about price and margin.[166]

169. As Table 25 shows, the Parties expect ARPU to be [redacted] over the next several years.[167] These projections reflect a continuation of recent industry experience. For example, Figure 20 demonstrates that while postpaid ARPU has [redacted] in recent years, this is largely a function of [redacted]. ABPU, which accounts for both subscription and device costs has been [redacted] Similarly, prepaid ARPU has been [redacted] over the past few years.

166 ARPU does not include revenues associated with leasing devices. We understand that the Parties do not earn substantial profits on device leasing. For example, the Parties lose money when leasing iPhones. As such, revenues and costs associated with device leasing are treated as a net cost in calculating margins. If one were to include device leasing revenue into the relevant price, e.g., by using average billings per user (ABPU), one would also need to make corresponding changes to the relevant margin calculations.

167 We use the projected ARPUs contained in Build 8.0 for the Parties' own brands and those in the T-Mobile Competitive Intelligence database (TMUS-DOJ-00045329) for brands owned by AT&T, Verizon, and US Cellular. We use the ARPU reported in América Móvil's 2018Q2 financial report for TracFone and other MVNOs (América Móvil News Release, "América Móvil's second quarter of 2018 financial and operating report," July 17, 2018, *available at* http://www.americamovil.com/sites/default/files/2018-07/2q18-report.pdf, *site visited* September 10, 2018).

Figure 20: ARPU and ABPU (2014-2022)

[redacted]

170. Figure 21 shows the trends in shares. The Parties' ordinary course documents project continuing increases in T-Mobile's shares. They also predict modest increases in Sprint's share. Our merger simulation model accounts for these projections by calibrating the model in each year to the relevant values for the year.

Figure 21: Share of Subscribers (2015-2024)

[redacted]

2. Margins

171. To compute margins, we use each Party's ordinary course of business customer lifetime value (CLV) model.[168] These models calculate the net present value of each customer accounting for the expected lifetime of the subscriber, the revenue over that lifetime, and

[168] T-Mobile, Unit Economics, May 2018, TMOPA_04647889_00000002; SPR-FCC-01965935; IKK Exhibit 6; Sprint FCC Information Request, Response 31 – Exhibit 21; Sprint FCC Information Request Response 31 – Exhibit 18.

incremental costs over that lifetime.[169] Incremental costs include customer acquisition and upgrade costs, non-network recurring costs that include customer care and billing costs, and incremental network costs.[170]

172. To calculate margins for use in the merger simulation model, we adjust each Party's CLV model, which is based on current data, to incorporate predicted future revenue, non-network costs, network costs, and churn. Specifically, we use future projected ARPU, non-network costs, acquisition and upgrades costs, and churn drawn from Build 8.0 of the financial model.[171] In addition, we use the standalone marginal network costs per subscriber derived from the network model that we describe in more detail in Section IV.A. Table 26 reports the CLV margins for each Sprint and T-Mobile brand for 2021 through 2024.

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169 We follow the Parties' ordinary course practice of assuming a customer lifetime equal to [redacted] months. Consistent with Build 8.0, we assume that T-Mobile's weighted average cost of capital (WACC) is [redacted] percent and Sprint's WACC is [redacted] percent.

170 CLV is equal to the net present value of recurring monthly margin minus incremental network cost minus subscriber acquisition and upgrade costs. The present value of the recurring monthly margin is equal to monthly ARPU minus monthly non-network recurring costs multiplied by the discounted present value of customer lifetime.

171 Financial Model Build 8.0, TMOPA_08060379_00000001.

We adjust these ARPU estimates to account for the fact that the ARPU in the financial model is averaged over all subscribers, while the ARPU in the CLV model is averaged over gross adds.

Table 26: CLV Margins (2021-2024)

[redacted]

3. Diversion Ratios

173. Diversion ratios are a common measure of the extent of direct competition between merging firms. A diversion ratio measures the fraction of the total unit sales that Firm A loses when it raises its price or lowers its product quality that divert (i.e., switch) to Firm B. In previous mobile telecom merger reviews, the Commission estimated diversion ratios using porting data; porting data tracks all users who port their numbers when switching from one mobile network operator to another. Although the Commission has used porting data to estimate diversion ratios, it recognizes that there are several potential problems with this approach.[172]

[172] For a discussion of potential issues with the use of porting data to estimate diversion ratios, see *AT&T/T-Mobile Commission Staff Report*, Appendix C, ¶¶ 9-10.

For other examples of the use of porting data to review wireless telecom mergers, see Memorandum Opinion and Order and Declaratory Ruling, *In the Matter of Applications of Deutsche Telekom AG, T-Mobile USA, Inc., and MetroPCS Communications, Inc. for Consent to Transfer of Control of Licenses and Authorizations*, WT Docket No. 12-301, rel. March 12, 2013, n. 115; Memorandum Opinion and Order, *In the Matter of Applications of Cricket*

174. First, diversion ratios theoretically capture customer switching in response to changes in price or quality, but porting customers may switch for other reasons and the data do not contain any indication of the reason for a switch. It is widely recognized by antitrust practitioners that porting data will provide biased estimates of diversion ratios when switching behavior (which carrier the customer switches to) is different depending on the reason for the switch.[173] However, we find that porting rates following pricing promotions by Sprint and T-Mobile (which should be influenced by price changes) generally are similar to the porting rates immediately before the promotions (which are not influenced by price changes).[174] This finding supports the conclusion that diversion ratios based on porting data are not systematically biased as a result of the reasons for porting.[175]

175. A second problem with using porting data to infer diversion ratios is that not all customers port their numbers when switching mobile network operators, and those who do port may not be representative of all switchers. We show below that this latter fact is present in the Local Number Portability ("LNP") porting data, which causes those data to overstate switching rates between Sprint and T-Mobile. Consequently, any merger analysis based on LNP porting data will overestimate the competitive effect of the merger.

License Company, LLC, et al., Leap Wireless International, Inc., and AT&T Inc. for Consent To Transfer Control of Authorizations Application of Cricket License Company, LLC and Leap Licenseco Inc. for Consent to Assignment of Authorization, WT Docket No. 13-193, ¶ 70.

173 See, e.g., Yongmin Chen and Marius Schwartz (2016), "Churn vs. Diversion: An Illustrative Model," *Economica*, **83**(332): 564-583.

174 We provide details of this analysis in our backup materials.

175 Commission Staff came to a similar conclusion when analyzing the proposed merger between AT&T and T-Mobile. (*AT&T/T-Mobile Commission Staff Report*, ¶ 55, n. 160.)

176. We show that the LNP porting data are unreliable for purposes of computing diversion ratios in several ways. First, LNP porting data account for only a small percentage of total gross additions and deactivations. In the second half of 2017, the LNP data report [redacted] port-ins and port-outs, which is just [redacted] percent of the [redacted] total gross additions and deactivations in the same time period.[176] Second, the LNP porting systematically overstate Sprint and T-Mobile switches relative to total gross additions and deactivations. Table 27 below shows that, although Sprint accounts for [redacted] of gross adds and [redacted] percent of switch-ins in the Harris survey data that T-Mobile uses internally, Sprint accounts for [redacted] percent of port-ins in the LNP data. Similarly, T-Mobile accounts for [redacted] of port-ins in the LNP data ([redacted] percent) than its share of gross adds ([redacted] percent) or switch-ins in the Harris survey data ([redacted] percent).[177]

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176 T-Mobile, Industry GA estimates based on carrier financials. See our backup materials for details.

177 With respect to the comparison of gross deactivations and port-outs, Sprint's share of deactivations is [redacted] percent while its share of port-outs is [redacted] percent and T-Mobile's share of deactivations is [redacted] percent while its share of port-outs is [redacted] percent.

Table 27: Comparison of Gross Adds, Switch-Ins, and Port-Ins

[redacted]

177. Finally, Sprint and T-Mobile offer incentives to customers to port their numbers when switching to the firms' prepaid brands, while MVNOs such as TracFone do not offer such incentives.[178] Porting data, which only capture the switchers who port their numbers, thus likely over-represent diversion between Sprint and T-Mobile. In particular, TracFone, which accounts for approximately 31 percent of prepaid subscribers and runs primarily on AT&T's and Verizon's networks, is likely under-represented in the LNP data because it does not offer incentives to subscribers to port their numbers while switching to TracFone.[179] Because the

178 T-Mobile, 2017 May Cheat Sheet, TMUS-DOJ-01053322; TMUS-FCC-01014607.

179 T-Mobile estimates that approximately [redacted] percent of TracFone traffic runs on AT&T's and Verizon's networks with the remainder on the T-Mobile network. (T-Mobile, "TracFone Payload Contribution," May 30, 2018, TMOPA_02814121_00000001.)

LNP data attribute MVNO ports to the facilities-based carriers, porting activity for AT&T and Verizon is under-represented in these data relative to the activity for Sprint and T-Mobile causing diversion rates between Sprint and T-Mobile based on LNP data to be overestimated.

178. Table 28 below compares porting-based estimates of diversion ratios to several alternative methods for assessing diversion ratios, including:

- Assuming diversion is proportional to either the average of the share of gross additions and gross deactivations or the share of subscribers.[180]
- Estimating diversion ratios from survey data and reflecting the average of switch-in and switch-out rates.[181]

We find that porting-based diversion ratios between Sprint and T-Mobile are substantially larger than those derived from share and survey data. Generally, diversion ratios assumed to be proportional to average of the shares of gross activations and gross deactivations are similar in magnitude to diversion ratios derived from the survey data, while diversion ratios proportional to shares of subscribers are lowest among all sources. T-Mobile relies on the survey data for gaining insights into the overall switching patterns in the industry.[182]

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180 Under the assumption that diversion is proportional to shares, the diversion ration from product A to product B is: $Div_{AB} = \frac{S_B}{1-S_A}$.

181 We use two sources of survey data: (a) Sprint Brand IQ survey, which contains questions identifying previous, current, and future carriers for respondents, and (b) Harris Mobile Insights survey, which contains questions identifying previous and current carrier for recent switchers. (Sprint, Brand IQ survey, IKK Exhibit 7; Harris Mobile Insights survey, TMUS-DOJ-00001173.)

182 See, for example, T-Mobile's Q1 2018 Switchers Summary Report, which relies on data from Harris Mobile Insights survey to show the origin and destination of T-Mobile's gross addition and deactivations. (T-Mobile's Q1 2018 Switchers Summary Report, TMOPA_04879063_00000001.)

Table 28: Diversion Ratio Estimates

[redacted]

4. Industry Elasticity

179. An important dimension of substitution is subscribers entering or leaving the marketplace.[183] This margin of substitution can be captured through the industry elasticity. The industry elasticity measures the percentage change in total industry output given a one percent change in every firm's price. Higher industry elasticity implies lower diversion ratios between firms. With a relatively high industry elasticity, a price decrease by a single firm will cause some subscribers to switch from rival firms, but it will also cause some subscribers

[183] Although wireless penetration already exceeds 100 percent, ordinary course documents project continuing increases in the wireless penetration rate (defined as total wireless subscribers divided by total U.S. population). For example, T-Mobile documents project the wireless penetration rate to increase from [redacted] percent in 2018 to [redacted] percent in 2022. (TMUS-DOJ-00045329 ['IndustrySummary'].) Although this increase alone is not sufficient to calibrate an industry elasticity, it does demonstrate that substitution with the outside good is a relevant dimension of substitution.

to consume more of the product (data services in this case).[184] In our analysis, we consider a range of industry elasticities that are consistent with those estimated in the empirical academic literature as well as those used by the Commission in prior reviews of wireless mergers.

180. There is a large empirical literature in economics that has estimated industry elasticities for the wireless services in the U.S. and other countries. Estimates of industry elasticities for the U.S. range from -0.3 to -1.8.[185] In its review of the AT&T/T-Mobile merger, the Commission used an elasticity range of 0.0 (no substitution to the outside good) to -0.51 for its economic modeling.[186, 187] As described further in Section II.A.2, we use an

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184 See, for example, Serge Moresi and Hans Zenger (2017), "Aggregate Diversion and Market Elasticity," unpublished manuscript (hereinafter, *Moresi and Zenger*).

185 Caves obtains 2SLS and 3SLS estimates of elasticities between -1.6 and -1.8. (Kevin Caves (2011), "Quantifying Price-driven Wireless Substitution in Telephony," *Telecommunications Policy*, 35(11): 984-998, Table 2 and Table 3.) Hausman derives estimates of industry elasticity between -0.95 and -1.05. (Jerry Hausman (2011), "Consumer Benefits of Low Intercarrier Compensation Rates," Attachment 4 to Letter from Robert W. Quinn, Jr., AT&T, et al., to Marlene H. Dortch, Federal Communications Commission, *In the Matter of Connect America Fund*, WC Docket No. 10-90, filed July 29, 2011, at 12.) Ingraham and Sidak obtain a 2SLS estimate of -1.3. (Allan Ingraham and Gregory Sidak (2004), "Do States Tax Wireless Services Inefficiently? Evidence on the Price Elasticity of Demand," *Virginia Tax Review* 24(2): 249-261, Table 5.) Rodini, et al. estimate industry elasticities between -0.39 and -0.6. (Mark Rodini, Michael Ward, and Glenn Woroch (2003), "Going Mobile: Substitutability between Fixed and Mobile Access," *Telecommunications Policy*, 27(5-6): 457-476, Table 4.)

186 Commission Staff referenced the Rodini, Ward, and Woroch (2003) article in support of its range of –0.36 to –0.51 for industry elasticity. (*AT&T/T-Mobile Commission Staff Report*, Appendix C at C-7.)

187 *Moresi and Zenger* derive a relationship between industry elasticity and aggregate diversion ratio. For the case of symmetric aggregate diversions (*i.e.*, each firm losing the same proportion of sales to the outside good), the relationship is: *Aggregate Diversion Ratio = 1 – average industry margin × industry elasticity*. Assuming average margin of 50 percent and an industry elasticity of -0.36 (-0.51), implies an aggregate diversion ratio of 82 percent (75 percent).

industry elasticity of -0.3 in our baseline merger simulations. As a robustness check, we also consider industry elasticities of -0.1 and -0.5.

D. NETWORK MARGINAL COSTS PER GIGABYTE OF TRAFFIC

181. Figure 22 below shows the marginal cost curves for each of the three networks in 2021.[188] The ranking for marginal costs matches that for incremental total costs, with standalone T-Mobile the highest, Sprint substantially lower, and new T-Mobile near zero. For example, at [redacted] (the expected combined usage of the standalone networks), T-Mobile's marginal network costs are approximately [redacted], Sprint's marginal network costs are approximately [redacted], and New T-Mobile's marginal network costs are approximately [redacted].

188 Network capacity is added in discrete increments. This lumpiness results in cost curves that are extremely non-linear and non-monotonic at low levels of traffic but more regular at relevant levels. Because these extreme non-linearities occur at traffic levels well below projected levels, they do not affect the analysis.

Figure 22: Marginal Costs per GB (2021)

[redacted]

182. Figure 23 below shows the marginal cost curves for each of the three networks in 2024. Again, the two standalone networks have higher marginal costs than does New-Mobile's network. The ranking of the three networks remains the same: At [redacted] (the expected combined usage of the standalone networks), T-Mobile's marginal network costs are approximately [redacted] Sprint's marginal network costs are approximately [redacted], and New T-Mobile's marginal network costs are approximately [redacted].

Figure 23: Marginal Costs per GB (2024)

[redacted]

APPENDIX II: QUALIFICATIONS

A. MARK ISRAEL

183. My name is Mark A. Israel. I am a Senior Managing Director at Compass Lexecon, an economic consulting firm where I have worked since 2006. From 2000 to 2006, I served as a full-time member of the faculty at Kellogg School of Management, Northwestern University. I received my Ph.D. in economics from Stanford University in 2001.

184. I specialize in the economics of industrial organization—which is the study of competition in imperfectly competitive markets, including the study of antitrust and regulatory issues—as well as applied econometrics. At Kellogg and Stanford, I taught graduate-level courses covering topics including business strategy, industrial organization economics, and econometrics. My research on these topics has been published in leading peer reviewed economics journals including the American Economic Review, the Rand Journal of Economics, the Review of Industrial Organization, Information Economics and Policy, and the Journal of Competition Law and Economics.

185. My work at Compass Lexecon has focused on the application of economic theory and econometric methods to competitive analysis of the impact of mergers, antitrust issues including a wide variety of single-firm and multi-firm conduct, class certification, and damages estimation. I have analyzed these competition issues on behalf of a wide range of clients, including private companies and government entities. I have testified in Federal court, multiple state courts, and in many regulatory and arbitration proceedings in the U.S. and around the world. I have presented my findings to both US competition agencies on dozens of occasions. I have also submitted expert reports, declarations, and affidavits to government agencies and Federal and state courts.

186. As one example of my work that is relevant to this case, I testified on behalf of the Federal Trade Commission in its successful lawsuit to enjoin the merger of Sysco Corp. and US Foods, two national broadline food distributors, in 2015.

B. MICHAEL L. KATZ

187. My name is Michael L. Katz, and I am the Sarin Chair Emeritus in Strategy and Leadership at the University of California at Berkeley. I hold a joint emeritus appointment in the Haas School of Business Administration and in the Department of Economics. I have also served on the faculties of the Department of Economics at Princeton University and the Stern School of Business at New York University. I received my A.B. from Harvard University *summa cum laude* and my doctorate from Oxford University. Both degrees are in Economics.

188. I specialize in the economics of industrial organization, which includes the study of antitrust and regulatory policies. I am the co-author of a microeconomics textbook, and I have published numerous articles in academic journals and books. I have written academic articles on issues regarding the economics of network industries (including telecommunications), systems markets (*i.e.*, markets in which consumers use multiple goods or services together to derive benefits, such as a mobile phone and wireless service), and antitrust policy enforcement. I am a co-editor of the *Journal of Economics and Management Strategy* and serve on the editorial board of *Information Economics and Policy*.

189. In addition to my academic experience, I have held several positions in government. I am currently a Senior Fellow in the Office of Healthcare Transformation in the Ministry of Health of Singapore. From January 1994 through January 1996, I served as the Chief Economist of the Federal Communications Commission. From September 2001 through

January 2003, I served as the Deputy Assistant Attorney General for Economic Analysis at the U.S. Department of Justice. My title as Deputy Assistant Attorney General notwithstanding, I am not an attorney.

190. I have consulted on the application of economic analysis to issues of antitrust and regulatory policy. I have served as a consultant to the U.S. Department of Justice, Federal Trade Commission, and Federal Communications Commission on such issues, and I have served as an expert witness before state and federal courts. I have also provided expert testimony before state regulatory commissions and the U.S. Congress.

C. BRYAN KEATING

191. My name is Bryan Keating and I am an Executive Vice President at Compass Lexecon. I received my Ph.D. in Economics from Stanford University in 2007.

192. I specialize in the study of industrial organization and applied econometrics. My research has been published in several journals, including the *Journal of Law and Economics*, the *Review of Industrial Organization*, and the *Review of Network Economics*. I have also contributed chapters to several books, including a chapter (with Mark Israel, Dan Rubinfeld, and Robert Willig) on the Delta-Northwest merger to the Antitrust Revolution, a chapter (with Robert Willig) on unilateral effects analysis to the forthcoming Oxford Handbook on International Antitrust Economics, and a chapter (with Chris Cavanaugh and Mark Israel) on Econometrics and Regression Analysis to the ABA Section of Antitrust Law, Proving Antitrust Damages, 3rd Ed.

193. I have been a consulting economist with Compass Lexecon since 2007. While at Compass Lexecon, I have conducted economic and econometric analysis in matters related to

antitrust litigation, arbitration/settlement discussions, regulatory matters (including telecommunications) and mergers. I have substantial experience designing and implementing complex econometric models using large-scale databases, especially in industries that involve differentiated products. I have analyzed issues relating to market definition, competitive effects, welfare analysis and merger simulation in a wide variety of industries including telecommunications, consumer products, computer software and hardware, airlines, health care, payment cards, and sports.

APPENDIX G: EVANS REPLY DECLARATION

ECONOMIC ANALYSIS OF THE IMPACT OF THE PROPOSED MERGER OF T-MOBILE AND SPRINT ON CONSUMER WELFARE FROM THE DEPLOYMENT OF STRONGER 5G CELLULAR NETWORKS RESULTING FROM DYNAMIC INVESTMENT COMPETITION

David S. Evans

September 17, 2018

Table of Contents

I. Introduction

1. My name is David S. Evans. I am an economist, and I submitted a declaration on behalf of the Parties in this Transaction.[1] Professor David Sappington, on behalf of DISH Network Corporation ("DISH"), has submitted a declaration that critiques some of my findings concerning the output and price effects of the Transaction.[2] In this reply declaration, I show that Professor Sappington's analysis is incorrect. Having reviewed his declaration, as well as the entire DISH Petition to Deny, including the Declaration of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas ("Brattle Declaration"),[3] I find nothing in them that invalidates the conclusions in my initial declaration.[4]

2. This introduction summarizes the key findings outlined in my initial declaration, disputed by Professor Sappington, and explains why his criticisms are misguided. The subsequent sections respond in more detail to each specific claim.[5]

[1] Declaration of David S. Evans ("Evans Declaration I"), June 18, 2018 (attached to T-Mobile and Sprint's Description of the Transaction, Public Interest Statement, and Related Demonstration ("T-Mobile/Sprint PIS"), June 18, 2018).

[2] Declaration of David E.M. Sappington ("Sappington Declaration"), Aug. 27, 2018 (attached to Petition to Deny of DISH Network Corporation ("DISH Petition to Deny"), Aug. 27, 2018).

[3] Declaration of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas ("Brattle Declaration"), Aug. 27, 2018 (attached to DISH Petition to Deny).

[4] Professor Sappington's analysis focuses almost exclusively on Section V of my 175-page initial declaration, particularly Section V.C, which reports estimates of the impact of the Transaction on GB per subscriber and price per GB. Apart from the DISH submissions, I am not aware of any other Petitions to Deny that directly critique my analyses or findings.

[5] My qualifications and curriculum vitae are provided in my initial declaration. The opinions expressed in this declaration are based on information available to me at this time. My work in this matter is ongoing and I reserve the right to revise of supplement my analysis if any additional information makes that appropriate, or to correct and inadvertent errors. Appendix I provides a list a materials relied on.

A. The Evans Declaration Demonstrated that, Given Merger-Specific Efficiencies, the Transaction Would Increase Data Output and Reduce Data Prices Through Dynamic Investment Competition.

3. My initial declaration presented a detailed, fact-based analysis of dynamic investment competition among cellular carriers, grounded in the long-standing business realities of the industry, and the implications of the Transaction for the prices, output, and quality for cellular data given these business realities. I showed that merger-specific efficiencies would increase cellular data output (*i.e.*, GB per subscriber or GB/subscriber) and decrease cellular data prices (*i.e.*, price per GB or price/GB) directly by New T-Mobile and indirectly by inducing supply responses by AT&T and Verizon. These estimates were based on assumptions that were tied back to empirical evidence regarding dynamic investment competition.[6] I presented an estimate of the impact of the Transaction on GB/subscriber and price/GB as of 2024 under a base case and a series of sensitivity analyses that showed broadly similar results.[7]

4. Given the merger-specific efficiencies estimated by T-Mobile, and assuming that average revenue per user ("ARPU") remains flat, which is generally consistent with T-Mobile's business planning documents,[8] the Transaction would increase GB/subscriber by 120.25 percent and reduce price/GB by 54.6 percent in the base case.[9] Contrary to DISH's assertion, these estimates assume, following the company's ordinary course business plans, that both stand-alone companies would have substantial 5G capacity in 2024 in the absence of the Transaction,

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[6] *See e.g.*, Evans Declaration I, §§ IV.C, IV.D & V.

[7] Evans Declaration I, § V.C; *see also id.* tbls. 17-19.

[8] T-Mobile's historical business plans generally showed flat ARPU, while its business plan for New T-Mobile shows a slight decline in ARPU. *See e.g.*, "2018 Plan: TMUS Board of Directors," *T-Mobile*, Dec. 1, 2017, at 21-22 [TMOPA_00571029]; "T-Mobile US, Inc. 9-7-16 Board Meeting Materials," *T-Mobile*, Sept. 7, 2016, at 99 [TMOPA_00602400]; "NewCo Discussion – Tahoe Board of Directors: 5G NewCo Plan," *T-Mobile*, Apr. 22, 2018, at 19-21 [TMOPA_00602204]; Project Lakes Master Build 9, *T-Mobile* (at "Proforma" tab) [TMUS-FCC-02505996].

[9] Evans Declaration I, tbl. 17.

although much less than the combined entity. These estimates therefore measure the merger-specific increases in 5G capacity over the stand-alone companies, not simply the benefit of 5G deployment generally.[10]

5. As I explained in my initial declaration, my analysis focused on dynamic investment competition, which is the main determinant of the evolution of prices and capacity in the cellular industry, and did not analyze the impact of the Transaction on static price competition.[11] Nonetheless, a comparison of the dynamic investment competition and DISH's static price competition results is instructive. The conclusion that price/GB falls substantially because of dynamic investment competition holds, even if ARPU is allowed to rise to the degree that DISH and its economic experts claim that it would.[12] Even assuming ARPU increased by 10.4 percent, the upper bound found by the Brattle economists, the Transaction would still reduce price/GB by 49.9 percent.[13]

B. Professor Sappington Provides No Credible Economic Criticism of the Finding that Merger-Specific Efficiencies Would Increase Data Output and Reduce Data Prices Dramatically.

6. My analysis is based on the Parties' forecasts of network performance for New T-Mobile and the stand-alone companies.[14] Putting disputes over those forecasts to one side, Professor Sappington does not provide any economic analysis that refutes or undermines the conclusion

[10] DISH Petition to Deny, at 5, 35. As shown in Exhibit 14B of my initial declaration, my estimates assume that, in the absence of the Transaction, [redacted] percent of stand-alone T-Mobile's capacity and [redacted] percent of stand-alone Sprint's capacity would be 5G in 2024. Evans Declaration I, ex. 14B.

[11] Evans Declaration I, § IV.D.

[12] *See e.g.*, Evans Declaration I, tbl. 17; DISH Petition to Deny, at 2, 7, 77-78; Brattle Declaration, at 10-11, 49-54, and tbl. 1. I refer to the economists who authored this declaration as the "Brattle economists." The Brattle economists conclude that their analysis indicates "that New T-Mobile would increase prices in the range of 4% to 10% following the merger." Brattle Declaration, at 54.

[13] Exhibit 1A.

[14] *See e.g.*, Evans Declaration I, § V.C.

that the Transaction will result in a substantial merger-specific increase in cellular data output and a decrease in cellular data prices in the United States. Nor does Professor Sappington dispute that increases in data capacity put downward pressure on cellular data prices. In addition, the unrefuted empirical evidence demonstrates that the Transaction will give AT&T and Verizon strong incentives to accelerate and intensify their investments in 5G under this premise, leading to further expansions in data capacity and cellular data price reductions.

7. Professor Sappington makes four primary claims about my analysis.

8. First, he claims that my analysis is "incomplete" because I did not conduct an analysis of static price competition.[15] His criticism is irrelevant given that, as mentioned above, price/GB falls substantially because of dynamic investment competition even if ARPU is allowed to increase to the upper bound estimated by the Brattle economists.[16] Moreover, the price/GB would also decline as a result of merger-specific efficiencies even assuming the merger would not induce a competitive investment response by AT&T and Verizon. Notably, a companion declaration by Mark Israel, Michael Katz, and Bryan Keating ("Israel *et al.* Declaration") finds that, once merger-specific efficiencies are accounted for, the Brattle economists' model shows that the Transaction promotes competition and benefits consumers.[17] See Section II.

9. Second, Professor Sappington claims that, as a result of the assumption that, in the absence of the Transaction, AT&T and Verizon would match T-Mobile and not Sprint, my

[15] Sappington Declaration, § IV.

[16] The estimates of price/GB declines for my base case and sensitivity scenarios range from 41 percent to 64.9 percent, which are much higher than the average weighted ARPU increases of between 4.2 percent and 10.4 percent determined by DISH's economic experts. *See e.g.*, Evans Declaration I, tbls. 17-19; Brattle Declaration, tbl. 1.

[17] Reply Declaration of Mark Israel, Michael Katz, and Bryan Keating ("Israel *et al.* Declaration"), Sept. 17, 2018, § I.A.

analysis is subject to "prediction bias."[18] He ignores, and does not contest, the evidence presented in my initial declaration that Sprint's network has substantially lower coverage, which limits its attractiveness to subscribers and makes it a weaker competitor.[19] He also ignores, and does not contest, the evidence in my initial declaration that AT&T and Verizon have historically responded to T-Mobile. Notwithstanding the evidence, Professor Sappington questions whether AT&T and Verizon would respond to a combination of the Sprint and T-Mobile networks that simply combined their capacities but did not further increase capacity. But in doing so, he ignores the fact that this hypothetical network would be a stronger competitor, since it would almost immediately provide more coverage to previous Sprint customers and more capacity to previous T-Mobile customers, thereby creating strong financial incentives for a competitive investment response by AT&T and Verizon.[20] See Section III.

10. Third, Professor Sappington claims that the assumptions used in my analysis are "not fully supported."[21] His analysis ignores, misstates, or downplays the extensive empirical evidence on investment competition among cellular carriers in my initial declaration.[22] That evidence showed that cellular carriers are forced to make investments to compete on network performance and do not willingly choose to leave capacity materially unutilized; the fact that carriers choose to use spectrum differently does not alter this conclusion. The assertion that the

[18] Sappington Declaration, § V.

[19] *See e.g.*, Declaration of Brandon Dow Draper ("Draper Declaration"), June 18, 2018, at 5-6 (attached to T-Mobile/Sprint PIS); Declaration of John C. Saw, June 18, 2018, at 6 (attached to T-Mobile/Sprint PIS).

[20] I refer to this as a "hypothetical" network combination because it does not pertain to the actual network combination for the Transaction at hand,. I did not consider this hypothetical network as a counterfactual in the sensitivity analyses in my initial declaration because it makes no sense to assume that New T-Mobile would not increase overall capacity by combining the spectrum assets of the two companies and through other efficiencies. Had I considered this hypothetical network, it would have been appropriate to assume that AT&T and Verizon would have increased capacity in response for the reasons discussed here and in more detail in Section III.

[21] Sappington Declaration, § VI.

[22] *See e.g.*, Evans Declaration I, §§ IV.A, IV.B & IV.C.

estimates of practical capacity are not "precisely" estimated for 2024 because many factors could affect capacity is not a serious substantive economic critique.[23] Professor Sappington does not show that any of his criticisms of the Parties' capacity forecasts would result in material changes to my conclusion that the Transaction will lead to substantial reductions in price/GB that far exceed the Brattle economists' estimated static price increases. See Section IV.

11. Fourth, Professor Sappington claims that "merger gains may only be incremental"— *i.e.*, that the merger merely brings forward in time gains that would materialize eventually anyway—apparently suggesting that my analysis overlooked this possibility and thereby overstated the gains from the merger as a result.[24] His claim is wrong given my premise, which is based on the declaration of Mr. Neville Ray (T-Mobile's Chief Technical Officer ("CTO")), that the Transaction will enable New T-Mobile to launch a stronger 5G network than the stand-alone companies could. The increased efficiency resulting from combining the two networks is a long-lasting gain. Moreover, even the Transaction-related gains that Professor Sappington characterizes as "incremental" would bring substantial benefits forward in time as a result of accelerating the deployment of 5G technology by New T-Mobile, as well as by AT&T and Verizon. Professor Sappington, and the Brattle economists, do not dispute the likely enormous value of deploying 5G networks in the United States. The fact that the considerable gains from accelerating 5G would be smaller than the even larger total value of 5G is irrelevant. Getting

[23] Sappington Declaration, § VI.A.

[24] Sappington Declaration, § VI.E.

stronger 5G deployment earlier is likely to be a massive benefit to U.S. consumers.[25] See Section V.

II. Professor Sappington's Claim that the Evans "Study Is Incomplete" Is Irrelevant Because the Dynamic Efficiency-Driven Price Declines Exceed the Brattle Economists' Estimates of Static Price Increases.

12. My initial declaration showed that dynamic investment competition in cellular networks has been the main determinant of data output increases and data price reductions in the cellular industry in the United States.[26] Professor Sappington does not rebut or even seriously contest that analysis. Nor does he provide any model of the determinants of cellular data prices or cellular data output based on empirical evidence.[27] In my initial declaration, I showed that Sprint was not a significant competitive constraint on investment competition.[28] However, as I explained in my initial declaration, my analysis did not examine the impact of the loss of Sprint on static competition. For that reason, Professor Sappington claims my estimates are "incomplete."[29]

13. The Brattle economists, working on behalf of DISH, have estimated that the Transaction would increase weighted average ARPU by between a lower bound of 4.2 percent and an upper bound of 10.4 percent as a result of the elimination of Sprint as a competitor.[30] The Israel *et al.* Declaration shows that these estimates are flawed because they fail to account for the merger-

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[25] My initial declaration reported numerical illustrations of this point for a two-year acceleration of a constant stream of benefits for a general-purpose technology like 5G and showed that these benefits were likely considerable. *See e.g.*, Evans Declaration I, tbl. 20.

[26] *See e.g.*, Evans Declaration I, § IV.D.

[27] Sappington Declaration, at 4.

[28] *See e.g.*, Evans Declaration I, at 126-30.

[29] Sappington Declaration, § IV.

[30] Brattle Declaration, tbl. 1.

specific efficiencies of the Transaction. Once adjusted to do so, the Brattle economists' model shows that the Transaction will benefit consumers.[31] Nonetheless, despite their flaws, I have examined the impact of the unadjusted Brattle economists' estimates of ARPU increases by assuming that ARPU, instead of remaining flat, would increase by the claimed 10.4 percent upper bound.[32]

14. In my initial declaration I found that the Transaction would reduce price/GB by 54.6 percent in the base case in 2024,[33] accounting for both the direct effects of the merger on New T-Mobile and the induced investment responses from AT&T and Verizon, assuming ARPU remained flat. Table 1 shows the impact on the base case of assuming ARPU increases by the Brattle economists' 10.4 percent. As shown in the last column, the Transaction would reduce price/GB by 49.9 percent as of 2024 using the Brattle economists' upper bound ARPU increase.[34]

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[31] *See e.g.*, Israel *et al.* Declaration, § I.A.

[32] *See e.g.*, Exhibits 1A, 2A, & 2B.

[33] *See e.g.*, Evans Declaration I, tbl. 17.

[34] Exhibit 1A. In Exhibits 2A and 2B, I show that the Transaction would reduce price/GB by 52.7 percent using Brattle's 4.2 percent lower bound ARPU increase estimate and 51.3 percent using the 7.3 percent midpoint between their lower and upper bounds.

Table 1
National Practical Capacity and
Price per GB With and Without the Transaction in 2024
(Incorporating Brattle Economists' 10.4 Percent ARPU Increase)

	Without Transaction	With Transaction	Percent Change Due to Transaction
National Practical Capacity per Smartphone Subscriber (GB/Month)	[redacted]	[redacted]	120.3%
Price per GB	[redacted]	[redacted]	-49.9%
Source: Exhibit 1A			

15. In my initial declaration, I reported sensitivity tests for the base case with various assumptions concerning AT&T and Verizon's national practical capacity with and without the Transaction.[35] Table 2 shows the impact of assuming ARPU increases by 10.4 percent for these sensitivity tests; the price/GB decreases as of 2024 range from 34.9 percent to 61.3 percent depending on the assumption.[36]

[35] Evans Declaration I, tbls. 18-19.

[36] Exhibits 1C, 2A,2B, and 3B to 3D show how results change for other sensitivities reported in my initial declaration, assuming ARPU increases by the 10.4 percent, the 4.2 percent, and 7.3 percent (*i.e.*, the upper bound, lower bound, and midpoint of the ARPU increases estimated by the Brattle economists). Exhibits 5 and 6 report estimates based on the updated offered traffic values in the Ray Reply Declaration and the Parties' forecasts of data usage per subscriber. My conclusions for the base line case and the sensitivity tests would not change materially using either the updated Ray offered traffic estimates or the Parties' data usage forecasts.

Table 2
The Percent Change in National Practical Capacity per Smartphone Subscriber and Price per GB Due to the Transaction Based on Different Assumptions Concerning AT&T and Verizon Investments in Capacity in 2024 (Incorporating Brattle Economists' 10.4 Percent ARPU Increase)

		Percent of New T-Mobile's National Practical Capacity per Smartphone Subscriber that AT&T and Verizon Match With the Transaction		
		80	**100**	**120**
Percent of T-Mobile's National Practical Capacity per Smartphone Subscriber that AT&T and Verizon Match Without the Transaction	**80**	116.6% (-49.0%)	150.8% (-56.0%)	185.1% (-61.3%)
	100	90.2% (-41.9%)	120.3% (-49.9%)	150.3% (-55.9%)
	120	69.5% (-34.9%)	96.3% (-43.8%)	123.1% (-50.5%)

Note: Changes in price per GB are reported in parentheses.
Source: Exhibit 1B.

16. In my initial declaration, I also reported that the Transaction would reduce price/GB by 14.0 percent in 2024 in the event there were no induced supply responses by AT&T and Verizon, assuming constant ARPU.[37] Assuming ARPU increased by between the lower bound of 4.2 percent and the upper bound of 10.4 percent estimated by the Brattle economists, the Transaction would reduce price/GB by 10.4 percent and 5.0 percent, respectively, as of 2024.[38] Taken together, the results from my initial declaration and the ones presented here indicate that the decline in price/GB arising from merger-specific dynamic efficiencies would remain even if the estimated ARPU increases put forward by the Brattle economists were correct.

[37] Evans Declaration I, at 7, 144; *see also* Exhibit 3A.

[38] Exhibits 3B & 3C. In Exhibit 3D, I show, assuming no investment response by AT&T and Verizon, that the Transaction would reduce price/GB by 7.7 percent using the 7.3 percent midpoint.

17. Professor Sappington also cites general economic literature on the impact of mergers on prices, concentration, and investment.[39] He has not reported any literature or conducted any analysis of his own on the relationship between concentration or market structure and prices in the U.S. mobile wireless industry. There is nothing in the economic literature cited by Professor Sappington or his discussion of this literature that changes my opinion regarding the impact of the Transaction, including that the Transaction will increase data output and reduce data prices for subscribers in 2024.

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[39] Professor Sappington says that increases in concentration could reduce investment but does not cite any econometric evidence that is particular to mergers among cellular carriers let alone that are particular to the United States. Sappington Declaration, at 11. He only cites to an article that provides a general analysis of tacit collusion. Marc Ivaldi, *et al.*, *The Economics of Tacit Collusion*, FINAL REPORT FOR DG COMPETITION, EUROPEAN COMMISSION (Mar. 2003). Genakos, Valletti, and Verboven ("GVV"), which is the only econometric study cited by DISH and its economists that addresses the relationship between investment and concentration in the mobile telecommunication industry, found higher concentration resulted in a statistically significant *increase* in carrier investment spending. *See* DISH Petition to Deny, at 8; Christos Genakos, *et al*., *Evaluating Market Consolidation in Mobile Communications*, CENTRE ON REGULATION IN EUROPE (Sept. 15, 2015); Christos Genakos, *et al*., *Evaluating Market Consolidation in Mobile Communications*, CESIFO WORKING PAPER 6509 (May 2017). GVV also found that reducing the number of carriers from four to three in a symmetric industry results in a 9.6 percent increase in overall industry investment spending, although this effect was not statistically significant. GVV (2017), tbl. 5. The table reports a point estimate for HHI of 1.196; multiplied by 8 (HHI is raised by 8 percentage points from 0.25 to 0.33 in a symmetric 4-3 merger) this yields the estimate of 9.6 percent. Alternative specifications reported in this table also imply positive, statistically insignificant effects of reducing the number of carriers from four to three on overall industry investment spending. Their study therefore did not find evidence that going from four to three carriers decreases either carrier or industry investment.

Professor Sappington also cites a 2014 OECD Report, based on 11 case studies, and concludes that higher industry concentration is associated with diminished innovation in the wireless industry, in particular when the number of carriers falls below four. Sappington Declaration, at 4 (citing *Wireless Market Structures and Network Sharing*, OECD DIGITAL ECONOMY PAPERS 243, at 5, 8 (2014)). The OECD Report does not demonstrate that reducing the number of carriers below four leads to lower improvements in data capacity, speeds, latency, or other metrics of network performance. Nor does the OECD Report present a systematic investigation of how carrier investment evolved over time in the markets considered or how industry investment changes with the number of carriers. *Id.* at 25-57. Yet industry investment has been the source of the dramatic improvements in data capacity, data speeds, latency, or other aspects of network performance by cellular carriers globally. Indeed, when it comes to innovation, investment in successive generations of wireless technology has been the main story of the cellular industry for decades.

III. Professor Sappington's Claim that My "Study Is Biased" Is False Because It Ignores the Evidence on Sprint's Coverage and Network Quality.

18. Professor Sappington asserts that a hypothetical network that simply combined Sprint and T-Mobile's capacity without producing any efficiencies would generate reductions in price/GB using my model because of the induced supply response by AT&T and Verizon.[40] His argument is equivalent to the point that my analysis would not show that the Transaction increased the industry-wide provision of national practical capacity if (a) AT&T and Verizon matched the average of Sprint and T-Mobile in the absence of the Transaction and (b) the combination of T-Mobile and Sprint did not produce any efficiencies.[41] Professor Sappington's point is not relevant because it does not address the substantial spectral efficiencies that the Transaction will produce. It also ignores that Sprint's network has lower coverage and issues that place its network at a substantial disadvantage;[42] consequently, AT&T and Verizon would not seek to match Sprint's capacity per subscriber in the absence of the Transaction.[43] I also explained why AT&T and Verizon would seek to match T-Mobile in the absence of the Transaction and why

[40] Professor Sappington characterizes the hypothetical network combination that does not increase the combined practical capacity of the T-Mobile and Sprint as a "no merger efficiency" condition. Sappington Declaration, at 6. As I noted in footnote 20, *supra*, this hypothetical network makes no sense, and I therefore did not consider it in my sensitivity analyses.

[41] In this case, my analysis would show that price/GB would not decline because AT&T and Verizon would not increase capacity and because the hypothetical network has not increased capacity. However, such a hypothetical network is in direct conflict with the history of the dynamic investment competition in the wireless industry and the substantial spectral synergies that the Transaction will produce as described below and in my initial declaration.

[42] *See e.g.*, Draper Declaration, at 5-6; "State of the Business," *Sprint*, Jan. 31, 2018, at 10, 14, 16 (Sprint FCC Information Request Response 42-Exhibit 2); "Profitability Assessment," *Sprint*, Oct. 13, 2017, at 10, 44-46 [SPR-FCC-01119583]; "SPS Follow Up," *Sprint*, July 25, 2018, at 24 (attached as Exhibit 7).

[43] Evans Declaration I, at 137.

that was the more plausible counterfactual.[44] Professor Sappington does not acknowledge or respond to that evidence or analysis.

19. To begin with, Professor Sappington questions whether a hypothetical network that simply combined the capacities of the stand-alone companies would induce AT&T and Verizon to respond.[45] His assertion ignores the evidence concerning the relative competitive strengths of the Sprint and T-Mobile networks. As I discussed in my initial declaration, Sprint's poor coverage limits its attractiveness to subscribers.[46] Mr. Dow Draper (Sprint's Chief Commercial Officer) stated in a declaration submitted to the Federal Communications Commission that the current Sprint network lacks consistent coverage on its mid-band spectrum, resulting in a "lack of a consistent, high-speed user experience," and that this is a key reason for the negative consumer perceptions surrounding the network as well as network-related churn.[47] Adding capacity to T-Mobile's base network unlocks its competitive potential by providing more capacity to previous T-Mobile customers and improving coverage to previous Sprint customers. Consequently, the hypothetical network posed by Professor Sappington would in fact be stronger, and more efficient, than the separate stand-alone Sprint and T-Mobile networks.

20. Therefore, Professor Sappington's hypothetical network supports, rather than undermines my conclusion that the New T-Mobile network will produce a capacity-expanding response by AT&T and Verizon. The combination of greater access to capacity for T-Mobile subscribers and a greater ability to use that capacity in more locations for Sprint subscribers would improve

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[44] Evans Declaration I, at 126-30, 138-40.

[45] Sappington Declaration, at 8-9.

[46] Evans Declaration I, at 125-26.

[47] Draper Declaration, at 5-6.

customers' experience. AT&T and Verizon would respond, contrary to Professor Sappington's claim, because even this hypothetical network, posed by Professor Sappington, would present them with a significant strategic challenge—a substantially stronger wireless network than they have ever confronted.[48] The financial performance of both AT&T and Verizon depends on their ability to attract the most lucrative customers by providing the highest quality networks. As I demonstrated in my initial declaration, it is inconsistent with the history of the mobile wireless industry that T-Mobile's acquisition of Sprint, even in the extreme hypothetical network case considered by Professor Sappington, would not cause a competitive response from the two largest wireless carriers.

21. Although Professor Sappington is using this hypothetical network as a rhetorical device, his fundamental criticism is that he believes my analysis is overstated because I project that AT&T and Verizon would seek to match T-Mobile, and not Sprint, in the absence of a Transaction. He does not contest, however, the factual evidence I presented that, in the absence of the Transaction, AT&T and Verizon would not consider stand-alone Sprint's capacity per subscriber in making their 5G investment decisions because Sprint is not a significant investment constraint given the poor coverage of its network.[49] Sprint recognizes that it has "underinvested in [its] network."[50] In early 2018, Sprint itself acknowledged that as a result of its

[48] Since Professor Sappington's hypothetical network combination would increase capacity far less than the actual Transaction, it would have a much smaller effect on price/GB and GB/subscriber. I estimate that the hypothetical network would result in an 18.8 percent decrease in price/GB compared to the 54.6 percent for the base case considered in my initial declaration. Exhibit 4A; Evans Declaration I, tbl. 17.

[49] Evans Declaration I, at 126-30, 138-40.

[50] "State of the Business," *Sprint*, Jan. 31, 2018, at 10 (Sprint FCC Information Request Response 42-Exhibit 2). In calendar year 2016, Sprint reported that it spent just $57 per subscriber on wireless capital expenditures (while AT&T, Verizon, and T-Mobile each spent between $97 and $104). *Id.* Sprint's investments as a percentage of service revenue have also been well below the industry average of roughly 15 percent: in the past three years Sprint has invested just 8 percent, 6 percent, and 8 percent of its service revenues in its network. "Profitability Assessment," *Sprint*, Oct. 13, 2017, at 44; "SPS Follow Up," *Sprint*, July 25, 2018, at 24 (attached as Exhibit 7).

underinvestment, the customer satisfaction gap between itself and rivals was widening and Sprint was "*losing momentum*, while competitors are gaining."[51] Professor Sappington has not provided any factual evidence that, to the contrary, AT&T and Verizon treat Sprint as a serious rival for the purpose of making investment decisions in network performance.

22. Professor Sappington also ignores the evidence that I presented on why, in the absence of the Transaction, AT&T and Verizon would respond to T-Mobile. AT&T and Verizon have sought to offer plans that are competitive with regard to the data usage and other quality attributes of T-Mobile's packages in recent years.[52] Further evidence on competition between AT&T, Verizon, and T-Mobile confirms this. For example, a September 2016 T-Mobile presentation noted that Verizon and AT&T were "continuing to respond to pressure," and acknowledged how T-Mobile was narrowing the coverage gap and working on network improvements.[53] As I explained in my initial declaration, the way cellular carriers ensure that they can offer comparable packages and network quality is by investing in their networks.[54] In

[51] "State of the Business," *Sprint*, Jan. 31, 2018, at 14, 16 (Sprint FCC Information Request Response 42-Exhibit 2) (emphasis in original).

[52] Evans Declaration I, at 91-94. In September 2013, T-Mobile observed that "[c]ompetitors are beginning to aggressively introduce competing offers, and customer network expectations are rising" in response to its Un-carrier launch. "T-Mobile Executive Committee Meeting Preliminary View of Capital Investment Strategy," ***T-Mobile***, Sept. 16, 2013, at 9 [TMOPA_00529940_00000001]. Other mobile carriers quickly responded to T-Mobile's Simple Choice by rolling out no-contract plans and eventually eliminating contracts altogether. For example, AT&T and Sprint began offering no-contract plans in 2013, shortly after the launch of Simple Choice. Carriers also began to eliminate annual contracts, with Verizon being the first in August 2015, and AT&T and Sprint ending annual contracts in January 2016. *See e.g.*, Roger Cheng, *AT&T: Now you pay less for a no-contract phone plan*, CNET (Dec. 5, 2013), https://www.cnet.com/news/at-t-now-you-pay-less-for-a-no-contract-phone-plan/; Jessica Guynn, *AT&T to stop offering two-year contracts*, USA TODAY (Dec. 30, 2015), https://www.usatoday.com/story/tech/2015/12/30/att-to-stop-offering-two-year-contracts/78087824/; AJ Dellinger, *Sprint officially kills two-year contracts, no one mourns*, DIGITAL TRENDS (Jan. 9, 2016), https://www.digitaltrends.com/mobile/sprint-kills-two-year-contracts-news/.

[53] "T-Mobile US, Inc. 9-7-16 Board Meeting Materials," ***T-Mobile***, Sept. 7, 2016, at 15, 17-19 [TMOPA_00602400].

[54] Evans Declaration I, at 91-94; *id.* § IV.

short, Professor Sappington's suggestion that AT&T and Verizon would not seek to offer networks that are at least equal to New T-Mobile's network is unsupported and not credible.

IV. Professor Sappington's Claim that "Other Elements" of the Evans Study "Are Not Fully Supported" Ignores the Detailed Empirical Evidence and Robustness Checks that Support the Study.

23. Professor Sappington makes several claims that "other elements" of my model are "not fully supported."[55] Each of Professor Sappington's assertions ignores the detailed empirical support that I provided in my initial declaration as well as the robustness checks I reported. Below I summarize and supplement that evidence.

24. The Brattle economists claim that AT&T and Verizon use spectrum more intensively than T-Mobile and Sprint on a subscribers per MHz per cell site basis.[56] It is not apparent why Professor Sappington believes this assertion is relevant. He first appears to suggest that this difference means that the ratio between practical capacity and total capacity observed for T-Mobile cannot be applied to AT&T and Verizon.[57] But I do not rely on that ratio in my calculations for AT&T and Verizon. My analysis assumed that AT&T and Verizon will not allow themselves to fall materially behind T-Mobile in terms of the amount of data that subscribers can consume without degrading network performance below competitive levels.[58] As explained above, and in my initial declaration, this assumption is well supported by a

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[55] Sappington Declaration, § VI.

[56] Brattle Declaration, tbl. 28.

[57] Sappington Declaration, § VI.A.

[58] Evans Declaration I, § V.C.3. As I noted in my initial declaration, this statement is meant to be approximate, and AT&T and Verizon may offset some disadvantage in capacity through other methods of differentiation. "It is possible that instead of matching national practical capacity they could compensate on other dimensions, such as bundling content which would then appear as a reduction in the quality-adjusted price. Therefore, one can think of the assumption of matching data per subscriber as covering the possibility that they either match or surpass data plans or provide some other compensating benefit." Evans Declaration I, § V.C.2.

documented history of substantial investments made by AT&T and Verizon to support network superiority claims and to match or exceed T-Mobile.[59] It does not rely on AT&T or Verizon having any particular—or, for that matter, even a stable—ratio of practical capacity to offered traffic or particular levels of "spectrum intensity."[60]

25. Professor Sappington next suggests that AT&T's and Verizon's more intensive use of spectrum casts doubt on the assumption that AT&T and Verizon would want to expand capacity and deploy it to customers so as to match New T-Mobile's practical capacity.[61] In suggesting that AT&T and Verizon make decisions about the quality of service they will offer on the basis of maintaining spectrum utilization rates, Professor Sappington's argument puts the cart before the horse. In reality, the different conditions under which carriers operate reflect the different approaches each has taken to build network capacity to attract and serve customers in competition with the other carriers.[62]

26. The evidence also demonstrates that AT&T and Verizon will not allow their networks to fall materially behind T-Mobile for any sustained period of time.[63] Network quality has been a central component of both AT&T's and Verizon's business strategies for many years, and AT&T and Verizon have historically invested as necessary to maintain and extend their network quality

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[59] Evans Declaration I, § IV.C.

[60] While neither Professor Sappington nor the Brattle economists provide a definition of spectrum intensity, they do use total customers per MHz per cell site as a metric for the intensity of spectrum use. *See e.g.*, Sappington Declaration, at 9-10; Brattle Declaration, at 91-92, tbl. 28.

[61] Sappington Declaration, at 10-11. Professor Sappington states that "Dr. Evans' own observations also raise doubts about his assumption that AT&T and Verizon will expand their capacities to secure the same practical capacity per subscriber as New T-Mobile." *Id.* at 10. My statement concerning AT&T and Verizon not *currently* planning to roll out 5G networks as strong as New T-Mobile refers to the situation in which AT&T and Verizon are competing with stand-alone Sprint and T-Mobile and not the situation in which they would be competing with a much larger New T-Mobile with a strong 5G network.

[62] Evans Declaration I, §§ IV.A & IV.B.

[63] Evans Declaration I, § IV.C.

advantage.[64] T-Mobile has observed that AT&T and Verizon therefore have strong incentives to increase investments when rivals appear capable of challenging claims to network superiority.[65] There is no reason to believe that either company would change this basic strategy.[66] Verizon and AT&T ranked first and second, respectively, in the RootMetrics network performance report for the first half of 2018.[67] Recent analyst reports note that investments in network quality remain a centerpiece of both companies' business plans.[68] T-Mobile leadership has determined that accelerated investment is necessary to close the gap with competitors (*i.e.*, AT&T and

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[64] For instance, a September 2013 T-Mobile investment strategy presentation noted that "[n]etwork is core to Verizon['s] brand" and the "keys to the castle." "T-Mobile Executive Committee Meeting Preliminary View of Capital Investment Strategy," ***T-Mobile***, Sept. 16, 2013, at 25 [TMOPA_00529940_00000001]. A presentation to the T-Mobile Board on capital planning given the next month labeled Verizon and AT&T as "un-compromising" on network quality. "T-Mobile Board Of Directors Meeting Preliminary Capital Plan," ***T-Mobile***, Oct. 23-24, 2013, at 8-9 [TMOPA_07050649_00000002]. And a February 2014 presentation to the T-Mobile Board noted that AT&T and Verizon had established significant advantages in network quality but were continuing to "invest [] in current and future network superiority." "T-Mobile Board of Directors Meeting: Capital Plan," ***T-Mobile***, Feb. 2014, at 7 [TMOPA_03996691_00000001].

[65] *See e.g.*, Email from Mark McDiarmid to Abdul Saad, *et al.*, "CTIA insights around Verizon 5G massive BB to the home," ***T-Mobile***, Sept. 11, 2015 [TMUS-FCC-01243906] ("VZ has traditionally been seen as a technology leader. With both ourselves and others showing that we can compete with them on 4G LTE, they are likely motivated to show some muscle and reclaim some technology high ground.").

[66] *See e.g.*, "Network Discussion – Capacity Presentation," ***T-Mobile***, Sept. 24-25, 2015, at 6 [TMUS-FCC-00632312] ("Network is the #1 reason for choosing a carrier . . . and the #1 reason customers leave TMUS."); "T-Mobile Board Of Directors Meeting Preliminary Capital Plan," ***T-Mobile***, Oct. 23-24, 2013, at 8-9 [TMOPA_07050649_00000002] ("Network [was] #1 driver of T-Mobile churn – continued improvements to experience needed to meet customer needs."); "T-Mobile Executive Committee Meeting Preliminary View of Capital Investment Strategy," ***T-Mobile***, Sept. 16, 2013, at 11[TMOPA_00529940_00000001] (comparing T-Mobile network performance with Verizon and AT&T and concluding that the "majority of prime customer choice [was] still driven by network performance.").

[67] "Neville 2Q18 Earnings Prep," ***T-Mobile***, July 25, 2018, at 21 [TMOPA_08645961_0000002].

[68] *See e.g.*, "Verizon (VZ): Takeaways from a Day with Management," *Moffett Nathanson*, Feb. 1, 2017, at 1 [TMUS-FCC-01225575] ("Verizon's strategy remains 'network superiority,' and throughout our discussions, Ellis emphasized network densification as the preferred path to achieve that superiority."); Email from Amir Rozwadowski to Nils Paellmann, "AT&T: Expect to Leverage Network and Cash Flow as Key Differentiators," ***T-Mobile***, Feb. 26, 2018 [TMUS-FCC-002597] ("[U]ltimately AT&T believes its infrastructure upgrade plans should drive a significant improvement in network quality and capacity providing a more sustainable means by which to attract and retain subscribers.").

Verizon) given the expectation that AT&T and Verizon will continue to invest heavily to maintain or grow that gap.[69]

27. Finally, Professor Sappington references the Brattle economists' results that different carriers use spectrum with different intensity to question my assumption that the cellular carriers will operate near national practical capacity.[70] He ignores the evidence presented in my initial declaration that AT&T, Verizon, and T-Mobile have operated near national practical capacity for a long time.[71] For example, even after carriers deployed 4G LTE technology, they were forced to drop unlimited data plans because their networks became congested.[72] In order to compete with T-Mobile's re-introduction of unlimited data, both Verizon and AT&T eventually brought back their unlimited data packages. However, both carriers' networks ran into congestion issues, meaning consumers were utilizing more data than AT&T and Verizon's networks could support without diminished quality. In response, AT&T and Verizon were forced to limit subscribers' data use aggressively.[73] Moreover, AT&T, T-Mobile, and Verizon have consistently invested in increasing their network capacity, which they would not likely do if they were not capacity constrained.[74]

28. Professor Sappington does not provide any evidence that there is a material sustained underutilization of capacity on the cellular carriers' networks that could alter the substantive findings of my analysis. The fact that many factors determine capacity utilization, including

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[69] *See e.g.*, "T-Mobile US Enterprise Risk Assessment (EV)," *T-Mobile*, Quarter 2 2018, at 8 [TMOPA_06412702_0000001].

[70] Sappington Declaration, at 9; *see also id.* §§ VI.A & VI.D.

[71] Evans Declaration I, at 129.

[72] Evans Declaration I, at 129.

[73] Evans Declaration I, at 129-30.

[74] Evans Declaration I, § IV.

differences in spectrum intensity, does not imply that carriers will leave substantial amounts of practical capacity unutilized. My conclusion certainly does not depend on "AT&T and Verizon [operating] with ***precisely*** the same practical capacity per subscriber as T-Mobile if the merger does not occur."[75] In fact, in my initial declaration, I reported the results of the sensitivity analyses I conducted allowing AT&T and Verizon to provide national practical capacity per subscriber that falls short of or exceeds New T-Mobile's (and stand-alone T-Mobile's).[76] These sensitivity analyses indicate that the resulting decrease in the price/GB exceeds the upper bound on the average ARPU increase estimated by the Brattle economists.[77]

29. Professor Sappington and the Brattle economists also question the estimates of capacity for New T-Mobile and the stand-alone companies put forward by T-Mobile's CTO, Mr. Neville Ray.[78] They ignore the basic economics behind those estimates. To realize value from the Transaction, New T-Mobile will need to integrate the Sprint and T-Mobile networks. For cost efficiency reasons, it plans to incorporate 5G radios and other 5G-related infrastructure components during this integration process, including adding Sprint's 2.5 GHz (and other spectrum) to its network.[79] It will therefore face a low incremental cost of deploying a stronger 5G network conditional on owning this spectrum and incurring the fixed cost of installing new

[75] Sappington Declaration, at 10 (emphasis added). As I noted in my initial declaration, "My base 'with Transaction assumption' is that AT&T and Verizon will approximately match New T-Mobile in terms of performance and the amount of data they could offer subscribers so that they remain competitive with New T-Mobile. They could not offer competitive packages if they had materially less national practical capacity available per subscriber." Evans Declaration I, at 138. I further noted that: "It is possible that instead of matching national practical capacity they could compensate on other dimensions, such as bundling content which would then appear as a reduction in the quality-adjusted price. Therefore, one can think of the assumption of matching data per subscriber as covering the possibility that they either match or surpass data plans or provide some other compensating benefit." *Id.* at 138 n.435.

[76] *See e.g.*, Evans Declaration I, tbl.18.

[77] Brattle Declaration, tbl. 1; Evans Declaration I, tbl. 18; *see also supra* tbl. 2.

[78] Sappington Declaration, § VI.B; Brattle Declaration, § II.

[79] Declaration of Neville R. Ray, June 18, 2018, at 17-18 (attached to T-Mobile/Sprint PIS).

radios and related equipment during the integration process.[80] Given that this reduction in cost for 5G coincides with an epochal transition to the next generation of cellular technology, New T-Mobile has powerful incentives to expand 5G capacity more than the stand-alone companies would.

V. Professor Sappington's Claim that the "Merger Gains May Only Be Incremental" Is Irrelevant Because My Study Shows that the Transaction Would Increase Consumer Welfare Through Both a Long-Lasting Increase in Data Capacity and the Acceleration of 5G Coverage.

30. Professor Sappington's point that "merger gains may only be incremental" ignores the evidence I presented on this point in my initial declaration showing why the Transaction would generate substantial economic benefits.

31. First, the Transaction results in a long-term increase in data capacity for 5G as result of long-lasting efficiencies from combining the Sprint and T-Mobile networks. Although Professor Sappington criticizes elements of the company's claims, he provided no material economic evidence that capacity and other dimensions of network performance would fail to increase as a result of the Transaction. As discussed above, there are obvious efficiencies even in the extreme hypothetical case in which the combined network simply combined the capacity and coverage of the two stand-alone networks. Accounting for the merger-specific benefits of combining complementary spectrum assets and the economies of scope from integrating the networks greatly magnify these efficiencies.

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[80] Reply Declaration of Neville Ray, Sept. 17, 2018, §§ II.D & IV; Reply Declaration of Peter Ewens, Sept. 17, 2018, § II.H.

32. Second, the Transaction also moves the benefit stream of 5G forward in time as a result of both the efficiencies resulting from the integration of the Sprint and T-Mobile networks and the induced investment response by AT&T and Verizon. As I stated previously,

> "[b]y enabling and accelerating the creation of a strong 5G network by New T-Mobile, the Transaction would force AT&T and Verizon to quicken and deepen their investments and thereby cause a substantial increase in the industry-wide supply of cellular data to mobile subscribers."[81]

The Transaction would also bring app development and improvements forward in time:

> "By creating a critical mass of 5G mobile subscribers earlier, and providing them with stronger networks, the Transaction is likely to accelerate the development of 5G apps and app features. Consumers would therefore be able to obtain larger benefits from new apps and app features sooner with the Transaction than without it."[82]

Indeed, Professor Sappington and the Brattle economists do not dispute the analysis I presented on the likely value of 5G networks to consumers, and the economy more broadly, and the effect that the deployment of 5G networks would have on the endogenous supply of new apps and app features that rely on 5G capabilities or other aspects of the virtuous cycle. The economic value generated from moving the benefit stream forward in time is a long-lasting value for society.

33. Additionally, the overall economic value of accelerating benefits from the deployment of 5G technologies could be considerable, even in the extreme hypothetical case, not relevant here, where there is no increase in merger-specific efficiency in long-run equilibrium. As part of my initial declaration, in discussing the implications of 5G beyond mobile subscribers, I provided an illustrative example of a new general-purpose technology introduced in the first year and

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[81] Evans Declaration I, at 114.

[82] Evans Declaration I, at 134.

diffused through the economy over subsequent years.[83] In that example, the new general-purpose technology added $100 billion of value in year 1, $200 billion in year 2, $300 billion in year 3, and so on, reaching $1 trillion in year 10. I compared this value stream with an identical value stream, except starting two years later. This illustrative example demonstrated that introducing the general-purpose technology two years earlier would increase its present value by almost $1.7 trillion (using a 2 percent discount rate) by simply moving a constant benefit stream forward.[84]

34. Professor Sappington's claim that gains from accelerating the deployment of 5G are a fraction of the total gains from deploying 5G is irrelevant. The point is that the gains from accelerating the deployment of 5G are likely to be very large for the reasons discussed in my initial declaration.[85] All past deployments of new generations of cellular technology generated enormous benefits.[86] The early deployment of LTE in the United States compared to other countries generated enormous benefits.[87] All indications are that 5G technology will generate enormous benefits.[88] By accelerating and intensifying the move to 5G the Transaction will not

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[83] Evans Declaration I, at 148-50.

[84] Evans Declaration I, at 149-50.

[85] Evans Declaration I, § V.D.

[86] "The mobile phone revolution – that began with devices that untethered consumers from landline phones and much later from desktop computers – resulted from the carriers' improvements, and deployment, of cellular technology families. These technologies lowered the costs of providing capacity, which enabled the carriers to make investments in network expansion, which in turn allowed carriers to provide more capacity for voice and data at lower prices." Evans Declaration I, at 13.

[87] "The deployment of cellular networks in the United States, including 4G LTE, where the United States was ahead of most large developed countries, created a massive base of U.S. consumers available to any entrepreneur who wanted to find use cases for new technology. U.S.-based companies and entrepreneurs seized this opportunity. They developed, introduced, and perfected their products and services in the U.S. market and then rolled them out around the world. They have made U.S. companies, at least outside of China, the leading providers for the smartphone ecosystem." Evans Declaration I, at 44-45.

[88] "[C]ellular carriers will [] be able to provide more data at a lower cost. As one measure of the potential capacity gains of 5G, the ITU has set a goal for area traffic capacity of 10 Mbps per square meter in the IMT-2020 objectives

only move this stream of benefits forward in time, and result in a long-term increase in those benefits, but will also generate substantial value in doing so.

that 5G technologies were developed to meet, which is 100 times as great as the goal for IMT-Advanced (*i.e.*, LTE)." Evans Declaration I, at 53; *see also id.* § III.B.

Exhibit 1A
National Practical Capacity and Price per GB of Mobile Data in 2024
With and Without the Transaction
Incorporating Brattle Economists' 10.4 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$48.50	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$43.65	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	120.25%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]			120.25%
Price per GB of Mobile Data[8]			-49.88%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 10.4 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity for Verizon and AT&T is calculated in Evans Declaration I, Exhibit 14C.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA Intelligence; Evans Declaration I, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 1B
National Practical Capacity and Price per GB of Mobile Data in 2024
Based on Different Assumptions Concerning
AT&T and Verizon Investments in Capacity

With and Without the Transaction

Incorporating Brattle Economists' 10.4 Percent Increase in ARPU[1]

Percent Change in National Practical Capacity per Smartphone Subscriber[2]

	Percent of New T-Mobile's National Practical Capacity per Smartphone Subscriber that AT&T and Verizon Match With the Transaction[3]		
Percent of T-Mobile's National Practical Capacity per Smartphone Subscriber that AT&T and Verizon Match Without the Transaction[3]	**80**	**100**	**120**
80	116.57%	150.84%	185.12%
100	90.16%	120.25%	150.34%
120	69.49%	96.31%	123.13%

Percent Change in Price per GB of Mobile Data[4]

	Percent of New T-Mobile's National Practical Capacity per Smartphone Subscriber that AT&T and Verizon Match With the Transaction[3]		
Percent of T-Mobile's National Practical Capacity per Smartphone Subscriber that AT&T and Verizon Match Without the Transaction[3]	**80**	**100**	**120**
80	-49.02%	-55.99%	-61.28%
100	-41.94%	-49.88%	-55.90%
120	-34.86%	-43.76%	-50.52%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] National Practical Capacity per Smartphone Subscriber is calculated following the methodology used in Evans Declaration I, Exhibit 14A. These figures refer to post-paid, pre-paid, and MVNO business segments.
[3] National Practical Capacity per Smartphone Subscriber for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C.
[4] Price per GB of Mobile Data is calculated following the methodology used in Evans Declaration I, Exhibit 14A.

Source: GSMA Intelligence; Evans Declaration I, Table 18; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 1C
National Practical Capacity and Price per GB of Mobile Data in 2024 Using 31.5 Percent as the Ratio of National Practical Capacity to National Total Capacity for Sprint Stand-Alone
With and Without the Transaction
Incorporating Brattle Economists' 10.4 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$48.50	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$43.65	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	131.87%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]	[redacted]	[redacted]	131.87%
Price per GB of Mobile Data[8]	[redacted]	[redacted]	-52.39%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 10.4 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. For the purposes of this analysis, National Practical Capacity for Sprint is calculated using a 31.5 percent ratio of National Practical Capacity to National Total Capacity. National Practical Capacity for Verizon and AT&T is calculated in Evans Declaration I, Exhibit 14C.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA Intelligence; Evans Declaration I, Table 19; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 2A
National Practical Capacity and Price per GB of Mobile Data in 2024
With and Without the Transaction
Incorporating Brattle Economists' 4.2 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$45.78	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$41.20	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	120.25%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]			120.25%
Price per GB of Mobile Data[8]			-52.69%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 4.2 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity for Verizon and AT&T is calculated in Evans Declaration I, Exhibit 14C.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 2B

National Practical Capacity and Price per GB of Mobile Data in 2024

With and Without the Transaction

Incorporating Brattle Economists' 7.3 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$47.14	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$42.42	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	120.25%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]	[redacted]	[redacted]	120.25%
Price per GB of Mobile Data[8]	[redacted]	[redacted]	-51.28%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 7.3 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity for Verizon and AT&T is calculated in Evans Declaration I, Exhibit 14C.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 3A

National Practical Capacity and Price per GB of Mobile Data in 2024
Assuming No Induced Supply Response from AT&T and Verizon

With and Without the Transaction

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[1]	$43.93	$43.93	-
Total Subscribers[2]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[3]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[4]	$39.54	$39.54	-
National Practical Capacity (EB/month)[5]	[redacted]	[redacted]	16.24%
National Practical Capacity per Smartphone Subscriber (GB/month)[6]	[redacted]	[redacted]	16.24%
Price per GB of Mobile Data[7]	[redacted]	[redacted]	-13.97%

Note:
[1] ARPU in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[2] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[3] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[4] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[5] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity per Smartphone Subscriber for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C. For the purposes of this analysis, it is assumed that AT&T and Verizon match 100 percent of New T-Mobile National Practical Capacity per Smartphone Subscriber with or without the Transaction.
[6] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[7] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, ¶240, Exhibits 5A, 14A-14C.

Exhibit 3B
National Practical Capacity and Price per GB of Mobile Data in 2024
Assuming No Induced Supply Response from AT&T and Verizon
With and Without the Transaction

Incorporating Brattle Economists' 10.4 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$48.50	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$43.65	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	16.24%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]	[redacted]	[redacted]	16.24%
Price per GB of Mobile Data[8]	[redacted]	[redacted]	-5.02%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 10.4 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity per Smartphone Subscriber for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C. For the purposes of this analysis, it is assumed that AT&T and Verizon match 100 percent of New T-Mobile National Practical Capacity per Smartphone Subscriber with or without the Transaction.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, ¶240, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 3C
National Practical Capacity and Price per GB of Mobile Data in 2024 Assuming No Induced Supply Response from AT&T and Verizon
With and Without the Transaction

Incorporating Brattle Economists' 4.2 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$45.78	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$41.20	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	16.24%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]	[redacted]	[redacted]	16.24%
Price per GB of Mobile Data[8]	[redacted]	[redacted]	-10.36%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 4.2 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity per Smartphone Subscriber for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C. For the purposes of this analysis, it is assumed that AT&T and Verizon match 100 percent of New T-Mobile National Practical Capacity per Smartphone Subscriber with or without the Transaction.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, ¶240, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 3D
National Practical Capacity and Price per GB of Mobile Data in 2024
Assuming No Induced Supply Response from AT&T and Verizon
With and Without the Transaction

Incorporating Brattle Economists' 7.3 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$47.14	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$42.42	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	16.24%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]			16.24%
Price per GB of Mobile Data[8]			-7.69%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 7.3 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated in Evans Declaration I, Exhibit 14B. National Practical Capacity per Smartphone Subscriber for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C. For the purposes of this analysis, it is assumed that AT&T and Verizon match 100 percent of New T-Mobile National Practical Capacity per Smartphone Subscriber with or without the Transaction.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA Intelligence; Evans Declaration I, ¶240, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 4A
National Practical Capacity and Price per GB of Mobile Data in 2024 Assuming New T-Mobile's National Total Capacity Equals the Sum of the National Total Capacity for Stand-Alone T-Mobile and Sprint
With and Without the Transaction

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[1]	$43.93	$43.93	-
Total Subscribers[2]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[3]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[4]	$39.54	$39.54	-
National Practical Capacity (EB/month)[5]	[redacted]	[redacted]	23.15%
National Practical Capacity per Smartphone Subscriber (GB/month)[6]			23.15%
Price per GB of Mobile Data[7]			-18.80%

Note:
[1] ARPU in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[2] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[3] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[4] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[5] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated following the methodology used in Evans Declaration I, Exhibit 14B, except that for the purposes of this analysis National Total Capacity for New T-Mobile is equal to the sum of the National Total Capacity for T-Mobile and Sprint. National Practical Capacity for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C.
[6] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[7] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, Exhibits 5A, 14A-14C.

Exhibit 4B

National Practical Capacity and Price per GB of Mobile Data in 2024 Assuming New T-Mobile's National Total Capacity Equals the Sum of the National Total Capacity for Stand-Alone T-Mobile and Sprint

With and Without the Transaction

Incorporating Brattle Economists' 10.4 Percent Increase in ARPU[1]

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[2]	$43.93	$48.50	-
Total Subscribers[3]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[4]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[5]	$39.54	$43.65	-
National Practical Capacity (EB/month)[6]	[redacted]	[redacted]	23.15%
National Practical Capacity per Smartphone Subscriber (GB/month)[7]	[redacted]	[redacted]	23.15%
Price per GB of Mobile Data[8]	[redacted]	[redacted]	-10.35%

Note:
[1] The Brattle Declaration, Table 1 estimates that the Transaction would increase ARPU by between 4.2 percent and 10.4 percent.
[2] ARPU without the Transaction in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). ARPU with the Transaction in 2024 is also based on implied ARPU in 2017, but assumes a 10.4 percent static increase in ARPU. These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[3] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[4] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[5] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[6] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated following the methodology used in Evans Declaration I, Exhibit 14B, except that for the purposes of this analysis National Total Capacity for New T-Mobile is equal to the sum of the National Total Capacity for T-Mobile and Sprint. National Practical Capacity for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C.
[7] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[8] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, Exhibits 5A, 14A-14C; Brattle Declaration, at 10-11, 49-54, and tbl. 1.

Exhibit 5
National Practical Capacity and Price per GB of Mobile Data in 2024
With and Without the Transaction
Based on Updated National Total Capacity Figures for the Baseline Network

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[1]	$43.93	$43.93	-
Total Subscribers[2]	397,209,827	397,209,827	-
Smartphone Penetration Rate	90%	90%	-
Smartphone Subscribers[3]	357,488,845	357,488,845	-
Percent of Time on Smartphone Spent Online	90%	90%	-
Data ARPU[4]	$39.54	$39.54	-
National Practical Capacity (EB/month)[5]	[redacted]	[redacted]	146.01%
National Practical Capacity per Smartphone Subscriber (GB/month)[6]	[redacted]	[redacted]	146.01%
Price per GB of Mobile Data[7]	[redacted]	[redacted]	-59.35%

Note:
[1] ARPU in 2024 is set equal to implied ARPU in 2017 (see Evans Declaration I, Exhibit 5A). These ARPU figures refer to post-paid, pre-paid, and MVNO business segments.
[2] Calculated using 2017 total connections (excluding machine-to-machine connections) as the base value (see Evans Declaration I, Exhibit 5A) and a compound annual growth rate of 2.17 percent, the average annual growth rate of total connections between 2014 and 2017. It is the average of the 2014-15 growth rate, the 2015-16 growth rate, and the 2016-17 growth rate.
[3] Calculated as Total Subscribers multiplied by the Smartphone Penetration Rate.
[4] Calculated as ARPU multiplied by the Percent of Time on Smartphone Spent Online.
[5] Without the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, Sprint, and T-Mobile. With the Transaction, National Practical Capacity is calculated as the sum of National Practical Capacity for Verizon, AT&T, and New T-Mobile. National Practical Capacity for T-Mobile, Sprint, and New T-Mobile is calculated following the methodology used in Evans Declaration I, Exhibit 14B, based on National Total Capacity figures included in the Ray Reply Declaration. National Practical Capacity for Verizon and AT&T is calculated following the methodology used in Evans Declaration I, Exhibit 14C.
[6] Calculated as National Practical Capacity divided by Smartphone Subscribers. These figures refer to post-paid, pre-paid, and MVNO business segments.
[7] Calculated as Data ARPU divided by National Practical Capacity per Smartphone Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, Exhibits 5A, 14A-14C; Ray Reply Declaration, tbls. 3 and 6.

Exhibit 6
GB per Subscriber and Price per GB of Mobile Data in 2024
With and Without the Transaction
Based on the Parties' GB per Subscriber Forecasts

	No Transaction	Transaction	Percent Change Due to Transaction
ARPU[1]	$43.93	$43.93	-
Data ARPU[2]	$39.54	$39.54	-
GB per Subscriber (GB/month)[3]	[redacted]	[redacted]	83.68%
Price per GB of Mobile Data[4]	[redacted]	[redacted]	-45.56%

Note:
[1] See Evans Declaration I, Exhibit 14A.
[2] See Evans Declaration I, Exhibit 14A.
[3] Without the Transaction, GB per Subscriber is calculated as a weighted average of GB per Subscriber for T-Mobile, Sprint, AT&T, and Verizon, weighted by each carrier's respective subscriber share used in Evans Declaration I, Exhibit 14A. With the Transaction, the same methodology is applied to GB per Subscriber for New T-Mobile, AT&T, and Verizon. AT&T and Verizon match 100 percent of T-Mobile's GB per Subscriber without the Transaction, and 100 percent of New T-Mobile's GB per Subscriber with the Transaction. GB per Subscriber for T-Mobile, Sprint, and New T-Mobile is calculated as a weighted average of that carrier's LTE GB per Subscriber and 5G GB per Subscriber, weighted by the share of that carrier's subscribers that are LTE and 5G subscribers. For all three carriers, the share of subscribers that are LTE and 5G subscribers is based on the Network Build Model. For T-Mobile, LTE GB per Subscriber is based on the Network Build Model and 5G GB per Subscriber is based on Ewens Reply Declaration Table B. For Sprint, LTE GB per Subscriber and 5G GB per Subscriber are based on "18.2 Customer Demand Forecast." For New T-Mobile, LTE GB per Subscriber is based on the Network Build Model and 5G GB per Subscriber is based on "5G Demand Forecast v9b."
[4] Calculated as Data ARPU divided by GB per Subscriber.

Source: GSMA INTELLIGENCE; Evans Declaration I, Exhibits 5A, 14A-14C; Ewens Reply Declaration, tbl. B; Network Build Model [Refer to information request response item 13, folder labeled "Specification 13 Exhibit A Engineering Model"]; "5G Demand Forecast v9b," *T-Mobile*, June 27, 2018 [TMOPA_04641354_00000001]; "18.2 Customer Demand Forecast," *Sprint*, p. 9 (attached as Exhibit 8).

Exhibit 7

[THIS EXHIBIT IS REDACTED IN ITS ENTIRETY.]

Exhibit 8

[THIS EXHIBIT IS REDACTED IN ITS ENTIRETY.]

Appendix 1
Additional Documents Relied Upon by David S. Evans

T-Mobile and Sprint Joint Opposition to Petitions to Deny

Joint Opposition of T-Mobile US, Inc. and Sprint Corporation, Sept. 17, 2018

Reply Declaration of G. Michael Sievert, Sept. 17, 2018

Reply Declaration of Neville R. Ray, Sept. 17, 2018

Reply Declaration of Peter Ewens, Sept. 17, 2018

Reply Declaration of John C. Saw, Sept. 17, 2018

Reply Declaration of Brandon Dow Draper, Sept. 17, 2018

Reply Declaration of Mark Israel, Michael Katz and Bryan Keating, Sept. 17, 2018

Petitions to Deny

Petition to Deny of DISH Network Corporation, Aug. 27, 2018

Declaration of David E.M. Sappington, Aug. 27, 2018

Declaration of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda and William Zarakas, Aug. 27, 2018

Applicant Documents

"2018 Plan: TMUS Board of Directors," *T-Mobile*, Dec. 1, 2017 [TMOPA_00571029]

"T-Mobile US, Inc. 9-7-16 Board Meeting Materials," *T-Mobile*, Sept. 7, 2016 [TMOPA_00602400]

"NewCo Discussion – Tahoe Board of Directors: 5G NewCo Plan," T-Mobile, Apr. 22, 2018 [TMOPA_00602204]

Project Lakes Master Build 9, *T-Mobile* [TMUS-FCC-02505996]

"State of the Business," *Sprint*, Jan. 31, 2018 (Sprint FCC Information Request Response 42-Exhibit 2)

"Profitability Assessment," *Sprint*, Oct. 13, 2017 [SPR-FCC-01119583]

"SPS Follow Up," *Sprint*, July 25, 2018 (attached as Exhibit 7)

"Network Discussion – Capacity," *T-Mobile*, Sept. 24-25, 2015 [TMUS-FCC-00632312]

"T-Mobile Executive Committee Meeting Preliminary View of Capital Investment Strategy," *T-Mobile*, Sept. 16, 2013 [TMOPA_00529940_00000001]

"T-Mobile Board Of Directors Meeting Preliminary Capital Plan," *T-Mobile*, Oct. 23-24, 2013 [TMOPA_07050649_00000002]

"T-Mobile Board of Directors Meeting: Capital Plan," *T-Mobile*, Feb. 2014 [TMOPA_03996691_00000001]

Email from Mark McDiarmid to Abdul Saad *et al*, "CTIA insights around Verizon 5G massive BB to the home," *T*-Mobile, Sept. 11, 2015 [TMUS-FCC-01243906]

"Neville 2Q18 Earnings Prep," *T-Mobile*, July 25, 2018 [TMOPA_08645961_00000002]

"Verizon (VZ): Takeaways from a Day with Management," *Moffett Nathanson*, Feb. 1, 2017 [TMUS-FCC-01225575]

Email from Amir Rozwadowski to Nils Paellmann, "AT&T: Expect to Leverage Network and Cash Flow as Key Differentiators," *T-Mobile*, Feb. 26, 2018 [TMUS-FCC-0002597]

"T-Mobile US Enterprise Risk Assessment (EV)," *T-Mobile*, Quarter 2 2018 [TMOPA_06412702_0000001]

"5G Demand Forecast v9b," *T-Mobile*, June 27, 2018 [TMOPA_04641354_00000001]

"18.2 Customer Demand Forecast," *Sprint* (attached as Exhibit 8)

Network Build Model [Refer to information request response item 13, folder labeled "Specification 13 Exhibit A Engineering Model"]

Articles

Wireless Market Structures and Network Sharing, OECD DIGITAL ECONOMY PAPERS 243 (2014)

Mark Ivaldi, *et al*., *The Economics of Tacit Collusion*, FINAL REPORT FOR DG COMPETITION, EUROPEAN COMMISSION (2003)

Christos Genakos, *et al*., *Evaluating Market Consolidation in Mobile Communications*, CENTRE ON REGULATION IN EUROPE (Sep. 15, 2015)

Christos Genakos, *et al*., *Evaluating Market Consolidation in Mobile Communications*, CESIFO WORKING PAPER 6509 (May 2017).

Roger Cheng, *AT&T: Now you pay less for a no-contract phone plan*, CNET (Dec. 5, 2013), https://www.cnet.com/news/at-t-now-you-pay-less-for-a-no-contract-phone-plan/

Jessica Guynn, *AT&T to stop offering two-year contracts*, USA TODAY (Dec. 30, 2015), https://www.usatoday.com/story/tech/2015/12/30/att-to-stop-offering-two-year-contracts/78087824/

AJ Dellinger, *Sprint officially kills two-year contracts, no one mourns*, DIGITAL TRENDS (Jan. 9, 2016), https://www.digitaltrends.com/mobile/sprint-kills-two-year-contracts-news/

Industry Data

FED. COMMC'NS COMM'N, OPENNESS IN THE MOBILE BROADBAND ECOSYSTEM (Aug. 20, 2013), https://transition.fcc.gov/cgb/oiac/Mobile-Broadband-Ecosystem.pdf.

All other materials cited in the declaration, exhibits, and appendices.

APPENDIX H: JOINT SUPPLEMENTAL DECLARATION OF PROFESSOR STEVEN C. SALOP AND DR. YIANIS SARAFIDIS

Charles River Associates

Reply to Harrington / Brattle Declaration on the Coordinated Effects Analysis of the Proposed T-Mobile / Sprint Merger Transaction

Table of Contents

I. Overview and Executive Summary

1. In our Initial Declaration, we presented analysis that led us to conclude that the Federal Communications Commission ("Commission") would lack a credible basis to conclude that the proposed T-Mobile / Sprint merger transaction would increase the risk of successful coordination or encourage attempts to coordinate.[1] Professor Harrington, and his co-authors, Dr. Bazelon, Dr. Verlinda, and Dr. Zarakas from the Brattle Group (hereinafter "Harrington / Brattle" or "HB"), submitted a declaration on behalf of DISH.[2] In their declaration, HB commented on our Initial Declaration and provided their own analysis of the coordinated effects of the proposed merger. They reached the conclusion that "the merger not only makes tacit collusion substantively more likely, but there would be a serious risk of tacit collusion in the post-merger market."[3]

2. In this Supplemental Declaration, we evaluate their comments and analysis. Their analysis falls short because it does not properly account for three key factors that are critical to consider in a proper economic analysis of this merger and formed the basis of our analysis. First, their declaration ignores the impact of the large expected efficiencies in 5G. Second, it ignores the fact that the interplay between these future efficiencies and the dynamic demand for wireless services would reduce the coordination incentives of New T-Mobile. Third, it ignores the impact on incentives of the disruptions to the market over time as technology shifts from 4G LTE to 5G and as New T-Mobile will be rolling out a 5G network that it expects to be superior to that of AT&T and Verizon.

3. HB consider factors that may make a market more or less vulnerable to coordination, as we did in our Initial Declaration, but they confine their analysis to a subset of the relevant factors. HB argue that the market is "suitable" for coordination, focusing on the reduction in the number of competitors, the increase in the market share of the merged firm, small retail buyers, nominal price transparency, and elimination of long term contracts. In this Supplemental

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1 Joint Declaration of Professor Steven C. Salop and Dr. Yianis Sarafidis, PUBLIC INTEREST STATEMENT OF T-MOBILE AND SPRINT (APPENDIX H) (hereinafter *Initial Declaration*).

2 Declaration of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda & William Zarakas, PETITION TO DENY OF DISH NETWORK CORPORATION (APPENDIX B) (hereinafter *HB Declaration*).

3 *HB Decl.* at 13.

Declaration, we explain that we addressed the factors raised by HB in our Initial Declaration, and also explain that a more complete analysis based on all the "checklist" factors, which include others that HB simply failed to analyze, supports our earlier conclusions.

4. HB calculate a vertical gross upward pricing pressure index ("vGUPPI") to gauge the incentives of T-Mobile and Sprint to raise wholesale prices to TracFone. HB implemented the formulas to calculate the index incorrectly. After correcting HB's errors, we find that the value of the index is significantly lower than they calculated. Moreover, the economic significance of the upward pricing pressure alleged by HB (when corrected) is trivial, in the sense that it corresponds to only a de minimis increase in TracFone's costs and therefore a de minimis effect on TracFone's subscribers.

5. In support of their analysis that the merger would increase the likelihood of coordination, HB also calculate a pricing pressure index of coordinated effects, the Coordination Price Pressure Index ("CPPI"). This index was developed by co-authors and ourselves to gauge the coordinated effects of the now-abandoned 2011 merger of AT&T and T-Mobile, and HB misunderstand the circumstances in which this metric is and is not a meaningful economic tool.[4] HB conclude that the difference between the post-merger CPPI and the pre-merger CPPI suggests that the proposed T-Mobile/Sprint merger likely would increase the incentives to engage in coordinated conduct through price leadership. In this Supplemental Declaration, we explain that the CPPI framework was developed to gauge incentives of coordinated conduct solely between two leading firms (e.g., AT&T and Verizon) and how these incentives would change if one of these two firms acquired a smaller firm (e.g., T-Mobile). Hence, this framework and the index are not applicable to the proposed T-Mobile/Sprint merger.

6. The HB criticisms are based on flawed economic analysis, and our earlier conclusion stands that the Commission would lack a credible basis to find that the merger would increase the risk of successful coordination or encourage attempts to coordinate.

7. The remainder of this declaration is organized as follows. Section II focuses on the three factors that were not properly taken into account by the HB Declaration. Section III reviews the

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4 Serge Moresi, David Reitman, Steven C. Salop & Yianis Sarafidis, *Gauging Parallel Accommodating Conduct Concerns with the CPPI* (2011), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1924516 (click "Open PDF in Browser," then click "Download Anonymously").

key arguments presented in our Initial Declaration and explains how the HB Declaration fails to undermine this analysis. Section IV discusses HB's and our analysis of coordination "checklist" factors. Section V explains the flaws in their vGUPPI and CPPI analyses of this merger. Section VI concludes.

II. The HB Analysis Did Not Properly Take into Account Three Key Economic Factors

8. One overarching theme of this Supplemental Declaration is that HB's analysis did not properly take into account three key factors that should be considered as part of an analysis of New T-Mobile's economic incentives. In this section, we explain why the omission by HB of these three key factors invalidates their criticisms of our analysis.

A. The Efficiency Benefits of the Proposed T-Mobile / Sprint Merger

9. In the Public Interest Statement ("PIS"), the Chief Technology Officers of both Sprint and T-Mobile explained that the merger will generate network efficiencies which will allow New T-Mobile to offer a substantially superior network than either of the standalone firms.[5] They explained that, relative to the standalone firms, New T-Mobile will have increased capacity, superior quality of experience, and reduced marginal cost of capacity expansion. The Chief Technology Officer of T-Mobile presented quantitative estimates of some of these efficiencies generated by a network model that was based on the model that T-Mobile uses in the ordinary course of business.[6]

10. The PIS also described three categories of merger efficiencies that will begin to be achieved during the transition period after the merger closing but before 5G efficiencies are fully realized. First, there will be reductions in non-network marginal costs associated with dealer commissions, equipment purchases, and other device costs. Second, there will be reductions in

[5] *See* Declaration of Neville R. Ray, Executive Vice President and Chief Technology Officer, T-Mobile US, Inc. (hereinafter *Ray Decl.*), and Declaration of John C. Saw, Chief Technology Officer, Sprint Corporation.

[6] *Id*. ¶¶ 53-58. These estimates pertained to the theoretical capacities and speeds of the three (T-Mobile, Sprint, and New T-Mobile) networks, that is assuming no congestion on these networks. T-Mobile has now extended the network model and obtained estimates of network quality as will be perceived by actual subscribers given projected congestion levels. Moreover, the model yields estimates of the network marginal costs on the three networks. These estimates are discussed in more detail in the Declaration of Israel, Katz and Keating.

legacy Sprint's network marginal cost due to elimination of roaming charges for legacy Sprint subscribers who will be able to use the legacy T-Mobile network. Third, there will be network quality improvements from New T-Mobile's implementation of a multi-operator core network ("MOCN"), which will allow customers with compatible devices to access sites and spectrum from both partners' legacy networks, thus taking advantage of the best of both networks in terms of coverage, signal strength and capacity.

11. As we noted in our Initial Declaration, the 2010 Horizontal Merger Guidelines ("Merger Guidelines")[7] state that "incremental cost reductions may make coordination less likely or effective by enhancing the incentive of a maverick to lower price or by creating a new maverick firm."[8] Because the merger is expected to generate substantial efficiencies in terms of reduced marginal costs and quality improvements, a coordinated effects analysis that fails to take account of these efficiencies and their effects on New T-Mobile's incentives, such as that offered by HB, is inadequate.

12. The HB Declaration does not take into account any effects of these expected efficiencies. As a result, their analysis of the impact of the merger on the incentives of New T-Mobile to behave as a maverick versus settle into coordinated conduct with AT&T and Verizon, and their criticisms of our analysis, are fundamentally flawed.

B. The Role of Dynamic Demand Coupled with Future Efficiencies for Short Term Incentives

13. The HB Declaration also ignores the key role of dynamic demand that we explained in our earlier analysis. When coupled with expected future efficiencies, dynamic demand creates procompetitive incentives for New T-Mobile to grow its subscriber base even before the expected future efficiencies are fully realized. While T-Mobile is already currently using its Un-Carrier strategies to build future share, New T-Mobile will have an increased incentive to continue its Un-carrier strategies and compete aggressively, in order to expand the customer base that will be able to take advantage of the efficiencies created by the merger.

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7 U.S. Dep't of Justice and Fed. Trade Comm'n, Horizontal Merger Guidelines (2010) (hereinafter *Merger Guidelines*), http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf.

8 *Id*. at 30.

14. In our Initial Declaration, we explained that various industry characteristics, such as word-of-mouth advertising, signaling effects, and switching costs make demand dynamic in the sense that gaining additional subscribers today will lead to more subscribers in the future.[9] Coupled with the fact that the merger is expected to significantly reduce the marginal cost of 5G network expansion and operations and increase 5G network quality over time (relative to the standalone firms), the presence of dynamic demand gives New T-Mobile significant incentives to continue to behave in procompetitive ways during the transition period after closing, passing through a portion of these future cost reductions and future quality improvements, and growing its subscriber base even before the 5G network is complete and before 5G-compatible devices are ubiquitous. The point is that the future cost and quality efficiencies reduce the opportunity cost of expanding output and lowering price even before New T-Mobile actually realizes those efficiencies.[10]

15. This incentive is further reinforced by the existence of increasing marginal costs of subscriber acquisition in any given time period. As a consequence of switching costs, only a limited pool of potential new subscribers is generally available in any period. As a result, the marginal out-of-pocket or opportunity costs of attracting additional new subscribers in any given period will tend to rise with the number of new subscribers obtained in that period, as more advertising and deeper cost promotions become necessary to attract more subscribers.[11] As a result, if a carrier wants a larger installed base in the future because of projected cost reductions, that carrier will have an incentive to begin attracting subscribers during the transition period before the efficiencies actually kick in.[12]

16. This analysis has important implications for coordinated effects analysis. As we explained in our Initial Declaration, New T-Mobile will have an increased incentive (relative to the standalone firms) to continue its disruptive, Un-carrier strategy, both in the future when the

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9 *Init. Decl.* ¶¶ 65-70.

10 *Id.* ¶¶ 56-58.

11 As explained by Peter Ewens with a simple numerical illustration, "it is less costly to add 1,000 subscribers in one quarter and another 1,000 subscribers in the following quarter, rather than add 2,000 subscribers in the same quarter." Declaration of Peter Ewens, Executive Vice President, Corporate Strategy, T-Mobile US, Inc. ¶ 22.

12 *Init. Decl.* ¶ 66.

transition to 5G technology is well underway, and also in the transitional period before the expected 5G efficiencies are realized.[13] Ignoring this part of our analysis is a serious deficiency in the HB analysis of New T-Mobile's incentives to continue to behave as a maverick firm.

C. Disruptions Brought About by Technological Shift to 5G

17. Successful coordination is facilitated by a stable competitive environment. Stability facilitates reaching a common understanding of how firms will coordinate and reduces the risk that a firm's cooperative behavior is misinterpreted by rivals as an attempt to cheat. In our Initial Declaration, we explained that the technological transition from 4G LTE to 5G will disrupt the industry in ways that make coordination unlikely.

18. We specifically explained that the transition to 5G will occur at the same time that New T-Mobile will be rolling out an improved and lower cost 5G network that it expects to be superior to that of AT&T and Verizon. Furthermore, the disruption by the new 5G technology will induce firms to experiment with offering new service packages, which emphasize each carrier's unique combination of assets. And, because each carrier will be rolling out its 5G network incrementally over time and geography by geography, the disruption will also have a diverse geographic dimension.[14] The HB Declaration fails to mention or analyze the disruption that will be caused by the arrival of 5G technology.

III. The HB Declaration Fails to Undercut Our Coordinated Effects Analysis

19. The criticisms and arguments in the HB Declaration do not rebut our analysis. They omit the critical factors discussed in the previous section, they often simply ignore our analysis, and they sometimes agree with our analysis regarding how certain industry factors tend to hinder successful coordination. We discuss their criticisms in the context of the three categories of potential coordination set out in our Initial Declaration.

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[13] *Id.* ¶¶ 60-63.

[14] *Id.* ¶¶ 43-45.

A. Coordination in Network Investment

20. While network investment has been an important dimension of competition among wireless carriers in the past, the imminent technological transition from 4G LTE to 5G elevates its importance going forward. Carriers must decide how much to invest in 5G, how quickly, and which geographies to prioritize.

21. In our Initial Declaration, we provided several reasons why coordination aimed at reducing 5G network investment is not a credible concern. First, the level and type of network investments cannot be easily or rapidly monitored. Even though network investment expenditures are public information, they are reported with a delay (e.g., when the previous quarter's financials are reported) and only at the national level. Permits can be monitored, but they do not provide adequate information on the type of investment. Therefore, deviations can go undetected, which undermines attempts to engage in coordinated conduct. Second, the merger efficiencies will reduce costs, increase network quality and increase New T-Mobile's capacity (relative to the standalone firms). This will give New T-Mobile an increased procompetitive incentive to invest in network quality to grow its subscriber base rather than to settle into coordinated interaction with AT&T and Verizon. Third, network investments are irreversible decisions (e.g., in contrast to price increases that can be rescinded relatively quickly). Fourth, there will be a long lead time before another carrier can respond to defections once they are detected. Long lead times, coupled with slow detection, means that would-be defectors would enjoy a long lasting advantage before any punishment would be possible. This increases the temptation to cheat and would make coordination less likely to succeed.[15]

22. The HB Declaration is essentially silent on the likelihood of coordination in 5G network investment. In a footnote, they simply state that our analysis is "incomplete."[16] But, they do not explain how or why our analysis is incomplete, or offer their own analysis of coordination in network investment.

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[15] *Id.* ¶¶ 37-40.

[16] *HB Decl.* at 89 n. 145.

B. Coordination in 5G Pricing and Quality

23. Pricing and quality of service are also important dimensions of competition and will remain so after 5G technology becomes established. In our Initial Declaration, we explained that coordination in 5G pricing and quality would face severe impediments, so that there is no credible basis for concluding that coordination is likely. First, merger efficiencies will lead New T-Mobile to significantly expand its network capacity, increase its network quality, and reduce its network and non-network marginal costs (relative to the standalone firms). These large efficiency benefits will decrease the likelihood of coordination because they provide a significantly increased incentive to the merged firm to grow its subscriber base, by increasing network quality and lowering quality-adjusted prices. Hence, the merged firm will have an increased incentive to deviate from a hypothetical price or quality coordination outcome, relative to the standalone firms. Second, the industry will be transitioning to 5G at the same time as New T-Mobile will be rolling out a 5G network that it expects to be superior to that of AT&T and Verizon. New T-Mobile also will have lower profitability than AT&T and Verizon.[17] This asymmetry, coupled with the overall industry disruption brought about by the arrival of 5G, will impose obstacles to attempts to coordinate. Third, product differentiation will continue to hinder reaching and maintaining a common understanding that is necessary for successful coordination. In light of the overall market disruption brought about by the arrival of 5G, each carrier will be searching for the right competitive positioning, given the characteristics of its own 5G network. It is reasonable to expect that the carriers will continue to offer service packages that differ according to each carrier's unique mix of assets on numerous dimensions of competition, including coverage, speed, handsets, throttling thresholds, zero rating content, the prices and components (i.e., triple-play and video content) of bundled packages, as well as the basic service plan price. This product differentiation will likely extend into the future and may well increase. For example, whereas AT&T has acquired DirecTV and Time Warner, Verizon has not vertically integrated in this way. Fourth, as carriers will be rolling out their 5G networks over time in different geographies, so the market will be disrupted in different ways in each

[17] As we noted in our Initial Declaration, in the first quarter of 2018, a combined Sprint and T-Mobile accounted for about 25 percent of industry EBITDA (approximately 12 percent each), lagging behind AT&T (30 percent) and Verizon (45 percent). *Init. Decl.* ¶ 79.

geography. In this environment, it will be difficult, if not impossible, to reach and enforce a common understanding, or facilitate parallel accommodating conduct, across the wide area of local areas. Fifth, the emergence of competition from cable MVPDs will provide additional impediments to successful coordination.[18]

24. The HB declaration does not take into account the merger efficiencies and disruption brought about by 5G. Both of these factors are central to our analysis of why coordination in 5G pricing and quality is unlikely. HB acknowledge that products are differentiated and complex, but fail to explain why coordination could occur despite this product differentiation and complexity.[19] And they entirely fail to consider how the transition to 5G may increase the degree and complexity of product differentiation, in addition to the other factors.

C. Coordination in the Short-Term Transition Period

25. In our Initial Declaration, we explained why there is no a credible basis for the Commission to conclude that the merger would increase the likelihood of coordination in the transitional time frame during which 4G LTE traffic is still predominant, and before most of the 5G network efficiencies are achieved. We made the following points. First, T-Mobile has built its branding image by being a disruptive force in the industry, the so-called “Un-carrier,” and plans to maintain and reinforce this image with continued maverick conduct.[20] Second, we explained that these plans to maintain its maverick conduct and compete intensely in the short-term are consistent with New T-Mobile’s economic incentives in light of the fact that demand is dynamic and there will be large 5G network efficiencies.[21] Third, while the full realization of the merger’s network efficiencies will take a number of years, we understand that New T-Mobile expects that the merger will generate efficiencies in the short run as well. These efficiencies will reinforce New T-Mobile’s incentive to behave like a disruptive maverick and seek additional incremental subscribers in this time frame, rather than to coordinate with AT&T and Verizon.[22]

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18 *Id.* ¶¶ 41-46.

19 *HB. Decl.* at 87 (“network operators do not charge a single price”; “network operators offer similar, but not identical, services”; “These complications would not prevent tacit collusion”).

20 *Init. Decl.* ¶ 24.

21 *Id.* ¶ 59.

22 *Id.* ¶ 61.

In our Initial Declaration, we also explained that analysis of coordination "checklist" factors do not change this conclusion.[23]

26. HB argued that T-Mobile's long reputation as a maverick will have no constraining impact on its willingness to coordinate in the future. In the view of HB, the elimination of the constraint from standalone Sprint and the increase in T-Mobile's market share will reduce or eliminate New T-Mobile's incentive to continue its maverick conduct. However, as we have explained, an analysis of maverick incentives that ignores merger efficiencies is not valid. This point is also recognized in the Merger Guidelines, which explain that "incremental cost reductions may make coordination less likely or effective by enhancing the incentive of a maverick to lower price or by creating a new maverick firm."[24]

27. As we discussed in our Initial Declaration, the combination of dynamic demand and future efficiencies will give New T-Mobile an incentive to continue to behave as a maverick during the transitional period when 4G LTE is still the predominant technology. Because the merger is expected to significantly reduce New T-Mobile's marginal cost over time (relative to the standalone firms), the presence of dynamic demand and the rising marginal cost of acquiring new subscribers in each period imply that New T-Mobile will have a significant incentive to begin to pass through these future cost reductions and future quality improvements starting right after the merger is consummated. In effect, the future cost and quality efficiencies reduce the opportunity cost of expanding output and lowering price even before actually realizing those efficiencies.

28. HB do not dispute this analysis of pricing incentives in the presence of dynamic demand and future efficiencies. They argue that the incentives to grow share will end once New T-Mobile directly gains scale from the merger.[25] But, they ignore any impact on incentives to grow share in the short term that result from merger efficiencies in the longer term.

29. HB argue that the market is vulnerable to coordination, focusing on the reduction in the number of competitors, the increase in the market share of the merged firm, small retail buyers,

[23] These "checklist" factors are discussed in Section IV *infra*.

[24] *Merger Guidelines*, *supra* note 7, at 30.

[25] *HB Decl.* at 69-70 ("With the demand-side and supply-side benefits realized from the expansion of its customer base as a result of the merger, it would not be optimal for New T-Mobile to employ a maverick strategy").

nominal price transparency, and elimination of long term contracts. However, we addressed these issues in our Initial Declaration and explained why those checklist factors, in conjunction with the other checklist and incentive factors that should be considered, fail to establish a valid basis to conclude that the merger would increase the risk of successful coordination or encourage attempts to coordinate. We turn next to a review of those checklist factors and HB's analysis of them.

IV. HB's Limited Analysis of Checklist Factors Does Not Provide a Valid Basis for Concluding a High and Increasing Likelihood of Coordination

30. In our Initial Declaration, we considered what antitrust practitioners refer to as "checklist" factors that may make a market more or less vulnerable to coordination. We concluded that the totality of these checklist factors do not indicate that New T-Mobile would soften or eliminate its disruptive maverick conduct.[26]

31. The HB Declaration also analyzes a selected number of these factors to argue, in contrast, that the market is "suitable" for tacit collusion,[27] and that "a merger between Sprint and T-Mobile would result in a market structure for which tacit collusion is significantly more likely."[28] However, they did not address our reasons for concluding that these checklist factors on balance (and in conjunction with the other key factors) fail to provide a valid basis for concluding that there is a significant likelihood of coordinated conduct after the merger.

A. Product Differentiation, Complexity and Transparency

32. HB observe that transparent pricing, by which they mean that "firms can easily and quickly observe rival firms' prices,"[29] is a factor facilitating coordination. This is a point we acknowledged.[30] However, we also made the point that this is an over-simplification because while nominal prices and the terms of the wireless plans are public, wireless service quality and

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26 *Init. Decl.* ¶¶ 71-88.

27 *HB Decl.* at 56-65.

28 *Id.* at 86.

29 *Id.* at 57.

30 *Init. Decl.* ¶ 73 (citing *Merger Guidelines*, *supra* note 7, at 26).

the offered service packages are differentiated and complex. Quality of service also has several dimensions (e.g., coverage, speed, latency) that can differ according to where and when a device is used within the subscriber's service area. Service plans also involve multiple dimensions that differ among carriers, including price differences in the number of lines, streaming speeds, throttling thresholds, zero rating content, international roaming, bundled packages, device availability, device pricing, as well as plan prices. In support of these points, we quoted from an FCC Report recognizing the complexity of wireless plans and the difficulty in comparing prices.[31] In fact, HB also seem to agree with these points.[32]

33. Therefore, despite the transparency of posted nominal prices, the existence of product differentiation and complexity would complicate attempts to coordinate. For example, a common understanding would need to be achieved on a significant number of important dimensions. The same complexity would also deter coordinated parallel accommodating conduct, as a potential defector could choose to deviate along a dimension where it would be more difficult for rivals to efficiently and rapidly respond. The HB Declaration acknowledges these points, referring to them as "complications" for coordination, but concludes that coordination is likely despite these complications.[33] In our view, all the checklist factors must be evaluated in total, and in conjunction with the key factors that HB ignore. When this analysis is carried out, our conclusion stands.

B. Market Asymmetries

34. HB point out that the merger will lead to more symmetric subscriber market shares, which they argue will more closely align the incentives of New T-Mobile with those of AT&T and Verizon.[34] In our Initial Declaration, we noted that, while not discussed in the Merger

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[31] *Id.* ¶ 75 (citing Federal Communications Commission, *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, 32 FCC Rcd. 8968 (Sept. 27, 2017) ¶ 57).

[32] *HB Decl.* at 87 ("A firm's offerings are multi-dimensional as a plan has a monthly payment with a maximum number of minutes, overage charges (which could take the form of an additional fee or slower speeds), discounts for additional lines, and so on.").

[33] *Id.* at 87 ("These complications would not prevent tacit collusion").

[34] *Id.* at 83 ("As the merger would result in New T-Mobile having a market share similar to that of AT&T and Verizon, the post-merger market would have firms whose pricing incentives are much better aligned compared to the pre-merger market.").

Guidelines, similarity or differences among firms in the market is one of the checklist factors that antitrust practitioners often consider.[35] However, HB did not take into account the other post-merger asymmetries that we explained would cut sharply in the other direction. These include asymmetries in the profits of the carriers,[36] and asymmetries in the product offerings of the carriers resulting from differences in their product portfolios and degrees of vertical integration.[37] Moreover, differences in product offerings, stemming from carriers' efforts to search for the right competitive positioning in the future 5G world given underlying differences in their assets, likely will create yet another source that misaligns carriers' incentives to coordinate.

35. There also are dramatic asymmetries in market shares in the enterprise segment, where, we understand, T-Mobile[38] and Sprint[39] have very small competitive significance relative to AT&T and Verizon. This is a large subscriber segment (about 40 million subscribers)[40] and the small share of T-Mobile and Sprint make it a significant profit opportunity. HB speculate that the carriers might engage in market division between the enterprise and retail segments or might agree not to poach rivals' customers. However, we see no reason to think that such a market division or customer allocation scheme would succeed.[41] In fact, HB themselves state that "it is unclear how easily firms could coordinate" on a no-poach agreement.[42]

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35 *Init. Decl.* ¶ 77.

36 *Id.* ¶ 79.

37 *Id.* ¶ 80.

38 As explained by G. Michael Sievert, "T-Mobile is not a significant competitive factor in the enterprise segment of the market today. It has only a very small share of the business market segment, including small businesses, and only a 4 percent share of the large enterprise and government portion of the segment." Declaration of G. Michael Sievert, President and Chief Operating Officer, T-Mobile US, Inc. ¶ 43.

39 As explained by Brandon Draper, "Sprint estimates that it has low single digit share of the total wireless enterprise business." Declaration of Brandon "Dow" Draper, Chief Commercial Officer, Sprint Corporation ¶ 31.

40 *Id.* ¶ 31.

41 We doubt that HB are assuming that AT&T and Verizon would cede the retail market to New T-Mobile in exchange for New T-Mobile not to compete in the enterprise segment. A no-poach agreement would be particularly unlikely, given the low shares of T-Mobile and Sprint in this segment. Aside from the very small shares of T-Mobile and Sprint, contracts are awarded by non-public RFPs. These facts suggest that pricing coordination or a no-poach agreement would be very difficult to sustain.

42 *HB Decl.* at 91.

C. Retail Buyer Size, Infrequency of Purchases and Switching Costs

36. Buyer size and frequency of purchases are additional checklist factors. The Merger Guidelines consider these two factors in conjunction when they explain that a "firm is more likely to be deterred from making competitive initiatives by whatever responses occur if sales are small and frequent rather than via occasional large and long-term contracts."[43] HB make the points that retail buyers are typically small[44] and long-term contracts are no longer the norm,[45] points that we recognized in our Initial Declaration.[46] But, we further observed that carriers face customer stickiness from other sources of switching costs, which makes sales infrequent and thus cuts in the opposite direction. We also explained how this consumer stickiness leads to the dynamic demand structure, which is important to understanding competitive dynamics in this market.

37. We explained that as a matter of economic theory, switching costs have an ambiguous effect on coordination incentives. On the one hand, switching costs reduce the profitability of defection by reducing the number of subscribers obtained by the defector when it initially cuts price. But, on the other hand, switching costs mean that the defector is more likely to retain the incremental subscribers gained by defecting when the defection is eventually detected and rivals respond to it.[47] This ambiguous effect of switching costs was also acknowledged by HB.[48]

38. While noting that the impact of switching costs on coordination incentives involves a general tension between two opposing effects, we explained that the existence of switching costs *in this merger* likely reduces the likelihood of successful coordination. This is because the switching costs contribute to dynamic demand, which coupled with anticipated future efficiencies, give New T-Mobile the incentive to behave in procompetitive ways, not only in the future, but also during the transition period after the merger closing before these efficiencies are fully realized.[49]

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43 *Merger Guidelines*, *supra* note 7, at 26.

44 *HB Decl.* at 59 ("buyers are largely individual consumers").

45 *Id.* at 59 ("the four network operators have not used long-term service contracts since late 2015").

46 *Init. Decl.* ¶ 81.

47 *Id.* ¶ 82.

48 *HB Decl.* at 61 ("The net effect of higher switching costs on the stability of tacit collusion is ambiguous.").

49 *Init. Decl.* ¶ 83.

Because their analysis does not take these efficiencies into account, HB failed to even address this point.

39. It does appear that HB generally would agree that switching costs make this industry less vulnerable to coordination. We base this inference on HB's statement that the "market has become more suitable for tacit collusion on prices since 2011 because the four network operators have not used long-term service contracts since late 2015."[50] But, HB argue that the elimination of long term contracts and termination fees has reduced switching costs. Their implication apparently is that whether switching costs make coordination more or less likely is a moot point because switching costs are no longer significant. However, their inference that switching costs have been substantially eliminated by the end of long term contracts and termination fees is erroneous for two reasons.[51]

40. First, their claim is controverted by the fact that churn rates have remained low.[52] The HB Declaration attempts to neutralize this fact by suggesting that the failure of churn rates to rise might have been caused by the fact the T-Mobile quality has increased over the same period.[53] However, this suggested explanation fails. While that higher quality might account for a constant or lower churn rate for T-Mobile subscribers, it would not account for the continued low churn rates of other carriers. In fact, if T-Mobile quality rose and there were not consumer inertia or other switching costs, that would tend to increase the churn rates at all three of the other carriers.[54]

41. Second, long term contracts are not the only source of switching costs, as we discuss in our Initial Declaration.[55] For example, the elimination of long term contracts has been accompanied by a growing fraction of subscribers purchasing their own phones. This means that

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50 *HB Decl.* at 59.

51 HB do not discuss the other sources of dynamic demand — word-of-mouth advertising and market signaling.

52 *Init. Decl.* ¶ 69.

53 *HB Decl.* at 62 ("A potential explanation for the declining churn rates for T-Mobile relative to the other carriers is due to this narrowing of the quality gap").

54 HB also point to pricing convergence as a possible reason for lower churn. *See HB Decl.* at 62 ("This decline in the quality differential along with the convergence in pricing"). However, this explanation fails because there are still significant price and quality differentials.

55 *Init. Decl.* at ¶ 68. .

there can be several hundred dollars of out-of-pocket costs if it is necessary to purchase a new device when switching carriers (i.e., if the subscriber's old device is not compatible with the new carrier). There also are time costs involved in researching other carriers, cancelling the old service and subscribing to the new carrier. The switching decision also involves uncertainty regarding the network quality and customer service of the new carrier, which consumers also may wish to avoid. These other switching costs are conceded by the HB Declaration, which notes the "time and psychological ("hassle") costs" involved in switching carriers and the reasons for these costs.[56]

D. MVNOs and Cable Competition

42. In our Initial Declaration, we explained that facilities-based carriers face competition from MVNOs, which could expand in response to an attempt by the facilities-based carriers to coordinate.[57] HB discount the potential role of MVNOs in defeating coordination by the facilities-based carriers on the grounds that the facilities-based carriers control the costs, quality of service, and capacity of MVNOs, so that the MVNOs should not be considered independent competitors.[58] However, as we explained in our Initial Declaration, MVNOs are powerful buyers with the ability to move significant purchases among the facilities-based carriers with long term contracts.[59] Contracts are not publicly observable, so deviations are hard to detect. Thus, MVNOs have the ability to defend themselves against attempts by the facilities-based carriers to control them or coordinate in the wholesale segment.

43. HB concede that coordination in the wholesale segment would be difficult.[60] But, they suggest that coordination in the wholesale segment could occur, either via customer allocation (whereby carriers agree not to poach each other's customers) or via multi-market contact (whereby carriers divide market shares between the retail segments).[61] As noted earlier in the

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56 *HB Decl.* at 61.

57 *Init. Decl.* ¶ 85.

58 *HB Decl.* at 60. We discuss HB's foreclosure analysis, in Section V.A *infra*.

59 *Init. Decl.* ¶ 86.

60 *HB Decl.* at 90 ("Earlier analysis expressed that the enterprise and wholesale markets are not particularly suitable for tacit collusion.").

61 *Id.* at 91.

context of coordination in the enterprise segment, these types of agreements seem highly unlikely.[62]

44. In our Initial Declaration, we also pointed out that coordination in the retail market would face cable MVPDs, who pose an entry threat. We explained that while they currently operate as MVNOs, they have several assets that make them a distinct threat. These assets include the ability to leverage Wi-Fi hotspots to offload traffic to reduce costs, the ability to market to their own cable subscribers which lowers subscriber acquisition costs, and countervailing bargaining power in dealing with the facilities-based carriers.[63] HB do not acknowledge cable MVPDs as a distinct type of MVNOs and do not discuss cable entry in their discussion of barriers to entry.[64]

V. The HB vGUPPI and CPPI Analyses are Fundamentally Flawed

45. The HB Declaration calculates two indices, the Vertical Gross Upward Pricing Pressure Index ("vGUPPI") and the Coordination Price Pressure Index ("CPPI"). They calculate the vGUPPI to gauge the impact of the merger on the incentives of T-Mobile and Sprint to increase wholesale prices to MVNOs. They use the CPPI to gauge the impact of the merger on the likelihood of successful coordination through price leadership. However, as explained next, their analyses of both these indices are fundamentally flawed.

A. The HB vGUPPI Analysis Is Invalid

46. HB discount the potential role of MVNOs in defeating coordination by the facilities-based carriers on the grounds that the facilities-based carriers control the costs, quality of service, and capacity of MVNOs. HB gauge New T-Mobile's incentives to foreclose MVNOs by increasing their costs with a vGUPPI analysis of wholesale prices charged to TracFone. However, HB implemented the formulas to calculate these indices incorrectly.[65]

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[62] *Supra* note 41.

[63] *Init. Decl.* ¶ 87. The countervailing power comes from their control over backhaul, small cell sites and video content. *Id.*

[64] *HB Decl.* at 59-61.

[65] *See* Serge Moresi & Steven C. Salop, *vGUPPI: Scoring Unilateral Pricing Incentives in Vertical Mergers,* 79 ANTITRUST L.J. 185 (2013). We follow HB's use of the equations in this article.

47. First, HB did not adjust for the fact that T-Mobile accounts for [redacted] of TracFone's subscribers and Sprint accounts for [redacted] of TracFone's subscribers.[66] Second, HB incorrectly implemented the equation for *vGUPPIu* for the case with input substitution.[67] Third, they failed to take into account the fact that, following a wholesale price increase by T-Mobile targeted at TracFone, Sprint earns a margin on sales diverted from TracFone to other MVNOs that purchase wholesale from Sprint.

48. We corrected these errors, using the other HB data inputs and assumptions. We made these corrections on the more relevant scenario that takes input substitution by TracFone into account.[68] The resulting *vGUPPIu* for T-Mobile is 5.5 percent.[69]

49. Furthermore, HB failed to analyze the magnitude of the downstream impact of any wholesale price increases. This failure can lead to a serious misinterpretation of the market impact. The *vGUPPIu* can be interpreted as an opportunity cost increase for the upstream firm. For example, the T-Mobile *vGUPPIu* of 5.5 percent expresses that the effect of the merger on the wholesale pricing incentives of T-Mobile (vis-à-vis TracFone) is equal in magnitude to the effect on T-Mobile's pre-merger incentives of a 5.5 percent increase in T-Mobile's marginal cost (expressed as a fraction of the pre-merger wholesale price paid by TracFone). This interpretation raises two issues: (i) TracFone's costs (i.e., the wholesale prices it pays) will rise only by a fraction of the *vGUPPIu*, which depends on the pass-through rate of T-Mobile and the input substitution options of TracFone; and (ii) to the extent that merger efficiencies reduce the marginal cost of T-Mobile, there will be an offsetting effect, thus reducing the "net" *vGUPPIu*, though we (like HB) do not take this efficiency effect into account in our calculations. The

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66 *See* T-Mobile's and Sprint's Responses to FCC Specification 40. These report the number of MVNO subscribers served on the T-Mobile and Sprint networks, separately for each MVNO. The total number of TracFone subscribers is estimated at 23 million subscribers, based on HB's Table 22, *HB Decl.* at 51.

67 This is equation (5) in Moresi & Salop, *supra* note 65, at 202.

68 HB also report a value for *vGUPPIu* that assumes no input substitution by TracFone following a wholesale price increase by New T-Mobile. The assumption of no input substitution is inappropriate because it implies that TracFone uses the network services of AT&T, Verizon, T-Mobile, and Sprint in fixed proportions. However, TracFone can change the facilities-based carriers' shares of its wholesale purchases. This ability of TracFone to substitute among facilities-based carriers for its procurement of network services makes the vGUPPIs for the case with input substitution more appropriate than the vGUPPIs for the case with no input substitution.

69 The corresponding *vGUPPIu* for Sprint is 9.5 percent. But, in light of the fact that Sprint accounts for [redacted] of TracFone subscribers, this is [redacted].

extent to which TracFone's own marginal cost rises is measured by the *vGUPPIr*, not the *vGUPPIu*.[70] Taking into account its ability to engage in input substitution, the *vGUPPIr* corresponding to TracFone's purchases from T-Mobile is only 4 cents (or 0.18 percent, as a percentage of TracFone's retail price of about $23).[71] Put simply, even if New T-Mobile engaged in input foreclosure, HB's (corrected) analysis shows that TracFone's input costs would rise by a de minimis amount. And, this is absent any merger efficiencies.

B. The HB CPPI Analysis Is Not Applicable to the Proposed T-Mobile / Sprint Merger

50. The HB Declaration calculates increases in the CPPI, but fundamentally misunderstands the appropriate application of this tool. Along with Dr. Moresi and Dr. Reitman, we developed this index in the context of the 2011 proposed (then abandoned) AT&T / T-Mobile merger. The HB Declaration argues that the estimated increases in these CPPIs between pre-merger and post-merger imply that a merger between T-Mobile and Sprint is likely to have anticompetitive coordinated effects through price leadership. However, their application of this analysis to this merger is invalid.

51. The CPPI is an index that gauges the incentives of two leading firms (e.g., AT&T and Verizon) to engage in parallel accommodating conduct, whereby one firm initiates a price increase in the hope that the other leading firm will match it. In developing the CPPI, we were quantifying how the incentives to engage in parallel accommodating conduct might change if one leading firm (i.e., AT&T) acquired a smaller firm (i.e., T-Mobile). We suggested that this change in incentives might be gauged by the difference between the post-merger CPPI and the pre-merger CPPI.

52. The fact that the CPPI only gauges coordination incentives between two leading firms, was not a limitation for applying this analysis to the AT&T / T-Mobile merger. In that situation, the CPPI analysis was capturing the fact that one of the merging firms (AT&T) had "a strong incumbency position and the other merging firm threaten[ed] to disrupt market conditions with a

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70 Moresi & Salop, *supra* note 65 at 190.

71 The *vGUPPIr* corresponding to TracFone's purchases from Sprint is [redacted], which is consistent with the fact that Sprint accounts for [redacted] of TracFone's subscribers.

new technology or business model."[72] The CPPI addressed the impact on the likelihood of post-merger coordination between the leading firms (AT&T and Verizon), once AT&T acquires and controls T-Mobile.[73]

53. However, the fact that the CPPI only analyzes coordination between two firms makes it inapplicable for this merger. For example, one proposed two-firm "pre-merger coalition" analyzed by HB is T-Mobile and Verizon.[74] The CPPI suggests that the likelihood of coordination between these two carriers would increase after T-Mobile acquires Sprint. But, in this industry it makes no economic sense to hypothesize successful coordination between T-Mobile and Verizon under the assumption that AT&T would not be part of the coordinating coalition. The same point applies to all the other two-firm coalitions that were analyzed in the HB Declaration that do not include both AT&T and Verizon. Valid inferences cannot be drawn from that analysis for larger coalitions that the CPPI cannot analyze.

54. The HB Declaration does not consider coordination solely between AT&T and Verizon. If the HB Declaration had considered the CPPI for coordination between AT&T and Verizon, it would have found that the T-Mobile / Sprint merger would have no effect. This is because the post-merger CPPI is evaluated at pre-merger prices for all firms. At those prices, neither the sales volume for AT&T and Verizon nor the diversion ratio between them is impacted by the merger, and therefore the merger does not change the CPPI for coordination between AT&T and Verizon.

55. The HB Declaration also does not consider coordination solely between T-Mobile and Sprint. In this case, HB's decision makes sense because coordination solely between them (while holding the prices of Verizon and AT&T constant) is a unilateral effect, not a coordinated effect.

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72 *Merger Guidelines*, *supra* note 7, at 3-4.

73 That CPPI assumed that Sprint would not be part of the group of coordinating firms. That assumption was consistent with Sprint's cost disadvantages and potential exclusionary effects from the AT&T/T-Mobile merger. Joint Reply Declaration of Steven C. Salop, Stanley M. Besen, Stephen D. Kletter, Serge X. Moresi and John R. Woodbury, REPLY COMMENTS OF SPRINT NEXTEL CORPORATION), RE: APPLICATION OF AT&T INC. AND DEUTSCHE TELEKOM AG FOR CONSENT TO ASSIGN OR TRANSFER CONTROL OF LICENSES AND AUTHORIZATIONS, WT Docket 11-65; DA 11-799; ULS File No. 0004669383 (June 20, 2011)(Attachment A)

74 *HB Decl.* at 85. *See* Table 27.

VI. Conclusion

56. As set out above, the analysis in the HB Declaration suffers from a number of factual omissions and analytical flaws, and does not undercut the analysis in our Initial Declaration. We continue to conclude that the Commission would lack a credible basis to conclude that the proposed T-Mobile / Sprint merger transaction would increase the risk of successful coordination or encourage attempts to coordinate.

9/17/2018

Steven C. Salop

Y. Sarafidis 17 Sept 2018

Yianis Sarafidis

APPENDIX I: DECLARATION OF DR. GLENN WOROCH

Declaration of Dr. Glenn A. Woroch

September 17, 2018

I am Adjunct Professor Emeritus of Economics at the University of California, Berkeley, where I was the Executive Director of the *Center for Research on Telecommunications Policy* for many years. I am currently a Senior Policy Scholar with the Georgetown University's *Center for Business & Public Policy*, and also Senior Consultant with Compass Lexecon, an economics consulting firm. Previously, I taught economics at the University of Rochester and Stanford University as well as at Berkeley, and was Senior Member of Technical Staff at GTE (Verizon) Laboratories. I received my Ph.D. in Economics from U.C. Berkeley, and have been an economic advisor to government agencies including the U.S. Departments of Justice and Energy and the Office of Technology Assessment. I have published many articles on industrial organization, regulation, antitrust, intellectual property and network industries. Several of those articles empirically investigated the demand for mobile wireless services and the prospects for competition in the U.S. wireless industry. I served on the editorial boards of *Information Economics & Policy*, the *Journal of Regulatory Economics*, and the journal *Telecommunications Policy*. My Curriculum Vitae is attached to this declaration.

T-Mobile USA has asked me to evaluate the possible competitive effects of its proposed merger with Sprint Corporation. In particular, it has asked that I consider the basis for claims that the merger will harm competition in the provision of prepaid and wholesale services. I summarize my analysis of these issues in this declaration. That analysis has led me to the following conclusions:

- Prepaid plans do not form a separate antitrust market and so this transaction should be evaluated in terms of its competitive effects on the combined "mobile telephony/broadband services" market;
- Any attempts by New T-Mobile to raise prepaid prices would be defeated by consumer behavior and competitors' responses;
- All of the major carriers, including New T-Mobile, will continue to have strong incentives to compete aggressively for prepaid subscribers;
- Wholesale supply of network access to MVNOs will continue to exert competitive pressure on prepaid retail service providers after the merger;
- New T-Mobile would not unilaterally increase wholesale rates because its MVNOs would shift their purchases to competing host networks, depriving it of substantial revenue;
- The merger does not diminish the powerful incentives of owners of spectrum and networks to utilize those sunk assets including sharing them with other providers of retail wireless mobile services.

All the views expressed in this declaration are my own.

I. INTRODUCTION

When prepaid plans were first introduced, they gave individuals with poor or no credit histories, or limited means, a way to enjoy the benefits of mobile telephony.[1] At that time, consumers would buy a phone and calling cards that provided them with a specified number of minutes of talk time. Prepaid plans today bear little resemblance to the original concept except that payments are made in advance of usage. While a user can still buy a "top up card" with minutes of use, the typical prepaid plan has undergone continual transformations over the years. Nevertheless, some have argued, including several Petitioners, that the prepaid segment of mobile subscribers represents a separate relevant market for purposes of competition policy.[2] That is not true today, if it ever had been in the past. I conduct my analysis of the competitive effects of this merger on the "mobile/telephony broadband services" market – a classification used by the Federal Communications Commission (the "Commission") to combine wireless voice and data communication and internet using mobile devices of all sorts.[3]

Resale of wholesale services leased from a network owner has a longer history in the telecommunications industry than prepaid services. Hundreds of long-distance resellers popped up after the divestiture of AT&T to offer interstate and international calling using the networks of the major carriers. Resellers of wireless services, usually called "Mobile Virtual Network Operators" (MVNOs), have been a part of the industry for at least as long as the prepaid model.[4] In fact, the vast majority of MVNOs offer their services on a prepaid basis. The MVNOs' reliance on access to the incumbents' networks and spectrum licenses has been raised by Petitioners as a source of anti-competitive behavior with this merger of two nationwide networks.[5] In reality, this new cohort of providers is pursuing novel applications of wireless technology and unconventional business models that are not completely dependent on incumbents' infrastructure. These include "WiFi first" models exemplified by Google's Project Fi and cable-based wireless services like Comcast's Xfinity Mobile that rely on operators'

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[1] Patents on the technology that implemented prepaid service on a cellular network were granted in the late 1990s. *See* U.S. Patent No. 5,826,185 (Aug. 19, 1996) and No. 6,223,026 (filed Feb. 13, 1998).

[2] Comments of Communications Workers of America (CWA Comments) at p.9; Petition To Deny of DISH Network Corporation (DISH Petition) at 52-56; Petition To Deny Of Common Cause, Consumers Union, New America's Open Technology Institute, Public Knowledge & Writers Guild Of America, West, Inc. (Common Cause, et al. Petition) at 26-28.

[3] *See* Public Interest Statement (P.I.S.) at 11 and the citations there in footnote 30.

[4] Virgin Mobile UK is credited with being the first operational MVNO when it launched in England in November 1999. Virgin Media: From pioneering virtual mobile operator to the world's first quad-play company, at https://www.virgin.com/virgingroup/virgin-media-pioneering-virtual-mobile-operator-worlds-first-quad-play-company).

[5] Petition To Deny Of The American Antitrust Institute (AAI Petition) at p.15; Petition to Condition, Or In The Alternative, Deny Any Grant Of the Sprint/T-Mobile Application (Cellular South Petition) at 11-13; Dr. George S. Ford, Potential Implications of the Sprint/T-Mobile Merger on Wholesale Markets, *Phoenix Center for Advanced Legal & Economic Public Policy Studies*, Submitted with Brief Comments Of The Digital Policy Institute (DPI Comments) at 2-3; Common Cause, et al. Petition at 28-29.

hybrid-fiber coaxial networks (including WiFi hotspots) in addition to the usual wireless infrastructure.

The developments in prepaid and wholesale services teach a familiar lesson: change is constant in the mobile wireless industry.[6] One element that has not changed, however, is the fact that supply of these services require enormous investments in network facilities and spectrum licenses, and those assets are highly sunk. As a result, facilities-based carriers have powerful incentives to utilize those assets with remunerative traffic. MVNOs in particular discover demand that may go unserved but for the wholesale arrangements that enable their businesses. And as New T-Mobile builds its 5G network, the cost of incremental capacity will fall significantly, creating opportunities to profitably accommodate MVNO customers. MVNOs will also be critical to discovering innovative uses of the 5G network as they experiment with novel applications. While many of those alternatives will fail, a few of them will also tap rich veins of revenue. New T-Mobile does not have incentives to raise wholesale rates to extract short term rents from its current MVNOs, and will have incentives to maintain and expand long-term relationships with MVNOs.

In this declaration, I analyze the likely competitive effects that would materialize as a result of this merger as they relate to the welfare of prepaid subscribers and subscribers of MVNOs. I will address theories of harm that have been alleged as a result of the merger affecting these services, and in particular, claims that the merged firm will unilaterally raise the price of prepaid and wholesale wireless services. While my focus will be on impacts to competition in these services, I will attempt to evaluate those impacts on the FCC's broader concept of the public interest. As such, I will explain how the merger will not only preserve the benefits that consumers derive from these services, but also how it will realize technical improvements that will benefit those consumers.

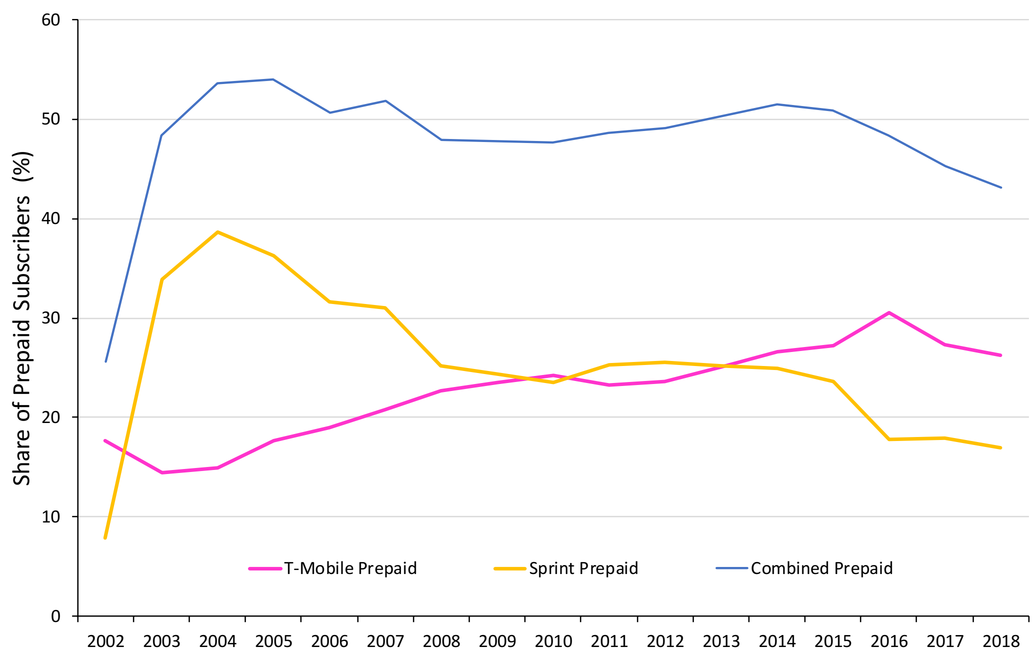
II. PREPAID SUBSCRIPTION PLANS DO NOT COMPRISE A RELEVANT PRODUCT MARKET DISTINCT FROM OTHER RETAIL MOBILE WIRELESS SERVICES

The popularity of prepaid services has grown steadily during the 20 years that they have been available. Since the turn of the century, the prepaid model has claimed an ever-increasing share of retail mobile wireless subscribers. In 2002, the share of prepaid plans was 9.3%; today, prepaid subscribers served by facilities-based carriers or by MVNOs total about 126 million and represent 32.8% of all U.S. mobile subscribers.[7] During this same time frame, the combined

[6] This observation applies more broadly to the telecommunications sector. *See* Robert W. Crandall, The Effects of Rapid Technological Change on Regulatory Policies In The Communications Sector, Aug. 17, 2018.
[7] These figures come from Bank of America/Merrill Lynch Global Wireless Matrix, 1Q2018, Apr. 9, 2018 (BAML Wireless Matrix). Note that, unlike the other carriers, Verizon does not separately report subscribers of MVNOs that are hosted on its network.

prepaid market share of T-Mobile and Sprint has been relatively flat until more recent years when it has fallen off because T-Mobile's growth has not been able to offset Sprint's decline. This is seen in Figure 1 below.

Figure 1: Share of Prepaid Subscribers by Carrier



Source: Bank Of America Merrill Lynch Global Wireless Matrix, April 9, 2018.
Notes: 2018 figures are estimates. T-Mobile Prepaid includes MetroPCS in all years.

The U.S. is not unusual in its acceptance of the prepaid model. Developed countries often have half their users on a prepaid plan. Bank of America/Merrill Lynch estimates that 45% of Germany's 117 million mobile subscribers are on a prepaid plan.[8] Shares of prepaid subscriptions in developing countries often approach 100%. For instance, BAML estimates that 82% of Mexico's 114 million mobile subscriptions are prepaid.[9]

A. THE FCC AND OTHER REGULATORY AUTHORITIES HAVE CONSISTENTLY DECLINED TO TREAT PREPAID SUBSCRIPTIONS AS A SEPARATE PRODUCT MARKET

While the FCC may separate prepaid and postpaid services in its analysis of market competition, it has declined to delineate prepaid services as a relevant market for purposes of investigating a proposed merger or a spectrum transfer. The Commission has resisted

[8] *Ibid*.
[9] BAML Wireless Matrix.

petitioners' suggestions to define a prepaid market distinct from postpaid services. Instead, the Commission has chosen to analyze the competitive effects of structural events in terms of their impact on the "retail mobile wireless services" market.

The Commission's position is clear from the 2011 staff analysis of the proposed AT&T/T-Mobile merger. That report did not conclude that there was a distinct prepaid market, nor did it make distinctions by device types, by wireless technologies, or by voice and data transmissions.[10] The Commission has left open the possibility of giving specific submarkets more scrutiny in line with the provisions of the FTC-DOJ Horizontal Merger Guidelines.

Other regulators have come to the same conclusions. In their review of a series of mobile wireless mergers dating back to 2006, the European Commission concluded that the prepaid and postpaid services are part of the same market for the purposes of evaluating unilateral competitive effects.[11] Recently, in its review of BT's acquisition of mobile provider EE, the UK's Competition & Markets Authority explicitly did not distinguish a separate prepaid market.[12] While making analogies across countries with different economic conditions and regulatory institutions is a hazardous undertaking, it is notable that these agencies relied primarily on supply-side substitution which is an inherent characteristic of wireless networks generally.

B. THE FEATURE SETS OF PREPAID AND POSTPAID PLANS HAVE GROWN MORE SIMILAR OVER TIME AND THIS TREND IS CONTINUING

Year after year, the wireless industry has witnessed how prepaid plans incorporate features that have historically been part and parcel of postpaid plans, and vice versa. For instance, whereas the early prepaid plans allowed for a predetermined number of minutes of talk time depending on the amounts deposited in the account, many prepaid plans now include unlimited usage, such as talk and text for the lower-end plans and unlimited data (with throttling) for the higher end plans.[13] When it was introduced in the industry, unlimited usage was a feature found only with postpaid plans. The pay-as-you-go schemes originally offered to consumers have now been almost completely displaced by unlimited plans involving monthly payments.

[10] FCC's Staff Analysis and Findings, In the Matter of Applications of AT&T Inc. and Deutsche Telkom AG For Consent To Assign or Transfer Control of Licenses and Authorizations, WT Docket No. 11-65, FCC, Nov. 29, 2011 (Staff Analysis & Findings), ¶¶ 30-31.

[11] *See* Case No COMP/ M.3916 – T-Mobile Austria/Tele.ring, Apr. 26, 2006, ¶¶ 10-11; Case No COMP/M.5650 – T-Mobile/ Orange UK, Mar. 1, 2012, ¶¶ 20-21; Case No COMP/M.6497 – Hutchison 3G Austria / Orange Austria, Dec. 12, 2012, ¶¶ 38-41; Case No COMP/M.7018– Telefonica Deutschland/E-Plus, July 2, 2014, ¶¶ 37-38.

[12] A report on the anticipated acquisition by BT Group plc of EE Limited, Competition & Markets Authority, Jan. 15, 2016, ¶ 10.16. ("We received no evidence that we should segment the market according to prepaid vs postpaid services, SIM-only vs handset post-paid services, or voice and data vs data only or machine to machine services.")

[13] For instance, T-Mobile currently offers four prepaid service plans, three of which have various combinations of unlimited usage for talk, text and data, and only one pay-as-you-go plan that specifies certain allowances. *See* Compare prepaid plan features, T-Mobile at http://s3-us-west-2.amazonaws.com/images.rebellion.prod/General/Prepaid/marketing/compare_plans.pdf.

In an important development, prepaid providers no longer require their customers to bring their own phones or to buy one from the carrier. Instead, carriers offer the prepaid customer a program to finance the phone purchase, not unlike the handset financing familiar from postpaid plans. And while in the past prepaid providers may have offered their customers only low-end feature phones, they now have available portfolios of phones that are increasingly similar to those available to postpaid customers. The flagship smartphone models of Apple and Samsung are widely available to prepaid customers.[14]

In another development, multi-line "family plans" are now available on a prepaid basis along with the ability to share minutes and data across members of the family. Family plans were first available on a postpaid basis. Now that they are available on both payment models the feature gap between prepaid and postpaid plans has shrunk.

Postpaid service plans have appropriated several characteristics from the typical prepaid plan as well. In an historic development a few years ago, carriers began to offer postpaid service without a long-term contract. Those contracts, typically running for 24 months, specified monthly payments that went both to pay for service and also to cover the discount on the handset. In their place, carriers have offered monthly payment plans along with an Equipment Installment Plan (EIP) that pays off the cost of phone. In the process, postpaid moved a long way toward the prepaid arrangement in which the consumer does not need to sign a long-term contract. The disappearance of the long-term contract not only makes postpaid and prepaid plans more similar to a consumer signing up for wireless service for the first time, but it also makes it easier for an existing subscriber to switch away from a postpaid plan.

Also critical to enabling consumers to move between carriers and plan types was the option of buying an unlocked phone that the user could bring to a carrier and sign up for postpaid service. Bring Your Own Device options was one of several developments in the U.S. wireless industry that has facilitated demand-side substitution, and hence competition, by lowering the consumer costs of switching carriers.

Despite these developments, the two contract types retain some of their distinctive features. Those features, however, are designed to meet the preferences of certain segments of consumers. By definition, prepaid service requires payment before service. This gives the subscriber greater control over the amounts that are spent by the individual and also by all members on the family plan. In contrast, postpaid has a more stable expenditure pattern with monthly billing especially as overages have been phased out. Prepaid plans have moved closer to postpaid-type billing by setting up the account for automatic payment using a bank account or

[14] Apple's iPhone X (64G and 256G) and Samsung's Galaxy S9 are both available on MetroPCS, Boost Mobile, and Cricket Wireless under prepaid plans.

credit card.[15] In addition, there are examples of providers extending loans to prepaid customers to finance their handsets, eliminating the need to purchase it upfront.[16] Separating the sale of wireless services and the sale of the phone has reduced the importance of the traditional credit check for postpaid service for some customers.

One drawback of postpaid plans in the past was the possibility of substantial "overages" that could lead to "bill shock" when users exceeded their monthly allowances, especially when data usage got out of hand. Consumer concerns over data overages were greatly eased when postpaid plans allowed for unlimited usage with data speeds reduced beyond a predetermined monthly amount. This development, spearheaded by T-Mobile, borrowed the speed-reduction feature from the typical prepaid plan—again blurring prepaid and postpaid options for consumers.

Prepaid continues to give the consumer great flexibility in selecting their service provider. It is possible for the prepaid user to simultaneously use two or more wireless carriers with a dual SIM phone. These phones are favored by international travelers and individuals who need separate personal and business lines.[17] And if the user is moving around constantly, prepaid has the advantage that the user does not need to provide the carrier with a permanent address for billing purposes.

Typically consumers were required to submit to a credit check to get approved for postpaid service. In response, low-income families with poor credit or young people with little credit history turned to prepaid plans. Carriers then began to offer their prepaid customers a migration path to a postpaid plan approving them for service provided they make on-time payments for their prepaid service (usually over 12 months).[18] This option is good for consumers and it is good for carriers. Users can take advantage of the pay-as-you-go arrangement when they are young adults with limited incomes and credit histories before committing to a postpaid plan. Carriers avoid the high cost of acquiring a new mobile subscriber when they keep current customers under the same brand umbrella.

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[15] Carriers have offered customers bonuses of various kinds (*e.g.*, GBs of data or a bill credit) to sign up for auto pay.

[16] *See*, for example, Boost Mobile's BoostUp financing plan, at https://www.boostmobile.com/boost-up-phone-financing.html?INTCID=HP:Panel3:BoostUP .

[17] Sascha Segan, The OnePlus 6 Might Be the Best Dual-SIM Phone in the US, *PC Magazine*, May 16, 2018, at https://www.pcmag.com/commentary/361168/the-oneplus-6-might-be-the-best-dual-sim-phone-in-the-us .

[18] Details of how customers can make the change are available at: https://support.t-mobile.com/docs/DOC-10465. In the first four months of 2018, it is estimated that 21.6% of the consumers that left a MetroPCS prepaid account switched over to a T-Mobile postpaid account. This switching rate comes from HarrisX Mobile Insights - Q1'18+April'18.

C. T-MOBILE'S UN-CARRIER INITIATIVE HAS BEEN INSTRUMENTAL TO ERODING THE DISTINCTIONS BETWEEN TRADITIONAL PREPAID AND POSTPAID PLANS

T-Mobile has played a critical role in making prepaid and postpaid plans more similar to one another. In fact, a key motivation for its Un-Carrier strategy was to take the best features from prepaid and postpaid models. T-Mobile kicked off its Un-Carrier movement in March 2013 with its "Simple Choice" plan. That plan put an end to annual service contracts, and included unlimited calling and text messaging with 500 MB of data (without speed reduction) for a base price of $50 per month.[19] A few months later, T-Mobile's "Upgrades for All" program broke with the postpaid convention of phone upgrades on a two-year cycle, and replaced it with the option of upgrading as often as twice per year. In a further attack on the long-term postpaid contract, T-Mobile announced its "Carrier Freedom" program in January 2014 in which it offered to pay Early Termination Fees of postpaid subscribers of AT&T, Sprint and Verizon who switched to T-Mobile.

T-Mobile's innovations in the mobile wireless consumer experience have spread as its competitors have responded by adopting similar practices. Today all four major carriers offer postpaid service without a contract,[20] and also allow customers to bring their own unlocked phone.[21] Consumers also have won much greater flexibility in choosing when to upgrade their phones.[22] And after moving away from earlier experimentation with unlimited plans, the three other major carriers responded to T-Mobile's unlimited offering with plans of their own that had unlimited talk, text and data.

The U.S. wireless industry, led by T-Mobile's Un-Carrier strategy, has cast off many practices that impede consumers from switching phones, plans and providers. These new consumer-friendly pro-competitive practices have become an enduring element of the wireless industry.

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[19] Donald Melanson, T-Mobile details its no-contract Simple Choice plans: starting at $50/month for unlimited talk, text and 500MB unthrottled data, *Engadget*, Mar. 26, 2013, at https://www.engadget.com/2013/03/26/t-mobile-details-its-no-contract-simple-choice-plans-starting-a/ .

[20] *See* Phil Goldstein, Sprint to abandon 2-year contracts by year-end, embrace leasing exclusively, *FierceWireless*, Aug. 17, 2015, at https://www.fiercewireless.com/wireless/sprint-to-abandon-2-year-contracts-by-year-end-embrace-leasing-exclusively ; Jon Brodkin, Verizon Wireless moving away from contracts and phone subsidies, *ArsTechnica*, Aug. 7, 2015, at https://arstechnica.com/information-technology/2015/08/verizon-wireless-moving-away-from-contracts-and-phone-subsidies /; David Goldman, AT&T is doing away with two-year contracts, *CNN*, Dec. 31, 2015, at https://money.cnn.com/2015/12/31/technology/att-2-year-contracts/index.html .

[21] *See* Phil Goldstein, Verizon, AT&T, Sprint, T-Mobile and others now fully embrace cell phone unlocking rules, *FierceWireless*, Feb. 12, 2015, at https://www.fiercewireless.com/wireless/verizon-at-t-sprint-t-mobile-and-others-now-fully-embrace-cell-phone-unlocking-rules .

[22] In July 2013, AT&T responded to T-Mobile's "Jump!" initiative with its "AT&T Next" plan that lets customers upgrade their smartphones once every 12 months. Users get their phones with no down payments or fees, and pay for them on a monthly basis (payments range from $15 to $50 depending on the device). *See* Salvador Rodriguez, T-Mobile blasts AT&T for copying phone upgrade plan, *Los Angeles Times*, July 17, 2013, at http://www.latimes.com/business/technology/la-fi-tn-tmobile-att-copycat-plan-20130717-story.html .

D. As Impediments To Switching Fall, Consumers Can More Easily Switch Away From Postpaid Plans

Policies undertaken by the FCC have been instrumental in removing several impediments that face consumers wanting to switch mobile carriers. Those policies have facilitated substitution between prepaid and postpaid services among other competitive effects.

First, the FCC established a policy of wireless number portability that was patterned off its local number portability program.[23] As of May 2004, consumers could demand that their phone number be ported to a new wireless carrier for a cost-based fee provided they honor their contracts with their previous wireless carrier. Combined with the disappearance of the two-year contract, postpaid wireless consumers could much more easily move from a postpaid plan to a prepaid plan, and *vice versa*.[24]

Second, working in cooperation with the Cellular Telephone & Internet Association, the Commission promoted wireless carriers' voluntary endorsement of the "Consumer Code for Wireless Service." This code asks wireless carriers, among other commitments, to pledge to "unlock" postpaid and prepaid mobile wireless devices under stipulated conditions.[25]

A number of technological developments have expanded the options available to consumers to take their phones and devices to a new carrier with the assurance they will be technically compatible. One development that impacts the ease of switching carriers is the compatibility between wireless networks (and their air interfaces) and the user handset. If a consumer's current phone is not compatible with the technology used by the network of the new carrier, then the consumer will either have to buy a new phone in order to make the switch, or will switch to a less preferred carrier that has a network compatible with the phone, or will simply choose not to make a switch. Handsets have increasingly become compatible across multiple carriers' networks.

Other developments in both the network technologies and in the phones themselves have increased the options available to consumers to choose their phone and their network. First, most new phones are multi-band and multi-mode so that they work on a wider array of networks which are built to particular protocols and use different spectrum bands. Second, the 4G "Long Term Evolution" standard when adopted by handset makers ensured compatibility with the network for a wider variety of handsets. Gone are the days of 2G and 3G networks when a GSM phone would not work on a CDMA network and *vice versa*. As the 5G standard develops, the

[23] Wireless Local Number Portability (WLNP), FCC Consumer and Government Affairs, at https://www.fcc.gov/general/wireless-local-number-portability-wlnp .

[24] Juan Pablo Maicas, Yolanda Polo, and F. Javier Sese. "Reducing the level of switching costs in mobile communications: The case of mobile number portability." *Telecommunications Policy* 33.9 (2009): 544-554.

[25] Consumer Code for Wireless Service, CTIA, at https://www.ctia.org/the-wireless-industry/industry-commitments/consumer-code-for-wireless-service .

industry is avoiding the incompatibilities that have plagued the wireless industry in the past.[26] In addition, as I will discuss below, the greater compatibility between phones and networks will also make it easier for MVNOs to switch their host networks and to multi-home.

One other technology that promises to further lower consumer switching costs is just coming into use. A new technology – called "eSIM" for "embedded Subscriber Identity Module" – makes it possible to switch wireless carriers by reprogramming the phone through the network. At present, eSIM technology is built into the latest Apple iPhone models, including XS and XR, as well as Google's Pixel 2 and Pixel 2 XL phones.[27] It also appears in the most recent versions of the Apple Watch Series 3 and Samsung Gear S2 G3 watch.[28]

E. Convergence Of Prepaid And Postpaid Plans Over Time Is Reflected In Expenditures Of Customers And Their Usage Of Services

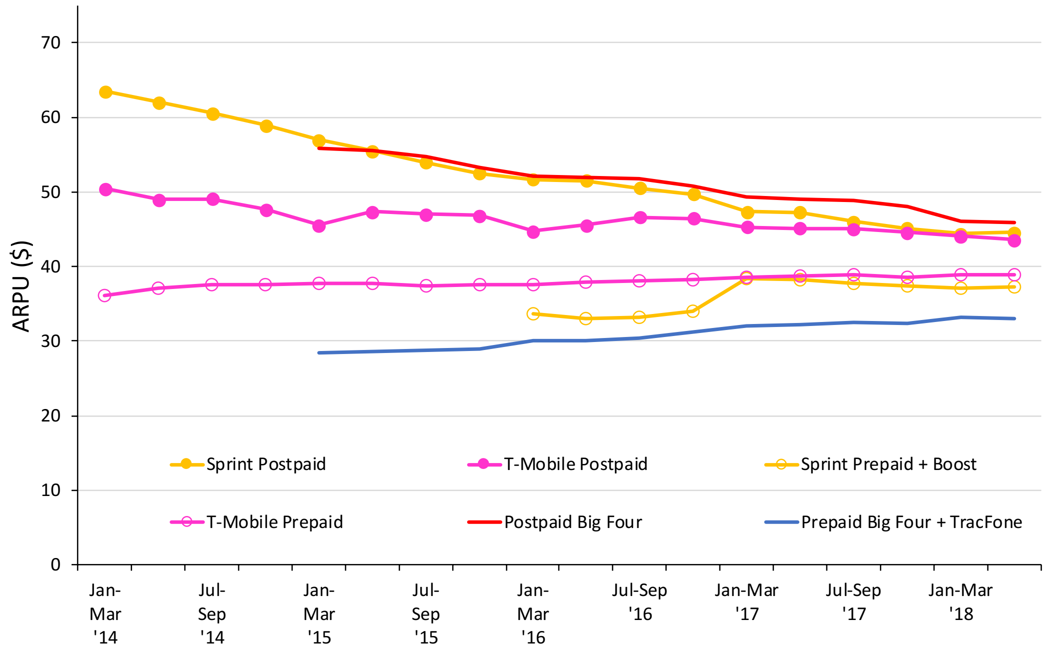
ARPU has been gradually declining over time for postpaid accounts, while ARPU for prepaid has been increasing, leading to convergence in spending patterns of the two groups of customers. This can be seen in Figure 2 which plots ARPU (in nominal terms) of different prepaid and postpaid brands. It shows that the ARPU of T-Mobile and Sprint prepaid customers has increased over the recent four years, as did the combined ARPU of all prepaid brands of all four major carriers plus TracFone. Over this same time frame, however, the corresponding amounts of postpaid ARPU fell. This was true for T-Mobile's brands and for Sprint's brands, as well as for all four carriers' postpaid plans. The result of these trends is that the ARPU of prepaid and postpaid subscriptions are converging because the features of the two plan types are converging. As average expenditure of postpaid service declined over the years, the prepaid spend has inched up a modest amount as customers consume ever greater amounts of data.

[26] Monica Alleven, 3GPP puts finishing touch on Standalone version of 5G standard, *FierceWireless*, June 14, 2018, at https://www.fiercewireless.com/wireless/3gpp-puts-finishing-touch-standalone-version-5g-standard .

[27] See, Shannon Liao, Apple's new iPhones use eSIM technology, but only ten countries in the world support it, *The Verge*, Sep. 13, 2018, at https://www.theverge.com/2018/9/13/17855976/iphone-xs-max-xr-esim-technology-dual-sim-limited-support; and Patrick Lucas Austin, You Don't Need a SIM Card for the New Google Pixel 2, *Life Hacker*, Oct. 11, 2017, at https://lifehacker.com/you-don-t-need-a-sim-card-for-the-new-google-pixel-1819373105.

[28] James Vincent, Samsung's Gear S2 has the first certified eSIM that lets you choose carriers, *The Verge*, Feb. 18, 2016 at https://www.theverge.com/2016/2/18/11044624/esim-wearable-smartwatch-samsung-gear-s2; and Shannon Liao, Apple's new iPhones use eSIM technology, but only ten countries in the world support it, *The Verge*, Sep. 13, 2018, at https://www.theverge.com/2018/9/13/17855976/iphone-xs-max-xr-esim-technology-dual-sim-limited-support. https://www.theverge.com/2016/2/18/11044624/esim-wearable-smartwatch-samsung-gear-s2; and Shannon Liao, Apple's new iPhones use eSIM technology, but only ten countries in the world support it, *The Verge*, Sep. 13, 2018, at .

Figure 2: ARPUs by Segment and Carrier



Source: Sprint Competitive Notebooks 2016Q1, 2017Q1 and 2018Q1.

III. ANY ATTEMPTS BY NEW T-MOBILE TO RAISE PREPAID PRICES WOULD BE DEFEATED BY CONSUMER BEHAVIOR AND COMPETITORS' RESPONSES

A. Subscribers to T-Mobile's Prepaid and MetroPCS Services and Sprint's Prepaid Brands Would Find Less Costly Alternatives In Response To Attempts To Raise Prices

Assessment of potential unilateral effects should consider incentives of New T-Mobile to raise prices or diminish quality of prepaid services as a result of the merger.[29] Specifically, is there upward pricing pressure on their rates in excess of any cost efficiencies and/or quality improvements that are likely to materialize? This condition will fail if a sufficient number of subscribers to T-Mobile and Sprint prepaid plans would respond by taking their business to other carriers or to postpaid service. To begin with, wireless customers are well known to be highly sensitive to price and quality and will respond in numbers to an increase in quality-adjusted price. Prepaid subscribers are relatively free to switch because, in part, they are not bound by long-term contracts that impose Early Termination Fees (though they may have a handset finance agreement). Many other wireless service providers stand ready to accept the switch by activating their unlocked phones which a prepaid customer already owns.

[29] U.S. Department of Justice and Federal Trade Commission, Horizontal Merger Guidelines (2010), § 6.

It is possible to quantify the extent to which, prior to the merger, prepaid subscribers are willing to make such a switch. For this purpose, I use the results of the HarrisX Mobile Insights consumer survey. Responses were collected for 13,299 individuals during the four-month period January-April 2018. The part of the survey questionnaire that is relevant to switching asks whether the respondent switched carriers in the past 12 months. The survey further determined whether the respondent had a prepaid or a postpaid plan both before and after the switch. T-Mobile uses the HarrisX Mobile Insights data in the regular course of its business.

The HarrisX data shows that the majority of customers that switch away from a T-Mobile and Sprint prepaid plan chose to go to an offering by another carrier that is not Sprint or T-Mobile. According to that data, 73.0% of subscribers who switched away from a T-Mobile prepaid plan opted for a plan from another carrier that was not T-Mobile or Sprint. Of the Sprint subscribers who switched away from one of its prepaid brands, 56.5% chose a plan from another carrier that was not T-Mobile or Sprint. The data confirm that prepaid customers of T-Mobile and Sprint have an array of other service options and, in fact, more often than not chose one of those other options when they switch.

B. PREPAID PROVIDERS HAVE THE INCENTIVE AND THE ABILITY TO ACCOMMODATE ANY AND ALL CONSUMERS WHO DIVERT FROM A PREPAID PLAN UNDER NEW T-MOBILE

As I noted, both AT&T and Verizon would have the ability and incentive to accommodate the prepaid customers who leave New T-Mobile in response to a price hike. Consider a hypothetical increase in T-Mobile prepaid prices that would cause 10% of T-Mobile's and Sprint's prepaid subscribers to drop their service and switch over to either AT&T or Verizon. This would amount to about 3 million subscribers switching to those two carriers, based on first quarter 2018 estimates.[30] Over the one-year period ending Mar. 31, 2018, AT&T and Verizon had added, on net, 12.3 million subscribers, or *four* times the additional subscribers in this example.[31] The two largest mobile wireless carriers have demonstrated that they are capable of taking on a significant number of new subscribers within a short period of time.

In the past, AT&T has been especially aggressive in its attempts to steal T-Mobile's prepaid customers.[32] In recent skirmishes, AT&T's Cricket and T-Mobile's MetroPCS have

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[30] T-Mobile and Sprint had 29,865,000 prepaid subscribers combined as of 1Q2018. *S & P Global Market Intelligence*, U.S. wireless prepaid subscribers, Q1 2017 - Q1 2018.

[31] AT&T and Verizon added 12,297,000 subscribers of all types over this period. *Ibid*.

[32] See, generally, Colin Gibbs, T-Mobile and AT&T are killing the gap between prepaid and postpaid, *FierceWireless*, May 4, 2016, at https://www.fiercewireless.com/wireless/t-mobile-and-at-t-are-killing-gap-between-prepaid-and-postpaid .

made repeated attempts to appropriate each other's customers.[33] Subsequently, Cricket has specifically targeted Sprint Prepaid, Boost and Virgin customers.[34]

The sparring between Cricket and MetroPCS is reflected in switching rates between the two prepaid providers: the HarrisX Mobile Insights survey shows that 11.9% of departures from MetroPCS turn to Cricket, and 31.7% of departures from Cricket opt for MetroPCS.[35] The merger will not diminish this head-to-head competition for prepaid subscribers and would likely intensify it.

AT&T and Verizon are not the only options available for consumers seeking prepaid wireless service. Besides the two majors, there is a host of MVNOs that stand ready to take on prepaid customers leaving New T-Mobile. TracFone, for instance, with its portfolio of prepaid brands would be positioned to accommodate subscribers coming from MetroPCS, Boost and Virgin. Consumer Cellular, Republic, Ting Mobile, *etc.* as well as newcomers Comcast's Xfinity Mobile and Charter's Spectrum Mobile are also in position to accommodate switchers from New T-Mobile.

IV. ALL MAJOR CARRIERS, INCLUDING NEW T-MOBILE, WILL CONTINUE TO HAVE STRONG INCENTIVES TO COMPETE AGGRESSIVELY FOR PREPAID SUBSCRIBERS

A. THE MERGER DOES NOT DIMINISH THE FINANCIAL INCENTIVES TO SELL PREPAID PLANS EITHER THROUGH A HOUSE BRAND OR THROUGH ONE OF NEW T-MOBILE'S AFFILIATED PREPAID BRANDS

Even as prepaid wireless plans grow more similar to the postpaid model, prepaid service will continue to appeal to some consumers. Some consumers may prefer the anonymity of a prepaid phone. Others may find the retail presence of prepaid providers more convenient. As are result a prepaid offering remains an indispensable component of the overall marketing strategy of a national carrier. It is compelling for any major carrier like New T-Mobile to capitalize on its name recognition acquired through tremendous expenditures on advertising and marketing. As mentioned above, a house-brand prepaid provides customers a path to transition

[33] Preempting T-Mobile's "Carrier Freedom" program to pay switchers ETFs, AT&T offered consumers switching from T-Mobile up to $450 in incentives to come to AT&T. Soon after its acquisition of Cricket in March 2014, AT&T offered $100 credit for switchers from T-Mobile or MetroPCS. Sprint eventually followed suit with an offer of a $200 credit for T-Mobile customers who trade in a smartphone. Phil Goldstein, AT&T's Cricket targets T-Mobile and MetroPCS subs with $100 credit to switch, *FierceWireless*, Aug. 22, 2014, at https://www.fiercewireless.com/wireless/at-t-s-cricket-targets-t-mobile-and-metropcs-subs-100-credit-to-switch ; Tara Seals, MetroPCS undercuts AT&T's Cricket, Boost with $75 2-line unlimited plan, *FierceWireless*, Aug. 9, 2017, at https://www.fiercewireless.com/metropcs-undercuts-at-t-s-cricket-boost-75-2-line-unlimited-plan .

[34] Dennis Bournique, Cricket's $100 Switcher Credit is Back and Now Includes Boost and Virgin, *Prepaid Phone News*, Nov. 13, 2014, at https://www.prepaidphonenews.com/2014/11/crickets-100-switcher-credit-is-back.html .

[35] HarrisX Mobile Insights - Q1'18+April'18.

seamlessly to its postpaid model, and the cost of branding this prepaid option is shared with the postpaid brand.

All four major carriers have demonstrated a long-term commitment to providing prepaid calling plans. Each one of the carriers offers a house-branded prepaid service: AT&T Prepaid, Sprint Forward, T-Mobile Prepaid, and Verizon Prepaid. A number of years ago AT&T, Sprint and T-Mobile acquired prepaid providers, and each one of them survives to this day. The fact that the house brands have co-existed alongside the affiliated brands for several years is testimony that they represent an essential component of the carriers' service offerings. The enduring role of these prepaid brands attests to the value the big carriers assign to them as part of their business plans.

The merger has a material impact on the commercial advantages of this strategy of serving prepaid consumers through three different channels: house-branded prepaid, affiliated prepaid brand, and prepaid service supplied by independent MVNOs hosted on the carriers' networks.

B. MERGING THE APPLICANTS' NETWORKS WILL BENEFIT CUSTOMERS OF THE VARIOUS PREPAID BRANDS OFFERED BY NEW T-MOBILE

The combination of the networks and spectrum licenses held currently by T-Mobile and Sprint will benefit many of their prepaid customers. A customer of one of the Applicants' prepaid services (an in-house plan or an affiliated brand) could see improved service upon gaining access to the integrated networks.[36] For instance, if a Sprint customer had a compatible handset, they could access 4G LTE service on the T-Mobile network – an option that may not be available to a user of Sprint's network.[37] Similarly, a T-Mobile customer with a compatible handset could take advantage of Sprint's 2.5GHz spectrum throughout the country.[38] In another example, a Sprint customer could roam outside Sprint's coverage area on the T-Mobile network and Sprint would not incur roaming charges.[39]

Prepaid customers of the two companies can anticipate further improvements as New T-Mobile rolls out its next generation 5G network. T-Mobile has now begun to deploy its recently-

[36] T-Mobile's CTO, Neville Ray, explains how Multiple-Operator Core Network (MOCN) technology used by both T-Mobile and Sprint's networks enables a Sprint customer with a compatible handset to access the T-Mobile capabilities. *See* Decl. of Neville R. Ray, Appendix B to Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 18-197 (June 18, 2018) (Ray Decl.), at ¶¶ 64-69.
[37] It is estimated that at least 20 million handsets from the Sprint network are compatible with T-Mobile's network. Ray Decl. at ¶ 64.
[38] It is estimated that 26.6 million T-Mobile devices, a number that includes the prepaid users, can access Sprint's 2.5 GHz band. Ray Decl. at ¶ 70.
[39] Currently, Sprint has a roaming agreement with T-Mobile that allows Sprint customers access to data usage (but not voice) on the T-Mobile network. The Sprint customer must have a compatible handset.

acquired 600 MHz spectrum, while Sprint is also increasing the use of its 2.5 GHz holdings.[40] The deployment of these spectrum resources will benefit both prepaid and postpaid customers through improved coverage and capacity.[41]

V. WHOLESALE SUPPLY OF NETWORK ACCESS WILL CONTINUE TO ENABLE MVNOs TO EXERT COMPETITIVE PRESSURE ON PREPAID SERVICE PROVIDERS AFTER THE MERGER

A. MVNOs Will Continue To Be A Valuable Distribution Channel For New T-Mobile Because They Capture Incremental Value From Its Network And Spectrum Holdings

T-Mobile and Sprint pursue an aggressive wholesale program that enables many Mobile Virtual Network Operators (MVNOs) to supply retail mobile wireless services to consumers. The same is true for the other two national facilities-based carriers, AT&T and Verizon. These carriers lease use of the networks and their spectrum holdings to MVNOs, most of which choose to sell prepaid plans.[42] In terms of subscribers, wholesale services have eclipsed prepaid service purchased from a network owner. See Table 1 which compares the three types of wireless connections in 4Q2013 and 4Q2016. The number of customers who subscribe to wireless services from MVNOs has been growing faster than postpaid customers as well. While postpaid connections increased at annualized rates of 4.7% and network-provided prepaid services have actually declined by 2.3%, wholesale subscribers have grown by 9.7% per annum.

Table 1: Growth of Subscribers by Customer Segment
(Thousands of subscribers)

	Carrier Prepaid Brands	Carrier Postpaid Brands	MVNO Wholesale
2013q4	48,311	223,759	43,350
2016q4	45,056	257,158	57,191
CAGR	-2.3%	4.7%	9.7%

[40] In its recent quarterly report, Sprint reported progress in using its 2.5 GHz band. It claimed that that band was running on nearly two-thirds of its macro sites, and it had more than 15,000 small cells on-air, plus 7,000 strand-mounted 2.5 GHz small cells on Altice's cable network. The company also distributed more than 65,000 2.5 GHz Sprint Magic Boxes during the quarter. Mike Dano, Amid new growth in service revenue, Sprint tests digital sales strategy, *FierceWireless*, Aug. 1, 2018, at https://www.fiercewireless.com/wireless/amid-new-growth-service-revenue-sprint-tests-digital-sales-strategy .
[41] Ewens Reply Decl. at ¶ 16.
[42] There are exceptions. For instance, Consumer Cellular, a major independent MVNO that is hosted on the AT&T and T-Mobile networks, offers postpaid calling plans.

Sources: FCC 20th Annual Mobile Wireless Competition Report, Appendix 2, September 27, 2017; 17th Annual Mobile Wireless Competition Report, Updated Appendix 2, May 29, 2015; KPMG Streamshare, April 2018.

Note: The FCC notes that TracFone is grouped under prepaid in the underlying data. The figure redistributes TracFone's subscribers from Prepaid to Wholesale using estimates of TracFone's market share according to KPMG Streamshare data for the given quarters.

Petitioners claim that Verizon does not compete in the prepaid market if only because, unlike the other three major carriers, it does not have an affiliated prepaid brand and has not aggressively promoted its house-branded prepaid service.[43] This leads them to characterize the merger as a 3-to-2 consolidation in prepaid services.[44] While this may have been true in the past, Verizon's recent actions demonstrate that it recognizes the commercial imperative of competing for prepaid customers, and hosting MVNOs with that same goal. While Verizon has its Verizon Prepaid brand, it does not have a standalone affiliated brand of prepaid service like the other three majors. Effectively, however, Verizon has chosen Straight Talk to be its independent prepaid brand even though it is one of TracFone's sub-brands that is hosted on the Verizon network.[45] More recently, Verizon is beta testing a new prepaid brand called "Visible" which offers a single plan option with unlimited talk, text and data speed capped at 5 Mbps for a low monthly price.[46]

The popularity of certain MVNO-based services among customers derives from the fact that these providers identify customer segments and tailor their offerings to meet the unique characteristics and needs of their consumers that are underserved or unserved by the major carriers. These include language groups (*e.g.*, Spanish speaking), age groups (*e.g.*, older Americans), occupations (*e.g.,* military) and segments interested in social causes. Several MVNOs have been created to leverage an existing brand that lies outside the wireless sector, *e.g.*, the wireless service under the brands of Walmart, Virgin, Kroger, and Disney. As mentioned above, host carriers bring several sub-brands under their corporate umbrellas, but they are understandably reluctant to do the same for another company's brand. It would likely create brand conflict and customer confusion.

[43] DISH Petition at 54-55.

[44] *Ibid*. at 55.

[45] Adam Levy, Verizon Needs to Start Paying Attention to Prepaid Verizon is bleeding prepaid customers, but there's a big opportunity there for the taking, *The Motley Fool*, Jun. 1, 2016.

[46] Mike Dano, Verizon's Visible hints at strategy and direction: Expect 'a completely different angle', *FierceWireless*, Jul. 9, 2018, at https://www.fiercewireless.com/wireless/verizon-s-visible-hints-at-strategy-and-direction-expect-a-completely-different-angle .

The Commission has acknowledged the competitive pressure that MVNOs bring to bear on the wireless marketplace.[47] And yet it has continued to count subscribers of MVNOs with the host networks in one product market.[48] Some Petitioners also insist on completely dismissing this competition by counting MVNO subscribers as part of the host network.[49] Effectively, the Commission and these Petitioners are agreeing that carrier-based services and MVNO-based services are near substitutes. Since the MVNOs offer almost exclusively prepaid plans, this implies that prepaid is not a separate market. It is evident that MVNOs are able to expand the overall customer base and the corresponding industry revenue because they reach consumer demand that are not satisfied by the standardized offerings of a nationwide carrier. And, as I will discuss below, by enabling an MVNO by providing it network access, a carrier wields an effective weapon to attack its facilities-based rivals.

B. Profitability of Mobile Wireless Services Has Given Birth to a New Hybrid Class of Wireless Service Providers

Cable companies, long known for multi-channel video entertainment, have recently branched out into the mobile wireless services. Comcast was first when it launched its Xfinity Mobile prepaid service in mid-2017. It is now approaching 1 million subscribers.[50] A year later in June 2018, Charter introduced Spectrum Mobile service and, like Comcast's offering, hosted its service on the Verizon network and cable WiFi hotspots. The cable company Altice has since announced its intentions to offer its wireless service, Altice Mobile, early next year. It will be hosted on Sprint's network using an innovative small cell AirStrand technology -- again in combination with WiFi hotspots.[51]

While at least initially the new cable entrants offer their wireless option only to current subscribers to one of the other services, they target the same consumer population as pure-wireless carriers like T-Mobile and Sprint. For instance, survey evidence shows that 60% of the subscribers to Comcast's Xfinity broadband service were subscribed to a mobile service from

[47] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Fourteenth Report, 25 FCC Rcd 11407, May 20, 2010 (14th Wireless Competition Report), at ¶ 32 ("MVNOs are mobile wireless service competitors which, like facilities-based providers, compete for subscribers.")
[48] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Mobile Wireless, Including Commercial Mobile Services, Twentieth Report, 32 FCC Rcd 8968, Sept. 26, 2017 (20th Wireless Competition Report) at note 99 ("Following widespread industry practices, the Commission generally attributes the subscribers of MVNOs to their host facilities-based service providers, including when it calculates market concentration metrics").
[49] DISH Petition at 45.
[50] Christine Torralba-Canencia, Analysts Believe Xfinity Mobile Will Have 3.3 Million Customers in Two Years, *Prepaid Phone News*, Aug. 14, 2018, at https://www.prepaidphonenews.com/2018/08/analysts-believe-xfinity-mobile-will.html .
[51] Mike Dano, Altice: We won't lose money on mobile, *FierceWireless*, Aug 6, 2018, at https://www.fiercewireless.com/wireless/altice-we-won-t-lose-money-mobile .

either T-Mobile or Sprint.[52] As cable operators attract wireless subscribers, some of those will be taken from incumbent wireless carriers. Other market research has estimated that 36.6% of Xfinity Mobile subscribers had previously been subscribers with either T-Mobile or Sprint.[53]

The appearance of the new entrants into mobile wireless services represents a significant development, not because they are the latest enterprise to be lured by opportunities in these services, but because of how they deliver their services. They are not resellers without a network or spectrum assets, nor do they own all of these necessary inputs. As Prof. Connolly describes them, they are "Hybrid" Mobile Network Operators.[54] These HMNOs own some assets, usually fixed-line broadband facilities, but also lease other inputs from traditional wireless infrastructure companies and a vast network of WiFi hotspots.

Access to WiFi hotspots on a fixed-line broadband network is a key element of their business model. Perhaps the first service that took advantage of WiFi was Google's Project Fi. That service will initially attempt to connect a subscriber requesting service to an approved WiFi hotspot and only if there is none available does it make a connection to one of its host cellular networks, Sprint and T-Mobile. In fact, the majority of data traffic on mobile devices takes place connected to WiFi, and so off-loading traffic to this access technology greatly economizes on cost.[55]

Incumbent physical networks are in a prime position to leverage their embedded infrastructure and spectrum holdings. The economies of scope enabled by the extensive fixed-line IP network of cable operators are especially obvious. Those networks cover wide swathes of both residential neighborhoods, but also dense urban areas. The Comcast and Charter networks have an extensive deployment of WiFi hotspots.[56]

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[52] Asked "Who is your primary internet service provider?" and "Who is the cell phone service provider used by the majority of people in your household?", 33% of respondents who were Comcast Xfinity subscribers also subscribed to MetroPCS service, and 27% were T-Mobile customers, for a combined total of 60%. TCS/Harris/Nielsen 3Q2017 data.

[53] Facebook Weekly Flowshare Data for the week of July 23, 2018. Facebook provides data on the survey respondents' selection of a mobile carrier. In particular, it records changes in the carrier in the prior 30-day period. For the month ending July 23, 2018, it reported that of all subscribers that had switched to Xfinity Mobile, 17.5% had come from Sprint, Boost or Virgin USA and 19.1% had come from T-Mobile or MetroPCS. T-Mobile uses the Facebook data in the ordinary course of business.

[54] Michelle Connolly, Competition in Wireless Telecommunications: The Role of MVNOs and Cable's Entry into Wireless, draft, Sept. 7, 2018.

[55] The WiFi average monthly usage by subscribers to each of the four major carriers is about four times the amount of cellular usage. Mike Dano, Cellular and Wi-Fi use —by operator and data plan type—for Verizon, AT&T, T-Mobile and Sprint: December 2017, FierceWireless, Jan. 12, 2018, at https://www.fiercewireless.com/wireless/cellular-and-wi-fi-use-by-operator-and-data-plan-type-for-verizon-at-t-t-mobile-and-sprint .

[56] Comcast has 18 million hotspots and Charter has more than 250,000. *See* Xfinity Mobile, June 13, 2018, at https://www.xfinity.com/mobile/support/article/221762167/what-are-xfinity-wifi-hotspots-and-how-do-i-connect ; and Get access to FREE Spectrum WiFi Hotspots in your state, Spectrum, at https://www.spectrum.com/free-wifi-hotspots.html, and Connolly, *op.cit.* at 20-22 and 28.

It is noteworthy that cable operators discovered a potential for scope economies of their networks in another type of service, Business Data Services (or "Special Access"). While traditionally those networks were built to deliver multi-channel video service to residential neighborhoods, they also passed by a significant number of buildings that were occupied by potential business customers. Today, cable operators have taken top spots in rankings of largest providers of business Ethernet connections.[57]

Cable operators are also able to leverage their huge broadband and video customer bases by offering mobile wireless to add to phone, internet and video services. The option of moving to a "quadruple play" is especially compelling for existing cable customers as a way to consolidate all their services in one account. In contrast, New T-Mobile is currently not positioned to offer customers the same sort of one-stop-shopping experience. Both T-Mobile and Sprint are single-play providers at the present time. In contrast, AT&T and Verizon currently can offer their customers a quadruple-play and as a result would be insulated from cable competitive foray compared with New T-Mobile. T-Mobile has very recently begun to explore delivering in-home broadband over its wireless network.[58] Adding an in-home broadband option to their wireless offerings will enable New T-Mobile to greatly improve its value proposition to consumers.

C. THE COMBINATION OF T-MOBILE AND SPRINT NETWORKS WILL BE A POWERFUL ATTRACTION FOR MVNOS, EITHER TO EXPAND THEIR WHOLESALE PURCHASE FROM NEW T-MOBILE OR FOR MVNOS TO INITIATE A NEW WHOLESALE RELATIONSHIP

In the early years of the wireless industry, MVNOs offered service in limited regions of the country if only because the available host networks were limited to metropolitan areas, and so too were their cellular spectrum licenses. The spread of roaming agreements with carriers outside the home region expanded MVNOs service territory, but usually at a steep cost to their users. Today, it is essential that MVNOs offer their customers a national service footprint and this will necessarily raise the consumer appeal of MVNOs hosted currently on the T-Mobile and Sprint networks.

Completion of the merger will expand the coverage that carriers' wholesale MVNOs can offer their customers including access to a nationwide 4G LTE network.[59] In particular, MVNOs hosted on Sprint will see an immediate improvement over what they have experienced in the past.[60] More specifically, MVNOs riding on the New T-Mobile will have a far easier time

[57] There are three cable operators among the largest 12 providers of business Ethernet services. *See* 2017 Leaderboard: U.S. Ethernet Carrier Services, Year-end 2017, *Vertical Systems Group*, Feb. 21, 2017, at https://www.verticalsystems.com/2018/02/21/2017-u-s-carrier-ethernet-leaderboard/
[58] P.I.S. at 58-64.
[59] Ewens Decl. at ¶24 and ¶28.
[60] Saw Decl. at ¶33; Joint Declaration of Professor Steven C. Salop and Dr. Yianis Sarafidis, June 18, 2018, at ¶ 31.

attacking the national markets served by Verizon and AT&T, because the scope and depth of their underlying network will be equal to – or superior to – their rivals'.

Construction of its 5G network, and redeployment of radio spectrum for 5G services, will greatly improve the quality of the wholesale services that New T-Mobile can offer to its MVNOs. Understandably, those MVNOs will be eager to offer their retail customers access to new 5G services -- to retain their business and to attract new subscribers.[61] Just as the three major carriers will be in a race to deploy the first nationwide 5G-capable network, the MVNOs will also be in a race to resell those services; as such they play a significant role in building New T-Mobile's 5G customer base.[62] For its part, New T-Mobile will be eager to deliver those wholesale services as they will provide a much needed source of revenue to quickly build out that network.

VI. NEW T-MOBILE WOULD NOT UNILATERALLY INCREASE WHOLESALE RATES BECAUSE ITS MVNOs WOULD SHIFT THEIR PURCHASES TO COMPETING HOST NETWORKS, DEPRIVING IT OF SUBSTANTIAL REVENUE

A. A Critical Concern Of Any Host Network Is The Extent To Which Supplying Wholesale Services Will Result In "Cannibalization" Of The Its Business

One concern Petitioners have expressed about this merger is the possibility that New T-Mobile would retreat from supplying wholesale services and reduce the competition provided by MVNOs in the process.[63] To assess this possibility, it is necessary to understand the forces that shape the wholesale relationship.

A carrier can deploy its network and spectrum assets in different ways. It can lease capacity on its network to an MVNO or it can use that same capacity to support its own subscribers. Carriers choose to do a combination by devoting most of their capacity for their own retail supply, and some to lease to MVNOs.

A core proposition of this merger is the creation of an enormous amount of capacity, coverage, and improved network quality from the joining of complementary network assets and crucially the carriers' spectrum holdings. T-Mobile's Chief Technology Officer, Neville Ray, quantifies these benefits for both 4G/LTE and 5G services. He estimates that by 2024, the

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[61] *See, e.g.*, TracFone Comments, at 2.

[62] For instance, AT&T's CFO, John Stephens, has stated that AT&T plans to rollout 5G technologies simultaneously with the company's roll out of FirstNet. *See* Sean Kinney, Telecom execs focused on spectrum at Deutsche Bank Conference, March 9, 2018, at https://www.rcrwireless.com/20180309/5g/telecom-execs-focused-on-spectrum-deutsche-bank-tag17.

[63] *See* Petition to Condition or Deny, Altice USA, WT Docket No. 18-197 at 23.

combined company would have more three times more 5G capacity, 3.9 to 5.8 times more average throughput, and 1.5 to 5.8 times more peak throughput than the companies' standalone networks are anticipated to offer. It is also estimated that the combined company would nearly double the 4G/LTE capacity by 2021 compared to either of the companies' standalone networks.[64] Moreover, the combined company would be able to cover over 95% of rural points-of-presence.[65] This expanded coverage will allow the combined company to compete for MVNO customers in these areas.[66]

An important consideration for the host network is whether they will lose customers to the MVNO by supplying it with wholesale services. Specifically, will the minutes, texts, and gigabytes sold to the MVNO generate a higher return at wholesale rates than the return the facilities-based carrier could earn should it sell services directly using its own prepaid plans? Effectively, the decision to supply network access to an MVNO must balance the "cannibalization" of its retail business against opportunities of market expansion.[67]

When capacity is leased to an MVNO, the MVNO must contribute the necessary retail services to support the business. Those services include billing and collections, customer care, technical support, advertising, sales commissions, and retail stores or distributor payments. When the carrier uses the capacity internally, it must do the retailing and incur these expenses. Which of the two providers is more effective at retailing will determine whether a wholesale contract generates surplus. One might think a larger carrier, given its relative size, may have lower cost to retailing. However, a MVNO may be uniquely skilled at promoting its service to its niche customer segment.[68] That advantage gives the MVNO leverage to secure network access that it can use to serve the niche but also possibly to compete for customers with incumbent wireless networks since the capacity can be used for either purpose. In the end, the issue is whether the wholesale relationship can generate more surplus than would the MNO's operations alone. If so, mutually beneficial exchange is possible – and, as seen in the long wireless market participation of MVNOs, commonly achieved.

B. CREDIBLE ESTIMATES OF THE INCENTIVES TO RAISE WHOLESALE PRICES AFTER THE MERGER ARE SWAMPED BY EXPECTED COST EFFICIENCIES

Petitioners have attempted to quantify the potential impact of the merger on the wholesale market.[69] I address one such effort that was filed as a position paper by Dr. George

[64] Ray Decl. at 26-32 and Figure 5.
[65] *Id.*, at ¶ 74.
[66] Ewens Reply Decl. at ¶ 16.
[67] Janusz Ordover and Greg Shaffer (2007). "Wholesale access in multi-firm markets: When is it profitable to supply a competitor?" *International Journal of Industrial Organization*, 25:5, 1026-1045.
[68] MVNOs may be more effective providing service to the customer segments (*e.g.*, bilingual representatives), and the sorting of prospective subscribers in terms of creditworthiness.
[69] *See* submissions attached to DPI Comments and DISH Petition.

Ford on behalf of the Digital Policy Institute.[70] The other one was contained in a declaration attached to the DISH Petition[71] and is examined in the reply declaration of Prof. Salop and Dr. Sarafidis.[72]

Dr. Ford offers a simple model intended to measure the impact of the merger on wholesale prices. He correctly acknowledges how cannibalization may occur when a host network offers access to an MVNO. He notes that the impact of cannibalization is incorporated in the host network's opportunity cost of supplying wholesale services. Dr. Ford suggests that the merger causes this opportunity cost to increase, and that increase would, in turn, cause the host network to raise its wholesale price.

To determine the extent of cannibalization, Dr. Ford assumes that any subscriber acquired by the MVNO is poached from another incumbent retail provider. He further assumes that the likelihood of a provider losing a current subscriber to the MVNO is equal to its market share. He observes that T-Mobile and Sprint have retail market shares of 16.6% and 12.3%, respectively, in which case those are the probabilities that the two carriers will have a customer poached by the MVNO. By increasing market share, the merger increases the chance of losing a customer to the MVNO.

Dr. Ford specifies that the opportunity cost is the sum of (i) the marginal cost of supplying the MVNO and (ii) the expected lost revenue from being poached. He estimates T-Mobile's retail margin to be $40 and so its opportunity cost is $C + (0.166) \times (\$40)$ where C is T-Mobile's marginal cost of network access. Presumably, this opportunity cost would be a lower bound on what T-Mobile would charge a MVNO for network access. A merger with Sprint would result in an opportunity cost to New T-Mobile of: $C + (0.166 + 0.123) \times (\$40)$. The increase in opportunity cost is: $(0.123) \times (\$40) = \$4.92$.

Assume that T-Mobile is the only wholesale supplier of the MVNO which passes through the higher wholesale cost 100%. Also assume that the MVNO has no other source of network access and that access is essential to supply its retail wireless services. In that case, Dr. Ford appears to conclude that wholesale prices of using T-Mobile's network would increase by about $5 per subscriber per month. Even if I were to accept the framework of Dr. Ford's numerical example, this reasoning and the inferences it implies are wrong for several reasons.

First, the zero-sum assumption that the MVNO simply poaches existing customers is contrary to strategy of MVNOs. As discussed above, resellers seek out and address demand that is overlooked by the host networks, in which case the MVNO sales may not cannibalize the host

[70] Dr. George S. Ford, Potential Implications of the Sprint/T-Mobile Merger on Wholesale Markets, *Phoenix Center for Advanced Legal & Economic Public Policy Studies*, Aug. 27, 2018 (Ford Paper).
[71] Exhibit B to DISH Petition, Declaration of Joseph Harrington, Coleman Bazelon, Jeremy Verlinda, and William Zarakas, Aug. 27, 2018 (Brattle Declaration).
[72] Supplemental Declaration of Prof. Steven C. Salop and Dr. Yianis Sarafidis (Salop-Sarafidis Supp. Decl.) (attached as Appendix H to Joint Opposition of T-Mobile US, Inc. and Sprint Corporation, Sept. 17, 2018), §IV.D . *See* also Appendix F, Declaration of Compass Lexecon, §I.B.2.

network, and so have no impact on the host network's opportunity cost. Furthermore, even if the MVNO was to poach an existing customer, they are known for addressing a particular sort of customer, with a usage profile likely different from the average customer of the facilities-based carriers. MVNOs often sell "small" plans that naturally have a smaller margin than assumed by Dr. Ford.

Second, Dr. Ford's formula for opportunity cost does not take account of the fact that the loss of a retail customer to the MVNO would save the host in retailing costs. In fact, it appears that Dr. Ford got the $40 margin for T-Mobile by ignoring the accounting item in their income statement for "Selling, general and administrative."[73] This line item includes expenses that T-Mobile would not incur if the subscriber signed up with the MVNO, and therefore, should be deducted from its opportunity cost. As a threshold matter, a margin of $40 is not credible. For instance, Sprint reported that as of the end of the second quarter of 2018 it had postpaid ARPU of $43.55 and prepaid ARPU of $36.27.[74]

Third, the higher wholesale prices that Dr. Ford predicts will not necessarily be passed through 100% to final consumers. The MVNO's pass through rate will depend on the nature of competition in retail mobile wireless services. A more reasonable pass-through rate, *e.g.*, 50%, would cut the expected price hike to retail consumers in half.[75]

Arguably, the more important disagreement I have with Dr. Ford is methodological. Setting aside the quantification of his opportunity cost approach, his methodology does not follow the standard approach to price impacts of a merger involving an upstream supplier to a downstream competitor. That approach seeks to quantify the upward pressure on wholesale prices that cause sales to divert to the downstream merging party.[76] In other words, how much would T-Mobile find it profitable to raise its wholesale rates to an MVNO, such as TracFone, because it will lead to an increase in TracFone retail prices and thereby divert sales to Sprint.

This approach calls for a measure of the "vertical gross upward pricing pressure index," or vGUPPI. Salop and Sarafidis estimate this value in the case when the MVNO is TracFone. Using reasonable values for the various parameters needed to calculate this index, Salop and Sarafidis estimate an upward pricing pressure on T-Mobile's wholesale charges that translates into an increase of 0.18% on TracFone retail price of about $22.83. an increase of $0.04 per subscriber per month.[77] They calculate this amount under the realistic assumption that TracFone is able to shift its supply to other host networks. Not only is this price increase *de minimis*, it is

[73] 2017 SEC Form 10-K, T-Mobile US, Inc. at 29.
[74] Sprint Form 10-Q for quarter ending June 30, 2018 at 48.
[75] A pass-through rate of 50% was assumed in Brattle Decl. at 55-56.
[76] *See* Serge Moresi and Steven Salop, vGUPPI: Scoring unilateral pricing incentive in vertical mergers, *Antitrust Law Journal*, (2013).
[77] Joint Supplemental Declaration of Professor Steven C. Salop and Dr. Yianis Sarafidis. Filed as Appendix H to Joint Opposition of T-Mobile US, Inc. and Sprint Corporation, at ¶ 49.

swamped by estimates of cost efficiencies that will be realized by this merger. Those efficiencies will, in turn, lead to lower prices for MVNOs, not higher prices.

C. New T-Mobile Is Constrained From Unilaterally Raising Its Wholesale Prices Because Its MVNOs Will Respond By Shifting To Alternative Sources of Supply

Petitioners have raised the possibility that New T-Mobile has an incentive to raise its wholesale prices that it charges MVNOs above pre-merger levels.[78] In most cases this possibility is based solely on the Applicants combined pre-merger share of wholesale subscribers. In two filings, however, there is an attempt to quantify the incentives to raise wholesale rates.[79]

In the short run, T-Mobile and Sprint have limited flexibility to raise wholesale rates that they charge their existing MVNO partners. Both carriers have existing multi-year wholesale agreements with MVNOs that must be honored after the merger. It is typical for these agreements to run three or four years, with adjustment of certain pricing terms typically occurring every 12 months.[80] Even if an agreement was canceled, New T-Mobile has commitments to supply the MVNO's customers for a significant length of time.[81]

When a wholesale agreement expires and negotiations begin regarding renewal, several scenarios could play out. If the MVNO has an existing wholesale agreement with either AT&T or Verizon, then it can shift its traffic to that network if New T-Mobile raises its wholesale rates appreciably. The MVNO would have to consider whether the volume of traffic it shifted away from New T-Mobile would trigger financial obligations under any "minimum payment guarantees" that it committed to with either T-Mobile or Sprint.

In the case in which the MVNO only purchases wholesale services from New T-Mobile, then over a longer period of time it could easily develop a relationship with AT&T and/or Verizon.[82] Table 2 shows the extent to which MVNOs "multi-home" on host networks, *i.e.*, source their network and spectrum services from two or more host networks. It shows the extent

[78] AAI Petition at 15, Cellular South Petition at 11-13, Ford Paper at 2-3, Common Cause, *et al.* Petition at 26-29.

[79] DPI Petition at 2-3 and Dish/Brattle Decl. at 11-22, 37-41, 54-56.

[80] *See, e.g.*, T-Mobile USA, Inc. and Ting, Inc., Third Amendment to Wholesale Supply Agreement, April 20, 2018; T-Mobile USA, Inc. and TracFone Wireless, Inc., 5th Amendment to 2016 Amended and Restated Wireless Service Purchase Agreement, August 1, 2017; T-Mobile USA, Inc. and Bandwidth.com, Inc. d/b/a Republic Wireless, Whole Sale Supply Agreement, April 28, 2015.

[81] For instance, in its agreement with TracFone, T-Mobile agrees to supply TracFone users under current terms for three years beyond the end of their agreement, provided the number of those users does not dip below 20,000. *See* T-Mobile USA, Inc. and TracFone Wireless, Inc., 2016 Amended and Restated Wireless Service Purchase Agreement, June 30, 2016, at Article XI.

[82] As a general matter, it would not be surprising that, over time, MVNOs will strike supplemental wholesale agreements for the purpose of preserving bargaining power when they negotiate wholesale agreements with the three nationwide networks.

to which MVNOs can respond to a unilateral increase in wholesale rates by New T-Mobile.[83] We have identified 100 MVNOs that sell retail mobile services to U.S. consumers and for which we could determine their host network(s). Seven of those MVNOs host on T-Mobile and Sprint networks together (and none others), while 49 are sole sourced by one of the two networks. As a result, currently the majority of MVNOs, 51, acquire their wholesale services from AT&T and/or Verizon.

It is important to note that the largest MVNOs (in terms of their subscribers and traffic) tend to have agreements with multiple hosts. In particular, the largest MVNO and the largest prepaid provider, TracFone, hosts its various brands of prepaid service on all four major networks plus U.S. Cellular (though it buys very little from Sprint). As a result, the ability of these large MVNOs to respond to a price hike, and to compete in prepaid services, should be unaffected by the merger. Indeed, AT&T and Verizon already have the contracts in place to undercut any price increases by New T-Mobile. MVNOs that sole source their network access from a single host tend to be quite small. For instance, many of the 29 MVNOs that get network access only from Sprint are quite small. Of the 24 sole-sourced MVNOs for which we have data from Sprint, 16 of them report fewer than 4,000 subscribers as of June 2018.

[83] The counts of MVNOs in Table 4 differ from the figures found Table 15 and Table 36 (Appendix B) of the Brattle Declaration. As stated in the notes to those tables, "This is not an exhaustive list of active MVNOs in the U.S." We counted twice as many MVNOs compared to Brattle because we did a more comprehensive search and we had access to the Applicants' active wholesale agreements. Our counts are more in line with those in other publications. For example, a 2014 OECD report claims there were 147 MVNOs in the U.S. as of 2014. *See* OECD, *Wireless Market Structures and Network Sharing*, OECD Digital Economy Papers, Nov. 6, 2014, Annex 1. Brattle Declaration cites this OECD report even though it finds only about a third of the number of MVNOs reported by the OECD. When compiling our MVNO list, we visited the websites of each prospective MVNO to determine that it provided voice, text and data service in the U.S. (and not just, *e.g.*, IoT wireless connections). We limited our list to active MVNOs for which we could ascertain the host network(s). An MVNO with multiple brands was just counted once. For instance, all 10 brands of TracFone were treated as a single MVNO. The Brattle Declaration counted brands as well as MVNOs.

Table 2: Multi-Homing by MVNOs on Host Networks

Extent of multi-homing by independent MVNOs	Number of independent MVNOs	
	Total	Subtotal
All four host networks	8	
Three of four host networks	8	
Two of four host networks	22	
Just T-Mobile and Sprint		7
Other pairs not T-Mobile and Sprint		15
Just one host network	62	
Just T-Mobile		13
Just Sprint		29
Just AT&T, or just Verizon		20

Source: various listings of MVNOs, web searches, current T-Mobile and Sprint wholesale agreements.

Note: Does not treat host networks' affiliated prepaid brands (Boost, Cricket, MetroPCS, Virgin) as MVNOs.

D. The Merger Will Enhance The Wholesale Service Offered To MVNOs Immediately Upon Closing And Will Greatly Improve With the Roll Out of New T-Mobile's 5G Network

Sprint's subscribers will be migrated onto the T-Mobile network relatively quickly and painlessly since it will involve just an over-the-air handset update and the use of LTE's Multi-Operator Core Network feature.[84] The migration is expected to be completed in three years. There is general agreement that Sprint's network lags in quality the other national carriers. It is known to cover a smaller population and less square mileage than any of the other three.[85] Once they make their way to the T-Mobile network, Sprint subscribers will see an immediate improvement. This is true, as well, for subscribers to Sprint's MVNO partners. The largest MVNO, TracFone, is technically a wholesale customer of Sprint. However, due to well-known quality issues, it has reduced its usage of the Sprint network shifting more subscribers to the

[84] Ray Decl. at ¶ 66.

[85] Saw Decl. at ¶ 13 and Saw Reply Decl. at ¶ 17; *see* also Ray Reply Decl. at ¶ 33 (stating that Sprint's network covers a smaller population and has fewer macro cell cites than the other three national networks)

other suppliers. In fact, five years ago, TracFone had a million subscribers on Sprint's network, and today that number has fallen to close about 10,000.[86]

Neither the T-Mobile nor the Sprint network offers complete coverage of the geography and population of the U.S., especially when it comes to the availability of 4G LTE technology.[87] Sprint, in particular, is known to have coverage gaps in its network.[88] As a remedy, both carriers currently rely on roaming agreements with AT&T and Verizon to achieve national coverage. These roaming arrangements raise the overall wholesale cost of supply to their MVNOs and could diminish the quality of the wireless service as well.

The merger will allow New T-Mobile to compete more effectively for the business of MVNOs, including those who currently contract only with AT&T and/or Verizon. MVNOs who place a premium on the broad coverage and advanced technology of those two carriers will now find comparable wholesale services from the merged firm.[89]

New T-Mobile will have adequate capacity to accommodate MVNOs even during the migration of Sprint customers. As part of the transition, greater use will be made of Sprint's holdings in the 2.5 GHz bands than Sprint would do so alone.[90] Applicants have identified thousands of network sites that will be redundant once the two carriers are combined. While New T-Mobile has outlined plans for decommissioning those facilities, the company has some control over the where and when it sheds this capacity while maintaining the quality of current users' experience.

Over the longer run, New T-Mobile will build and deploy its 5G network that will deliver not boost available capacity but deliver faster and more reliable service. Again, these improvements will also be available to subscribers of New T-Mobile's MVNO partners. Of course, AT&T and Verizon will simultaneously be deploying their 5G networks that similarly will lead to greater capacity and better network quality.[91] Both carriers will be compelled to make use of those networks and in particular to make attractive offers to MVNOs.

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[86] *See* Reply Decl. of Brandon "Dow" Draper, Appendix E to Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, WT Docket No. 18-197 (June 18, 2018) (Draper Reply Decl.) at ¶ 16.
[87] Ray Decl. at ¶ 39; Ewens Reply Decl. at ¶ 16; Saw Reply Decl. at ¶ 18.
[88] Saw Reply Decl. at ¶ 18.
[89] Ewens Reply Decl. at ¶ 16.
[90] Ray Decl. at ¶16, ¶¶ 33-42.; Saw Reply Decl. at ¶¶ 8-10, 13; Ewens Reply Decl. at ¶ 17.
[91] In the case of AT&T, by partnering with FirstNet, the carrier will gain access to additional spectrum bandwidth that will add to its capacity. *See* Ray Reply Decl. at ¶ 43, and citing J. Horwitz, AT&T says 5G will be a software upgrade to cell towers with FirstNet, *VENTUREBEAT*, Jun. 21, 2018, found at: https://venturebeat.com/2018/06/21/att-says-5g-will-be-a-software-upgrade-to-cell-towers-with-firstnet/ .

VII. THE MERGER DOES NOT DIMINISH THE POWERFUL INCENTIVES THAT OWNERS OF SPECTRUM AND NETWORKS TO SHARE THOSE ASSETS WITH OTHER PROVIDERS THAT COMPETE IN THE MARKETPLACE

A. Economic Forces Spur the Owners Of Network Facilities And Spectrum Licenses To Generate Revenue From These Valuable Resources

The two essential inputs to the supply of wireless telecommunications services -- network facilities (including the switching equipment, cell sites and towers, and backhaul facilities) and radio spectrum -- are highly sunk. They have limited uses outside the provision of wireless services. As a result, the opportunity costs of those investments, once they are acquired, are quite low. In addition, the nationwide 5G network that New T-Mobile plans to build will result in a further significant reduction in the costs of providing service to all subscribers, whether they subscribe to a New T-Mobile plan or to a plan offered by one of its MVNO partners. The exceptionally low costs to provide service will compel all the major carriers to compete for revenue-generating customers of all types up to the point when their networks would become congested.

In addition, as discussed above, the network and spectrum resources are highly fungible in their ability to provide service to all types of subscriptions: postpaid, prepaid or wholesale. Subscribers who choose one type of arrangement will generally receive the same coverage, capacity and quality as another type (conditional on the characteristics of the subscribers' wireless devices). In other words, carriers are highly supply elastic with respect to allocating their network resources among different subscription types, enabling them to accommodate significant shifts in a timely way. New T-Mobile, as well as AT&T and Verizon, will have strong economic incentives to use the capacity on its network and its airwaves to increase the number of prepaid and wholesale customers they serve.

B. MVNO Partners Will Contribute Valuable Assistance That Will Help Realize A Return On Carrier Investment In New 5G Networks

I explained how MVNOs serve a function that is complementary to the efforts of its host network. In particular, MVNOs find pockets of demand and useful applications that would not be commercialized by the host network. This is true for AT&T and Verizon as well as for T-Mobile and Sprint. MVNOs' contributions will be even more valuable as these carriers continue to build and evolve their 5G networks, and the ecosystem that will surround them. The MVNOs will be among the many partners that will be enlisted to explore applications -- many of which are simply unimaginable today -- that will discover the rich possibilities of 5G technology.

The importance of reaching out to third parties is a strategy that has a long history in high-tech markets. Apple represents an instructive example. The company wisely recognized the power of third-party developers soon after it launched its iPhone in June 2007. It opened its

"App Store" is July 2008 and now hosts more than 2 million iOS applications. Apple recognized that the success of its iOS mobile platform would be limited if it were to rely on its ingenuity alone. By opening the app platform it tapped a far bigger source of software creativity. Working with its MVNOs, its network and user equipment suppliers, and other partners, New T-Mobile will magnify the innovation that is possible with its 5G network, and help the U.S. wireless industry capture the lead over this promising technology.

APPENDIX J: Declaration of Dr. Harold Furchtgott-Roth

Executive Summary

I have been asked to address the following question: What are the potential consumer benefits from the proposed merger associated with: (1) New T-Mobile's fixed wireless in-home broadband offering; and (2) substitution of New T-Mobile's mobile broadband offering for consumer's fixed broadband services?

I begin by assessing the likely change in in-home broadband services for American consumers as a result of the proposed merger, including: (1) those who switch to the New T-Mobile fixed wireless in-home broadband service; (2) those who, in response to lower prices, initiate in-home broadband services with another provider; (3) customers who choose the New T-Mobile mobile broadband service to substitute for their fixed in-home broadband service; and (4) those who remain with their current broadband provider but at higher quality of service and lower prices. I consider a wide range of price changes.

Although I consider a wider range of price outcomes, as a base case of potential reasonable values in 2024, I consider the following: (1) New T-Mobile in-home fixed wireless customers would pay [redacted] less per month than they would have absent the proposed merger; (2) the customers who substitute New T-Mobile mobile broadband service for in-home fixed broadband services would have incremental consumer savings of [redacted] per month; and (3) other in-home broadband customers who do not switch to either New T-Mobile broadband offering would pay $5-$10 less per month than they would have absent the proposed merger.

The annual consumer savings by 2024 in the base case would be as follows:

- [redacted] for the 9.5 million consumers switching to New T-Mobile's in-home fixed wireless broadband service assuming they are paying [redacted] less per month;
- $195 - $780 million for an estimated 6.5–13 million new fixed broadband customers;
- [redacted] for the 6.3 million New T-Mobile mobile broadband customers who unsubscribe from fixed broadband services altogether saving $25 - $35 per month; and
- $3.972- $7.944 billion for the 66.2 million in-home fixed broadband consumers not switching to New T-Mobile service but benefitting from the competitive response of other in-home broadband providers and paying $5-$10 less per month.

Combined, these consumer savings are between $7.197 - $13.65 billion annually.

The estimates of consumer savings in this paper are illustrative and only associated with a range of possible price changes. Of course, future prices are not knowable today, but the New T-Mobile clearly plans to offer prices lower than would prevail absent the merger for fixed in-home broadband services.[1] I have not attempted to estimate the increase in the quality of in-home broadband service, both by New T-Mobile and its competitors, as a result of the merger—and the associated improvement in consumer surplus, but the quality increase and consumer

[1] *See, e.g.*, Sievert Reply Declaration, pp. 3-5.

surplus are likely substantial. Consequently, the estimates of increased consumer surplus based only on price changes presented in this paper almost certainly *underestimate* total consumer surplus changes that would also account for quality improvements.

Improved New T-Mobile Services would attract customers and lead to a consumer-beneficial responses from other firms to remain competitive

The Public Interest Statement states that New T-Mobile would serve 9.5 million customers with its in-home fixed wireless broadband services by 2024.[2] I also understand that 1.9 million customers are anticipated being served by 2021.[3] I also note that the Public Interest Statement reasonably observes the following: (1) broadband speeds and average usage would with technological advancements increase substantially by 2024;[4] (2) New T-Mobile's 5G broadband capabilities would be substantially greater, and prices would be substantially lower, with a combined network than either T-Mobile or Sprint could offer independently;[5] (3) although the exact pricing of New T-Mobile's in-home fixed broadband service is not determined, it would be at a higher quality of service and below current prices generally by [redacted];[6] and (3) these improved services would attract many households to use New T-Mobile's in-home fixed wireless broadband services.[7]

The David Evans Declaration quantifies as a result of the proposed merger the increased national practical cellular mobile broadband capacity, the expanded national practical cellular mobile broadband capacity per subscriber, and the decrease in cellular mobile broadband prices per GB.[8] The analysis is based partly on the economically rational response of AT&T and Verizon to the increased competition in cellular mobile broadband provided by New T-Mobile. If those carriers were to fail to react, New T-Mobile would capture an even larger share of customers with its new offering. To remain competitive in providing cellular mobile broadband services, AT&T and Verizon and other providers must accelerate investment schedules, offer more and better services at lower prices, and the beneficiaries are all cellular broadband subscribers, including New-T-Mobile subscribers.[9] My analysis focuses on lower prices, not accelerated investment or improved quality of service associated with the proposed merger.

The in-home fixed broadband offering of New T-Mobile would result in a similar competitive threat to, and competitive response by, wireline in-home broadband providers. As will be discussed in more detail below, New T-Mobile would capture a substantial share of the

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[2] Public Interest Statement, p. 60.

[3] Sievert Reply Declaration, p. 4.

[4] Public Interest Statement, footnote 207.

[5] Ibid., pp. 18-55.

[6] Sievert Reply Declaration, pp. 3-5.

[7] Public Interest Statement., pp. 58-59.

[8] *See* David S. Evans, Market Platform Dynamics, "Economic Analysis of the Impact of the Proposed Merger of T-Mobile and Sprint on the Deployment of 5G Cellular Technologies, the 5G App Ecosystem, and Consumers, Enterprises, and the Economy," Appx. G, Section V.C., ¶¶220-44.

[9] The Evans Declaration did not examine how cellular carriers would change their prices, in fact it assumes that ARPU in 2024 would be the same as in 2017.

approximately 82 million broadband households with its fixed wireless broadband service. To achieve this penetration rate, New T-Mobile would market the fixed wireless service to a large portion of American households. To remain competitive in providing in-home broadband services, incumbent wireline broadband service providers must offer more and better services, at lower prices. The beneficiaries would be all in-home broadband subscribers, including New-T-Mobile subscribers.

Measuring annual consumer benefits from the New T-Mobile in-home fixed wireless broadband service

The correct economic measure of the consumer benefit of the merger is the increase in consumer surplus—the area under the demand curve but above the market price for in-home broadband services—that would result from the proposed merger and the consequential higher quality of in-home broadband services and lower prices for in-home broadband services.

Consumer savings for this proposed merger can be approximated in the following parts:

1. *Benefits of reduced prices for those consumers who switch from other in-home broadband providers to purchase the New T-Mobile in-home fixed wireless broadband services.* This value can be estimated as the number of new T-Mobile in-home fixed wireless broadband subscribers times the price reduction, holding quality of service constant. The price reduction is the amount these consumers would have paid for in-home broadband services absent the merger minus the price they wind up paying for the new T-Mobile in-home broadband service as a result of the merger.[10]

   I present calculations of the consumer benefits for those who switch from other in-home broadband providers to purchase the New T-Mobile in-home fixed wireless broadband services in Table 1. Rather than a single price reduction, I present a range of monthly price reductions from [redacted] because the exact future pricing of the in-home broadband service is unknown. As a base case, I examine [redacted] per month price reductions, although the actual price reductions may ultimately be different.[11] I also present the annual consumer savings. The resulting annual savings range from [redacted] in 2021, and from [redacted] in 2024. If the New T-Mobile's in-home fixed wireless broadband offering were priced [redacted] lower than traditional wired broadband services and if the anticipated market penetration of 1.9 million households by 2021 and 9.5 million households by 2024 were met, the result would be [redacted] in monthly consumer savings by 2021 and [redacted] in monthly consumer savings by 2024. These values correspond to [redacted] in annual savings by 2021 and [redacted] billion in annual savings by 2024.

[10] The calculations on price reductions in the Evans Declaration are for cellular services only, not for in-home wireline broadband services.

[11] Sievert Reply Declaration, pp. 3-5.

2. *Benefits to consumers who previously did not purchase in-home broadband services but who would purchase in-home broadband services from any provider as a result of the lower prices and higher quality of service.* The reduced prices for in-home broadband services would attract new customers—some for New T-Mobile, some for other providers—who had found previously the combination of the lower quality of service and the higher prices unaffordable. The number of such customers can be estimated based on the elasticity of demand for in-home broadband services. For example, let's say the elasticity of demand for in-home broadband services is -1.0.[12] If the initial service price for in-home broadband were $60/month, a $5/month price reduction would be an 8% price reduction. If the own price elasticity of demand were -1.0, that should result in an 8% increase in demand for in-home broadband service which is estimated at 82 million, or approximately 6.5 million new customers. Each of those 6.5 million new customers would have consumer surplus estimated as the average incremental triangle above the market price on the demand curve, or .5*$5/month, or $2.5/month.[13] With 6.5 million new customers, that would be $16.25 million per month or approximately $195 million/year.

   If, however, the price decline were $10 rather than $5 monthly, that would correspond to a 16% increase in quantity demanded, or 13 million new customers. For each, their consumer surplus would average .5*$10/month, or $5/month. With 13 million new customers, combined consumers surplus would be $65 million monthly, or $780 million annually.

   I present calculations of the consumer surplus benefits for those new in-home broadband customers attracted by lower prices and higher quality of service as a result of the proposed merger in Table 2. Rather than a single price reduction, I present a range of monthly price reductions from $1 to $25, and I present a range of new in-home broadband customers ranging from 1 million to 20 million. The base case is a price decline of $5 or $10 for 6.5 or 13 million customers, although the actual price reductions may ultimately be different.[14] For each combination of price reduction and new in-home broadband customers, I present the calculated annual consumer surplus. The resulting annual consumer surplus values in Table 2 range from $6 million for a $1 price reduction and one million new customers to $3 billion for a $25 price reduction and 20 million new customers. The base case ranges annually from $195 million to $780 million.

3. *Benefits to those New T-Mobile mobile subscribers who unsubscribe from fixed broadband services*. Some New T-Mobile mobile subscribers would substitute their mobile service for their in-home fixed broadband service. The increase in consumer surplus could be substantial as illustrated in the following example. Suppose that, without the merger, a consumer purchases mobile broadband communications services

[12] I have not found estimates of contemporary own-price elasticities of demand for in-home broadband services. In the following discussion, I assume an elasticity of -1.0. If the elasticity has a lower absolute value, the change in consumer surplus would be less; if the elasticity has a higher absolute value, the change in consumer surplus would be greater.

[13] This analysis assumes a simple linear demand curve, a reasonable first-order approximation.

[14] As a base case, I assume that other providers reduce prices by [redacted]

for $50 per month and in-home fixed broadband services for $50 per month.[15] After the merger, the consumer purchases New T-Mobile mobile broadband services for [redacted] per month, and drops the in-home fixed broadband service.[16] The consumer's monthly payments decline from $100 ($50+$50) to [redacted] per month. The consumer benefits from switching from higher-priced to lower-priced mobile broadband service, but also from no longer paying the $50 per month for in-home broadband services.

There is no simple quantification across all households of the consumer benefit from dropping in-home broadband. All that can be said with certainty in this example is that a consumer preferred the combination of new T-Mobile mobile service at a cost of [redacted] per month to the competing combinations of mobile broadband at $50 per month plus $50 per month for in-home broadband services. The consumer might still be willing to pay an amount less than $50 to continue in-home broadband services. The net consumer surplus in this particular example for the household from abandoning in-home broadband services is more than zero but quite likely less than $50 per month. Of course, consumers pay a wide range of fees for in-home broadband services. Some pay less than $50 per month; others pay well over $100 per month.

I have seen estimates that, by 2021, 5.8 million New T-Mobile mobile customers would substitute mobile service for in-home fixed broadband service.[17] By 2024, 6.3 million New T-Mobile mobile customers would substitute mobile service for in-home fixed broadband service.[18] In Table 3, I present estimates of the consumer surplus associated with this substitution. I examine a range of the net savings from eliminating in-home fixed broadband service of between [redacted] The increases in consumer surplus range from between [redacted] annually. Although actual consumer surplus may ultimately be different, I assume a base case of household consumer surplus of [redacted] which yields total annual consumer surplus benefits between [redacted].[19]

4. *Benefits of reduced prices for current consumers of in-home fixed wireless broadband services who do not switch to New T-Mobile services*. This value can be estimated as the number of in-home fixed wireless broadband subscribers who do not switch to T-Mobile times the price reduction from other providers.

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[15] The average advertised price for in-home broadband services is around $50 per month. *See* highspeedinternet.com, accessed on August 31, 2018, at https://www.highspeedinternet.com/resources/how-much-should-i-be-paying-for-high-speed-internet-resource/

[16] The value of [redacted] per month reflects at the low end a [redacted] per month price reduction relative to prices absent the merger by New T-Mobile.

[17] Sievert Reply Declaration, p. 5. Of course, the actual number of consumers abandoning in-home broadband services would depend on changes in price and quality. I have seen only a point estimate, not a range, of the number of customers changing service. There presumably is a similar effect of other mobile broadband customers for other carriers substituting that service for in-home fixed broadband, but I have not seen estimates of that effect.

[18] Ibid.

[19] The values [redacted]

Surprisingly, there are few good estimates of the number of in-home broadband subscribers in the United States. The FCC provides no estimates. Leichtman estimates that 84% of U.S. households receive Internet services at home, a figure that appears to include cellular broadband access.[20] A more useful estimate is that 68% of households get Internet access both at home and on a smartphone. According to the Census Bureau, there were 117.7 million households in 2016.[21] That figure would likely grow to at least 120 million over the next few years. Let's say that 68% of households would subscribe to broadband in the home without the proposed merger. That would be approximately 82 million households.

If 1.9 million wireline broadband households were to switch to New T-Mobile fixed in-home broadband services in 2021, that leaves 80.1 million households still with other wireline broadband providers. If 5.8 million New T-Mobile mobile subscribers substitute their mobile broadband service for any fixed broadband service in the home, that still leaves 74.3 million in-home fixed broadband subscribers for other carriers.

With 9.5 million New T-Mobile fixed in-home broadband service subscribers in 2024, that still leaves 72.5 million subscribers to other wireline broadband services in 2024. And if 6.3 million New T-Mobile mobile subscribers substitute their mobile broadband service for any fixed broadband service in the home, that still leaves 66.2 million in-home fixed broadband subscribers for other carriers.

There is good reason to believe that other providers would reduce prices and improve quality in response to the New T-Mobile in-home broadband offering. For example, I have seen estimates that New T-Mobile would offer the in-home broadband service in 52% of zip codes in the country.[22] It is difficult to see how Comcast and other providers of fixed in-home broadband services would not reduce prices and improve quality to remain competitive.

The competitive response from other wireline broadband providers need not be dollar-for-dollar the same as the New T-Mobile in-home fixed wireless offering. Thus, if hypothetically New T-Mobile were to offer in-home fixed wireless services at $10 per month less than would have been available absent the proposed merger, some competitors might respond with a $10 monthly price reduction, while others might respond with a $5 monthly price reduction, and still others would have different price responses. As a base case, I examine $5 and $10 per month price reductions, although the actual price reductions may ultimately be different.[23]

[20] Leichtman Research Group, "84% of U.S. Homes Get an Internet Service at Home," December 13, 2017, at https://www.leichtmanresearch.com/84-of-u-s-households-get-an-internet-service-at-home/

[21] Census Bureau, Quick Facts, at https://www.census.gov/quickfacts/fact/table/US/PST045217.

[22] Sievert Reply Declaration, p. 3.

[23] As a base case, I assume that other providers reduce prices [redacted]

> I present calculations of the consumer benefits for those wireline broadband customers who do not switch to New T-Mobile in Table 4. Rather than a single price reduction, I present a range of monthly price reductions from $1 to $25. I also present the annual consumer savings. The resulting annual savings range from $892 million to $22 billion in 2021, and from $794 million to more than $19 billion in 2024. If the more than 66 million broadband households not subscribing to New T-Mobile's mobile or in-home fixed broadband services in 2024 were to see an average monthly price reduction of at least $10, this would lead to $662 million in monthly consumer savings and $7.9 billion in annual savings.

Each of these four components of the change in consumer surplus as a result of the proposed merger is additive. Depending on the specific assumptions about changes in prices and the number of customers switching the services, the annual change in consumer surplus is likely well above $1 billion. In Table 5, I present the range of the change in consumer surplus from Tables 1 through 4 in the base case by 2024. The total change in annual consumer surplus in the base case is estimated at between $7.197 billion and $13.65 billion.

Measuring the net present value of consumer benefits from the New T-Mobile in-home broadband service

The values in Tables 1 – 4 are based on increases in consumer surplus in individual years, either 2021 or 2024. The future consumer savings, however, are not limited to these individual years and are likely to continue for many years into the future. Net present value ("NPV") calculations are the usual method to value a stream of future benefits. I find it reasonable to assume, at least from a consumer perspective, that a price reduction may be seen as a permanent price reduction.

If the consumer savings were to continue indefinitely, using a 10% discount rate, each of the values in Table 1 – 4 could be multiplied by 10 to measure a NPV in either 2021 or 2024. Of course, those future NPVs could be brought forward to 2018 again with a 10% discount rate. The resulting value is that, the NPV in 2018 at a 10% discount rate of a stream of values in 2021 and successive years as presented in Tables 1 – 4 would be approximately 7.5 x the value in each table.[24] Similarly, the resulting value is that, the NPV in 2018 at a 10% discount rate of a stream of values in 2024 and successive years as presented in Tables 1 – 4 would be approximately 5.6 x the value in each table.[25]

[24] A value in 2021 is discounted today by dividing its 2021 value by 1.331. A value of 10 in 2021 is thus = to 10/1.331 = approximately 7.5 today. If the discount rate were less than 10%, the factor would be greater than 7.5. If the discount rate were more that 10%, the factor would be less than 7.5.

[25] A value in 2024 is discounted today by dividing its 2024 value by 1.77. A value of 10 in 2024 is thus = to 10/1.77 = approximately 5.6 today. If the discount rate were less than 10%, the factor would be greater than 5.6. If the discount rate were more that 10%, the factor would be less than 5.6.

Table 1

Calculation of Benefits to Customers Switching to T-Mobile's In-Home Fixed Wireless Broadband Service

[redacted]

Year	Number of households benefitting from lower prices (in millions)	price reduction per month	Total monthly price reduction (in millions)	Annual price reduction (in millions)
2021	1.9	[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
2024	9.5	[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]

Table 2

Annual Consumer Surplus for New In-Home Broadband Customers From Combinations of Price Declines and Number of New Customers
(in millions)
Base Case highlighted in green

		Number of New Household Customers (in millions)						
		1	5	6.5	10	13	15	20
	$1	$6	$30	$39	$60	$78	$90	$120
Monthly	$5	$30	$150	$195	$300	$390	$450	$600
	$10	$60	$300	$390	$600	$780	$900	$1,200
Price	$15	$90	$450	$585	$900	$1,170	$1,350	$1,800
	$20	$120	$600	$780	$1,200	$1,560	$1,800	$2,400
decline	$25	$150	$750	$975	$1,500	$1,950	$2,250	$3,000

Table 3

Calculation of Benefits to Customers in 2024 from Switching to New T-Mobile's Mobile Broadband Service in Substitution for In-Home Fixed Broadband Services
[redacted]

Year	Number of New T-Mobile mobile broadband subscribers abandoning fixed services (in millions)	price reduction per month	Total monthly price reduction (in millions)	Annual price reduction (in millions)
2024	6.3	[redacted]	[redacted]	[redacted]

Table 4

Calculation of Benefits to Customers Not Switching to New T-Mobile's Broadband Services

Best Case highlighted in green

Year	Number of households benefiting from lower prices (in millions)	price reduction per month	Total monthly price reduction (in millions)	Annual price reduction (in millions)
2021	74.3	$1	$74	$892
		$5	$372	$4,458
		$10	$743	$8,916
		$15	$1,115	$13,374
		$20	$1,486	$17,832
		$25	$1,858	$22,290
2024	66.2	$1	$66	$794
		$5	$331	$3,972
		$10	$662	$7,944
		$15	$993	$11,916
		$20	$1,324	$15,888
		$25	$1,655	$19,860

Table 5

Summary of ranges of changes in annual consumer surplus in the base case by 2024 associated with in-home broadband associated with proposed merger

	Estimated Range (in billions of dollars)	
Switching to New T-Mobile Fixed In-Home broadband service	[redacted]	[redacted]
Purchasing In-Home broadband service for first time	0.195	0.78
Abandoning Fixed In-Home broadband service in favor New T-Mobile mobile service	[redacted]	[redacted]
Benefits of lower prices to consumers not switching to New T-Mobile	3.972	7.944
Total	7.197	13.65

APPENDIX K: SUPPLEMENTAL DECLARATION OF
DR. JEFFREY A. EISENACH, PH.D.
Managing Director, NERA Economic Consulting, and
Co-Chair, NERA Communications, Media, and Internet Practice

SUPPLEMENTAL DECLARATION OF DR. JEFFREY A. EISENACH, PH.D.
Managing Director, NERA Economic Consulting, and
Co-Chair, NERA Communications, Media, and Internet Practice

1. My name is Jeffrey A. Eisenach. I am a Managing Director at NERA Economic Consulting and Co-Chair of NERA's Communications, Media, and Internet Practice. My credentials are a matter of public record. *See* Appendix I: Declaration of Jeffrey A. Eisenach, Ph.D, WT Docket No. 18-197 (June 18, 2018).

2. I prepared this report at the request of T-Mobile US, Inc. (T-Mobile). I have updated and revised portions of my previous assessment of the employment-related effects of T-Mobile's proposed merger with Sprint Corporation (Sprint) (the Transaction), specifically the impact of the Transaction on employment in the United States. Subsequent to submitting my original declaration, I received revised forecasts of 5G penetration from T-Mobile. In the revised paragraphs of my declaration attached as Exhibit A, I update my estimates of the Transaction's effect on 5G adoption based on the new data, and revise the definition of one variable I used to estimate the impact of quarterly changes in the adoption of 5G resulting from the Transaction on employment. I define the quarterly penetration variable as the difference in the *change* in penetration from quarter to quarter rather than the difference in the *level* of penetration resulting from the Transaction, which I applied in my original declaration. Using the updated data and reinterpreting this single variable within the same methodology I employed to obtain the estimates reported in my original declaration results in a higher estimate of additional job-years from accelerated 5G adoption: an additional 117,500 job-years from 2021-2023 (an average of about 39,000 job-years/year), compared with 73,600 job-years from 2021-2023 (an average of about 24,000 job-years/year) that I reported in my original declaration. I provide more details on these points below.

3. My original declaration presented an estimate of the impact of accelerated 5G adoption resulting from the Transaction on employment. That estimate was based on applying coefficients estimated by Drs. Robert Shapiro and Kevin Hassett representing the impact of 3G adoption on employment.[1] Specifically, Drs. Shapiro and Hassett estimated the impact of quarterly changes in the adoption of 3G handsets (which they refer to as "ΔGenPen") on state-level employment. In my original declaration, I used estimates supplied by T-Mobile to calculate the impact of the Transaction on 5G adoption rates in each quarter from 2021-2023. For example, if the level of adoption in Q1 2022 was estimated to be 1.1 percentage points higher with the Transaction than without it, I set ΔGenPen for that quarter to be 0.011 and applied the coefficients used by Drs. Shapiro and Hassett to estimate the resulting effect on the level of employment. I averaged those changes over four quarters to estimate the effect of the Transaction on job-years.

4. Subsequent to submitting my original declaration, I obtained data on mobile device penetration similar to the data used by Drs. Shapiro and Hassett but extending through the 3G-to-4G transition, and performed an independent econometric analysis of the effects of changes in mobile wireless penetration on employment and other economic variables, effectively replicating and extending Dr. Shapiro's and Hassett's results. In the course of conducting this analysis, it became apparent that the appropriate definition of the ΔGenPen variable in this context is not the difference in the *level* of penetration resulting from the Transaction but rather the difference in the *change* in penetration from quarter to quarter. Thus, for example, if 5G penetration would increase by 3.5 percentage points between Q1 2022 and Q2 2022 without the Transaction, and would increase by 3.7 percentage points

[1] Robert Shapiro and Kevin Hassett, *The Employment Effects of Advances in Internet and Wireless Technology: Evaluating the Transitions from 2G to 3G and from 3G to 4G,* New Policy Institute (January 2012).

with the Transaction, then the correct approach is to set ΔGenPen for Q2 2022 at 0.002 and apply the coefficients Drs. Shapiro and Hassett used accordingly.

5. In contrast with the interpretation of the coefficients used in my initial declaration, which I interpreted as yielding estimates of changes in employment *levels* in each quarter, the revised approach is correctly interpreted as yielding estimates of the *change in new jobs* created in each quarter. As I explain in the revised portions of my declaration, these changes are summed over time to yield changes in employment levels, assuming conservatively that new jobs persist for only four quarters.

6. Using the new updated 5G adoption data and applying this approach results in an estimate of an additional 117,500 job-years in 2021-2023 (an average of about 39,000 job-years/year) due to accelerated 5G adoption resulting from the Transaction, compared with 73,600 job-years in 2021-2023 (an average of about 24,000 job-years/year) that I provided in my original declaration.

7. For the same reasons set forth in my original declaration, my revised declaration shows that the Transaction will result in higher network investment and increased U.S. employment than the U.S. wireless market would experience with T-Mobile and Sprint continuing to operate as standalone companies. Indeed, the results described in the declaration as revised constitute even stronger evidence of the positive employment benefits resulting from the Transaction.

Jeffrey A. Eisenach

Exhibit A:
Appendix I: Declaration of Jeffrey A. Eisenach, Ph.D. (Revised Paragraphs)

* * * *

12. As I explain further below, the I/O model does not account for changes in employment associated with the broader economic effects of accelerated 5G deployment from the Transaction. Thus, I separately estimate the employment effects of accelerated 5G deployment. My analysis indicates that accelerated 5G deployment will contribute an additional 117,500 job-years from 2021 through 2023, bringing total job creation to approximately 168,600 job-years. As a result, the Transaction can reliably be expected to contribute net new jobs each year for the foreseeable future.

* * * *

1. Shapiro and Hassett's coefficient estimates provide an empirical basis for assessing the employment effects of the accelerated 5G deployment which I understand will result from the Transaction. In preparing its *pro forma* business model, T-Mobile has projected the impact of the Transaction on both overall subscribership and on the adoption of 5G devices by New T-Mobile subscribers. Those projections are shown in Table 5. As the table indicates, T-Mobile projects that the Transaction will increase T-Mobile/Sprint 5G penetration by approximately three percentage points in 2021 ([redacted] percent with New T-Mobile vs. [redacted] percent with the standalone companies), four percentage points in 2022 ([redacted] percent vs. [redacted] percent) and six percentage points in 2023 ([redacted] percent vs. [redacted] percent).[1]

[1] Note that the difference in 5G penetration of six percentage points in 2023 does not match the difference between [redacted] percent and [redacted] percent due to rounding. *See also* Strategy Analytics, "US Wireless Outlook: T-Mobile/Sprint Merger Accelerates 5G with 17% Uplift" (May 29, 2018) (*available at* https://www.strategyanalytics.com/access-services/service-providers/service-providers-strategies/reports/report-detail/us-wireless-outlook-t-mobile-sprint-merger-accelerates-5g-with-17-uplift#.WxBfN0gvzDc) (projecting 17 percent increase in 5G adoption as a result of the Transaction).

TABLE 5:
5G PENETRATION: STANDALONE VS. NEW T-MOBILE
(FORECAST 2021-2024)

[redacted]

Source: T-Mobile.

* * * *

51. The Shapiro and Hassett model is estimated on quarterly data, and, for a given quarterly change in 5G penetration, the model predicts increased employment growth in the next three quarters. Specifically, a one-percentage point increase in penetration results in a 0.007 percentage point increase in employment growth in the following quarter, a 0.00581

percentage point increase in the subsequent quarter, and a 0.00483 percentage point increase in the third quarter.[2] Because the Shapiro and Hassett model relates quarterly changes in mobile wireless adoption to quarterly changes in the rate of employment growth, the annual differences in levels of 5G penetration indicated in Table 5 must be converted to quarterly changes in penetration with and without the Transaction. Then the change in quarterly penetration growth due to the Transaction can be calculated by taking the difference between the rate of increase in each quarter if the Transaction is consummated and the rate of increase if it is not. These calculations are shown in Table 5B.

TABLE 5B:
IMPACT OF THE TRANSACTION ON QUARTERLY CHANGE IN 5G PENETRATION

	2021				2022				2023			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Standalone 5G Pen	*6.1%*	*12.2%*	*18.2%*	**24.3%**	*26.8%*	*29.3%*	*31.7%*	**34.2%**	*38.0%*	*41.9%*	*45.7%*	**49.5%**
Merger 5G Pen	*6.8%*	*13.5%*	*20.3%*	**27.0%**	*29.8%*	*32.5%*	*35.3%*	**38.0%**	*42.3%*	*46.5%*	*50.8%*	**55.0%**
ΔStandalone 5G Pen	6.1%	6.1%	6.1%	6.1%	2.5%	2.5%	2.5%	2.5%	3.8%	3.8%	3.8%	3.8%
ΔMerger 5G Pen	6.8%	6.8%	6.8%	6.8%	2.8%	2.8%	2.8%	2.8%	4.3%	4.3%	4.3%	4.3%
Δ5G Penetration	0.7%	0.7%	0.7%	0.7%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%

Source: T-Mobile Engineering Network Model (September 5, 2018). Note: Differences do not always match the differences in the figures as shown in the table due to rounding.

The annual penetration rates from Table 5 serve as the Q4 values for the first two rows in each calendar year. The prior three quarters for each year are then filled in by assuming that penetration increases evenly across quarters. The third and fourth rows show the difference in penetration between the indicated quarter and the prior quarter. The last row shows the impact of the Transaction on the quarterly change in 5G adoption – that is, the difference in the quarterly percentage change in penetration if the Transaction is consummated and the quarterly percentage change if it is not, which is equivalent to the change in quarterly penetration variable utilized by Shapiro and Hassett.

[2] *Shapiro and Hassett* at 18.

52. Finally, because the Shapiro and Hassett model relates changes in penetration to percentage changes in employment growth, projecting the increase in employment requires an estimate of the level of employment in each quarter. Every two years, the Bureau of Labor Statistics (BLS) estimates the level of employment ten years into the future.[3] The most recent estimate used 2016 employment data to project employment in 2026.[4] To estimate the level of employment in each quarter, I assume the incremental change in employment is distributed evenly across quarters, and use the predicted values from 2021 to 2023.

53. Table 6 shows my calculations of the quarterly increase in employment and annual job-years using the Shapiro and Hassett methodology.

TABLE 6:
TRANSACTION-SPECIFIC QUARTERLY INCREASE IN EMPLOYMENT ENABLED BY 5G
(Thousands) (2021-2023)

[redacted]

Source: Shapiro and Hassett at 19.

54. The first increase in 5G penetration modeled in the table above is a [redacted] percent increase in Q1 2021. The cumulative effect of this shock is a projected increase in employment growth of approximately [redacted] jobs in Q2 2021,[5] approximately [redacted] jobs in Q3 2021[6] and

[3] Bureau of Labor Statistics, "Employment Projections: 2016-2026 Technical Note" (January 30, 2018) (*available at* https://www.bls.gov/news.release/ecopro.tn.htm).
[4] Bureau of Labor Statistics, "Employment Projections: 2016-2026 Summary" (January 30, 2018) (*available at* https://www.bls.gov/news.release/ecopro.nr0.htm).
[5] Specifically [redacted] jobs, where 0.007 is the coefficient estimate from Shapiro and Hassett of the job effect one quarter into the future.
[6] Specifically, [redacted] jobs, where 0.00581 is the coefficient estimate from Shapiro and Hassett of the job effect two quarters into the future.

approximately [redacted] jobs in Q4 2021.[7] However, because penetration shocks are assumed to occur every quarter, the total effect in any given quarter is the sum of the effect from the shocks in each of the previous three quarters.

55. Application of the Shapiro and Hassett coefficient estimates to the projected increases in the quarterly rate of 5G adoption yields the number of new jobs created in each quarter. The increase in the level of employment due to accelerated 5G adoption in each quarter is the employment increase in that quarter plus the additional employment that persists due to accelerated 5G adoption in previous quarters. I assume conservatively that new jobs created due to accelerated 5G adoption persist for four quarters.[8] The employment effects shown in Table 6 represent changes in the level of employment in each quarter, e.g., the model predicts that there will be approximately 40,900 more people employed during the fourth quarter of 2023 than if the Transaction had not occurred. To convert those quarterly figures to job-years, I take the average of the quarterly figures for each year as an estimate of the number of additional job-years in that year. For example, the average of the quarterly employment increases for 2021 is approximately 17,500, which is the increase in job-years I attribute to 2021.

56. Table 7 shows the employment effects of the Transaction due to accelerated 5G deployment alongside the effects from changes in capex, opex and revenues from growth opportunities. Accelerated 5G deployment resulting from the Transaction will contribute approximately

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[7] Specifically [redacted] jobs, where 0.00483 is the coefficient estimate from Shapiro and Hassett of the job effect three quarters into the future.

[8] An alternative assumption, which is frequently applied in the literature, would be to treat increases in employment as permanent jobs over the study period. *See, e.g.*, *Shapiro and Hassett* at 1; Robert Crandall, William Lehr and Robert Litan, "The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data," *The Brookings Institution Issues in Economic Policy* 6 (July 2007) at 2.

117,500 job-years from 2021 to 2023. In total, the Transaction will add approximately 168,600 job-years to the economy from 2019 to 2023.

TABLE 7:
EMPLOYMENT EFFECTS OF THE TRANSACTION
(THOUSAND JOB-YEARS) (2019-2023)

[redacted]

Sources: See Table 4 sources; Shapiro and Hassett; Bureau of Labor, "Employment Projections" (available at https://data.bls.gov/projections/occupationProj). Note: Some figures do not sum to totals due to rounding.

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