Pantelis Michalopoulos
202 429 6494
pmichalopoulos@steptoe.com

1330 Connecticut Avenue, NW
Washington, DC 20036-1795
202 429 3000 main
www.steptoe.com

Steptoe
STEPTOE & JOHNSON LLP

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February 4, 2019

BY ECFS

Marlene Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

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

Dear Ms. Dortch:

In its Reply in this proceeding, DISH demonstrated that the Applicants have dramatically oversold the marginal cost savings to be produced by their proposed merger by ignoring the reality that each of the standalone companies needs, and plans, to add millimeter wave frequencies to its spectrum resources.[1] The addition of these frequencies dilute the effect of the spectrum consolidation that would be produced by the merger and reduces the merger's claimed effect on marginal costs.

DISH's experts demonstrated that the addition of 200 MHz of millimeter wave spectrum by each company would reduce the claimed marginal cost savings by **{{BEGIN HCI END HCI}}**, or more than half, from **{{BEGIN HCI END HCI}}** to **{{BEGIN HCI END HCI}}**[2] In this letter, DISH provides additional evidence that each Applicant plans to add significant millimeter wave spectrum to its existing resources. Indeed,

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[1] *See* Reply of Dish Network Corp. at 7, WT Docket No. 18-197 (Oct. 31, 2018) ("DISH Reply").

DISH has denoted with **{{BEGIN HCI END HCI}}** information that is deemed to be Highly Confidential Information pursuant to the *Protective Order*. A public, redacted version of this filing is being filed with the Commission. Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, *Protective Order*, WT Docket No. 18-197, DA 18-624 (June 15, 2018).

[2] *See* DISH Reply at 7 (for the years 2021-2024).

both Sprint and T-Mobile documents reflect plans **{{BEGIN HCI**

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As explained in the accompanying report, the Brattle Group has conducted a sensitivity analysis for its 200 MHz estimate.[3] To that end, Brattle estimated the impact on the Applicants' claimed marginal cost savings in two scenarios: each Applicant adds 100 MHz of millimeter wave spectrum, with the combined company adding 200 MHz ("100 MHz scenario"); and each Applicant adds 500 MHz of millimeter wave spectrum, with the combined company adding 1 GHz ("500 MHz scenario"). The results validate Brattle's original analysis: in the 100 MHz scenario, marginal cost savings are reduced by **{{BEGIN HCI END HCI}}**, from **{{BEGIN HCI END HCI}}** to **{{BEGIN HCI END HCI}}** In the 500 MHz scenario, they are reduced by **{{BEGIN HCI END HCI}}**, from **{{BEGIN HCI END HCI}}** to **{{BEGIN HCI END HCI}}**

I. Internal Documents Confirm Each Applicant's Plans to Add Substantial Millimeter Wave Capacity

As DISH previously explained, the Applicants' engineering model (which is supposed to model New T-Mobile through 2024) does not include *any* additional spectrum beyond what the Applicants held in 2018.[4]

To remedy this defect, the Brattle Group added 200 MHz of millimeter wave spectrum to each of standalone Sprint and T-Mobile (or a total of 400 MHz to New T-Mobile). The Applicants' internal documents **{{BEGIN HCI**

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Furthermore, Sprint plans to spend between **{{BEGIN HCI END HCI}}** on millimeter wave spectrum.[6] Similarly, T-Mobile's **{{BEGIN HCI**

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[3] Coleman Bazelon, Jeremy Verlinda, and William Zarakas, *Network Engineering Model's Sensitivity to Millimeter Wave Adjustments* at 7 (Feb. 1, 2019), included as Attachment A to this letter.

[4] *See* DISH Reply at 7.

[5] SPR-FCC-11891567 **{{BEGIN HCI END HCI}}**

[6] SPR-FCC-12630223 at SPR-FCC-12630243 **{{BEGIN HCI END HCI}}**.

END HCI}}[7] T-Mobile plans to spend **{{BEGIN HCI END HCI}}**[8]

Adding a reasonable 200 MHz of mmWave spectrum to each Applicant significantly affects the alleged efficiency improvements predicted by the Applicants' models: the estimated efficiency improvement goes from a **{{BEGIN HCI END HCI}}** increase in offered capacity in 2021 down to a fraction—only a **{{BEGIN HCI END HCI}}** increase. This translates into an **{{BEGIN HCI END HCI}}** reduction in claimed marginal cost savings over the years 2021-24, down to **{{BEGIN HCI END HCI}}**[9]

The Applicants have not provided any justification for their model's failure to include any additional millimeter wave spectrum, beyond claiming that millimeter wave "alone will not support the robust, nationwide 5G network that New T-Mobile intends to deliver."[10] But this is a strawman—DISH is not claiming that millimeter wave spectrum is solely necessary for a 5G network, only that the inclusion of additional millimeter wave spectrum in the Applicants' model is reasonable. Indeed, Applicants admitted that "there are invaluable uses for millimeter wave spectrum."[11] And of course, T-Mobile participated in the recent millimeter wave auction 101 (for 28 GHz spectrum) and both T-Mobile and Sprint intend to participate in auction 102 (for 24 GHz spectrum).[12]

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[7] TMUS-FCC-01722351 at 01722354 **{{BEGIN HCI END HCI}}** *See also* TMUS-FCC-04224061 at 04224062 **{{BEGIN HCI END HCI}}**

[8] TMUS-FCC-01722351 at TMUS-FCC-01722356.

[9] *See* DISH Reply at 7.

[10] Joint Opposition of T-Mobile US, Inc. and Sprint Corporation at 54, WT Docket No. 18-197 (Sept. 17, 2018).

[11] Reply Declaration of Neville Ray ¶ 54, Appendix B to Opposition.

[12] *See* Auction of 28 GHz Upper Microwave Flexible Use Services Licenses for Next-Generation Wireless Services, 40 Applicants Qualified to Bid in Auction 101, Public Notice, Docket No. 18-85, DA 18-1115, Attachment A (Oct. 31, 2018); Auction of 24 GHz Upper Microwave Flexible Use Service Licenses for Next-Generation Wireless Services; Applications of 58 Applicants for Auction 102 Deemed to Be Complete, *Public Notice*, AU Docket No. 18-85, DA 18-1116, Attachment A (Oct. 31, 2018).

II. Sensitivity Analysis Validates the Conclusion that the Addition of Millimeter Wave Spectrum Eliminates More than Half of the Applicants' Claimed Marginal Cost Savings

To test the sensitivity of the Applicants' estimated marginal cost savings to the amount of millimeter wave spectrum added to the network models, Brattle provides two additional scenarios: the 100 MHz scenario and the 500 MHz scenario. The below tables show how these scenarios and Brattle's original assumption of adding 200 MHz compares to the Applicants' claimed marginal network cost savings.

Table 1: Summary of Network Marginal Cost Savings by Millimeter Wave Scenario ($/Subscriber/Month) (Maintains Usage Restrictions)

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Source: IKK Table 12 and Brattle Calculations based on IKK Financial Backend Model and IKK Revised Network Engineering Model.

Table 2: Percentage Decrease in Marginal Cost Savings Relative to Compass Lexecon (by Millimeter Wave Scenario) (Maintains Usage Restrictions)

	Sprint				T-Mobile			
Description	2021	2022	2023	2024	2021	2022	2023	2024
Percentage Decrease Relative to IKK								
Millimeter Wave - 100/200 MHz	67.6%	65.0%	34.7%	-2.2%	85.8%	71.9%	68.6%	49.8%
Millimeter Wave - 200/400 MHz	69.1%	67.2%	57.9%	54.1%	87.5%	84.4%	82.2%	68.0%
Millimeter Wave - 500/1,000 MHz	69.3%	67.1%	57.8%	56.8%	87.6%	92.5%	94.4%	94.2%

For the lower-bound 100 MHz scenario, marginal network cost savings still decrease significantly compared to Compass Lexecon's claimed efficiencies. For the upper bound 500 MHz scenario, the marginal network cost savings are also much lower than the Applicants' estimates.

Even in the 100 MHz scenario, the marginal network cost savings are reduced by almost 60%, or **{{BEGIN HCI END HCI}}** Thus even at the lower end of what is a reasonable amount of spectrum to be added to each of the networks, the marginal network cost savings are more than cut in half in comparison to the Applicants' claimed cost savings.[13]

In sum, the inclusion of 200 MHz of millimeter wave spectrum to each standalone company would vastly increase capacity for the standalone companies, reducing the merger's claimed effect on marginal costs. The Commission should therefore include additional millimeter wave spectrum in its analysis of the two standalone companies.

Respectfully submitted,

/s
Pantelis Michalopoulos
Counsel to DISH Network Corporation

[13] *See* Attachment A at 8.

Attachment A

THE Brattle GROUP

Network Engineering Model's Sensitivity to Millimeter Wave Adjustments

Coleman Bazelon
Principal, The Brattle Group

Jeremy Verlinda
Principal, The Brattle Group

and

William Zarakas
Principal, The Brattle Group

February 4, 2019

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I. Introduction and Summary

The analysis presented by Sprint and T-Mobile of the benefits of their proposed merger assume that the parties will not add any additional spectrum to their networks beyond what they were licensed to use in 2018.[1] This assumption is profoundly unrealistic. As we noted in our previous filings, the models presented are artificially spectrum constrained.[2] To illustrate the impact of relaxing this unrealistic assumption, we showed the significant reduction in merger benefits if the companies added modest amounts of millimeter wave spectrum to their networks.[3] Here we expand on that analysis.

In our prior analysis, we showed the impact of adding 200 MHz of millimeter wave spectrum to each of the standalone Sprint and T-Mobile networks for a total of 400 MHz to the New T-Mobile network.[4] Here we test the sensitivity of the Applicants' estimated marginal cost savings to the amount of millimeter wave spectrum added to the network models. We find that if less spectrum is added to the networks, the benefit of adding additional frequencies is still high; if significantly more is added, the incremental benefit of additional spectrum is reduced. Consequently, the 200 MHz/400 MHz assumption is reasonable for illustrating the impact of correcting for the artificial spectrum scarcity in the merging parties analysis. It is also **{{BEGIN**

END HCI}} of millimeter wave spectrum.[5]

Applicants' internal materials provide evidence that the stand-alone firms plan on purchasing at least **{{BEGIN HCI END HCI}}** of millimeter wave spectrum. A Sprint 2018 presentation **{{BEGIN HCI END**

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1 See Network Engineering Models as submitted by Neville Ray.

2 Reply 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, October 31, 2018, Section III.C. (henceforth "HBVZ Reply Declaration" or "*HBVZ 2*").

3 *HBVZ 2*, Section III.

4 *HBVZ 2*, Section III.

5 See SPR-FCC-11891567; TMUS-FCC-01706562 at slide 7.

HCI}}[6] Furthermore, Sprint plans to spend between **{{BEGIN HCI**

END HCI}} millimeter wave spectrum.[7] In January of 2018, T-Mobile noted that it would need **{{BEGIN HCI**

END HCI}} [8] T-Mobile, as of April 2018, plans to spend **{{BEGIN HCI**

END HCI}} [9] T-Mobile plans to acquire **{{BEGIN HCI END HCI}}** in the 24 GHz band and roughly **{{BEGIN HCI END HCI}}** in the 37/39 GHz band.[10] These internal, ordinary course documents **{{BEGIN HCI**

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II. Marginal Cost Sensitivity Analysis

In our reply declaration[11] to the Israel, Katz, and Keating report[12], we presented analysis that showed how the claimed marginal cost savings from the merger are significantly reduced by adding a reasonable quantity of millimeter wave spectrum to the network engineering models. Based on conservative estimates of millimeter wave spectrum the firms were likely to acquire, we added 200 MHz to the network models for each of the standalone firms and 400 MHz to that of New T-Mobile.[13] Assuming restricted usage, IKK estimates a net present value of **{{BEGIN HCI**

END HCI}} in network marginal cost savings.[14] After adding 200 MHz/400 MHz of

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6 SPR-FCC-11891567.

7 SPR-FCC-12630223 at slide 21.

8 TMUS-FCC-042240161 at slide 2.

9 TMUS-FCC-01706562 at slide 9.

10 TMUS-FCC-01706562 at slide 7.

11 *HBVZ 2*.

12 Declaration of Compass Lexecon, Mark Israel, Michael Katz, and Bryan Keating, Appendix F to Joint Opposition of T-Mobile US, Inc. and Sprint 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, September 17, 2018 (henceforth "IKK Declaration").

13 *See HBVZ 2*, Table 9. *See* HBVZ 2, Section III and Appendix A 1.B for discussion of how millimeter wave is deployed. *See* SPR-FCC-11891567, which shows that Sprint is targeting **{{BEGIN HCI**

END HCI}} of millimeter wave spectrum.

14 *See HBVZ 2*, p. 37. All net present values are in 2019 dollars.

millimeter wave spectrum, those network marginal cost savings are reduced by {{BEGIN HCI END HCI}}.[15]

Table 1 below shows how marginal network costs savings for T-Mobile and Sprint, respectively, decrease after various adjustment scenarios. The millimeter wave adjustment alone greatly reduces most of the claimed marginal network cost efficiencies from the merger.

Table 1: Summary of Network Marginal Cost Savings by Adjustment Scenario ($/Subscriber/Month) (Maintains Usage Restrictions)

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Source: HBVZ 2, Table 9.

Notes: IKK also estimate that Sprint will save approximately **{{BEGIN HCI END HCI}}** in reduced roaming costs for its postpaid service. Note that the spectral efficiency adjustment is made to all sectors that deploy 2.5 GHz spectrum. While this may overstate the capacity gain associated with adjusting spectral efficiency for massive MIMO, it will not have any effect on marginal cost because sectors without MIMO **{{BEGIN HCI END HCI}}** In the Sprint stand-alone model, for example, there are **{{BEGIN HCI END HCI}}** sectors in 2021 that face congestion and do not have massive MIMO deployed. In the millimeter wave scenario, we deploy 200 MHz on Sprint and T-Mobile and 400 MHz on New T-Mobile.

Given the significant impact of the addition of 200 MHz/400 MHz of millimeter wave spectrum on marginal cost estimates, we now test how sensitive the Applicants' marginal cost savings are to the quantity of millimeter wave spectrum added to the network engineering models. We have considered two additional scenarios. The first represents a lower bound on millimeter wave addition. In this scenario, we add only 100 MHz to Sprint and T-Mobile and 200 MHz to New T-

[15] *Id*, at pp. 36-37.

Mobile.[16] In the second scenario, we add 500 MHz to Sprint and T-Mobile and 1,000 MHz to New T-Mobile.[17] This represents an effective upper bound of millimeter wave acquisition.

Table 2 below shows how the marginal network cost savings from these scenarios and our original assumption of 200 MHz/400 MHz compares to the original claimed IKK efficiencies.

For the scenario in which we add 100 MHz/200 MHz of millimeter wave spectrum, marginal network cost savings (on a dollar per subscriber per month basis) still decrease significantly in comparison to the original IKK claimed efficiencies. They are significantly lower in all years for T-Mobile. They are also significantly lower for Sprint in all years except 2024.[18]

For the scenario in which we add 200 MHz/400 MHz, marginal network cost savings (on a dollar per subscriber per month basis) are also significantly lower than the IKK estimates. Furthermore, they are lower than the 100 MHz/200 MHz savings, significantly so in most years, suggesting that only adding 100 MHz leaves additional gains to be had from more spectrum.

Finally, for the scenario in which we add 500 MHz/1,000 MHz, the marginal network cost savings are still much lower than the IKK estimates. In this case, however, the decrease in marginal cost savings over the 200 MHz/400 MHz scenario is modest for Sprint but larger for T-Mobile in the later years.[19]

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[16] For justification of 100 MHz as the minimum deployment for millimeter wave spectrum, see Section III.C.1 of HBVZ 2. FCC Auction 102 will offer seven 100 MHz blocks of 24 GHz spectrum. See FCC, "Auction 102: Spectrum Frontiers – 24 GHz," accessed October 30, 2018, https://www.fcc.gov/auction/102/factsheet. See TMUS-FCC-042240161 at slide 2, which shows that **{{BEGIN HCI END HCI}}** of millimeter wave spectrum.

We continue to provide New T-Mobile with twice the spectrum added to the standalone Sprint and T-Mobile networks.

[17] Although adding spectrum beyond 500 MHz has only a minimal impact on any model outputs, for consistency we model New T-Mobile with twice the amount of spectrum as added to the two standalone networks. The calculated marginal costs savings are barely changed if only 500 MHz is added to the New T-Mobile network.

[18] See note to Table 2 for explanation of why marginal cost savings decrease less in 2024 in comparison to 2021 through 2023.

[19] For some years, it is clear that the additional frequencies are not alleviating sector level congestion. (There are further improvements in throughput, but from already high levels.) This means it is unlikely that this quantity of spectrum would be acquired. For example, the marginal cost savings

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Table 2: Summary of Network Marginal Cost Savings by Millimeter Wave Scenario ($/Subscriber/Month) (Maintains Usage Restrictions)

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Source: IKK Declaration, Table 12 and Brattle Calculations based on IKK Financial Backend Model and IKK Revised Network Engineering Model.

Notes: IKK also estimates that Sprint will save approximately {{BEGIN HCI END HCI}} in reduced roaming costs for its postpaid service, which is not included in these tables. The greater savings for Sprint in 2024 reflects that 200 MHz reduces relatively more congestion on the New T-Mobile network in comparison to the effect of 100 MHz on Sprint's network in 2024. This is driven by an increase in congestion on New T-Mobile's network relative to congestion on Sprint's network in 2024 relative to 2023.

Table 3: Percentage Decrease in Marginal Cost Savings Relative to IKK by Millimeter Wave Scenario (Maintains Usage Restrictions)

	Sprint				T-Mobile			
Description	2021	2022	2023	2024	2021	2022	2023	2024
Percentage Decrease Relative to IKK								
Millimeter Wave - 100/200 MHz	67.6%	65.0%	34.7%	-2.2%	85.8%	71.9%	68.6%	49.8%
Millimeter Wave - 200/400 MHz	69.1%	67.2%	57.9%	54.1%	87.5%	84.4%	82.2%	68.0%
Millimeter Wave - 500/1,000 MHz	69.3%	67.1%	57.8%	56.8%	87.6%	92.5%	94.4%	94.2%

Source: Calculated based on values in Table 2.

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change very slightly when providing New T-Mobile 1,000 MHz rather than 500 MHz of millimeter wave spectrum.

For the lower bound scenario in which we cut the spectrum acquired in half from our original 200 MHz scenario, the aggregate reduction in marginal cost savings is almost 60%, a decrease of **{{BEGIN HCI END HCI}}** from **{{BEGIN HCI END HCI}}**[20] Thus, even at the lower bound of what is a reasonable amount of spectrum to be added to each of the networks, the marginal network cost savings are more than cut in half in comparison to IKK's claimed cost savings.

For the upper bound scenario of 500 MHz/1,000 MHz, the claimed marginal network cost savings are reduced further. They are reduced by a net present value of **{{BEGIN HCI END HCI}}** [21] This is a decrease of almost 88%.

By adding millimeter wave spectrum to the network engineering models, the number of sectors that face congestion decreases. Additional spectrum will also increase the offered traffic as well as the average theoretical user throughput of a network. Table 4 below shows how the calculated merger benefit in terms of Level 1 offered traffic decreases with various quantities of additional millimeter wave spectrum.[22]

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20 Calculation: **{{BEGIN HCI END HCI}}**

21 Calculation: **{{BEGIN HCI END HCI}}**

22 Based on adjusted IKK network engineering models in which usage restrictions are maintained.

Table 4: 5G Offered Traffic with Additional Millimeter Wave Spectrum (IKK), 2021 and 2024

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Sources: IKK Revised Network Engineering Models.

Notes: Sectors that merit millimeter wave deployment in the two stand-alone models have a minimum of 100/200/500 MHz deployed depending on scenario. Sectors that merit millimeter wave deployment in New T-Mobile's model have 200/400/1,000 MHz deployed depending on scenario.

Network capacity is calculated based on a theoretical sector level throughput. User throughput, however, will degrade based on the load of a network. Table 5 below shows how average user throughput changes with the different quantities of additional millimeter wave spectrum and a constant level of demand. {{BEGIN HCI

END HCI}}[23] These speeds are well in excess of the minimum required for 5G.

[23] See our reply declaration to the Cornerstone report for a discussion on the relative benefit of an increase in throughput at different levels of throughput. At higher levels of throughput, incremental speed is not as valuable. *See* Further Reply Declaration of Coleman Bazelon, Jeremy Verlinda, William

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Table 5: 5G Average User Throughput with Additional Millimeter Wave Spectrum (IKK), 2021 and 2024

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Sources: IKK Revised Network Engineering Models.

Notes: Sectors that merit millimeter wave deployment in the two stand-alone models have a minimum of 100/200/500 MHz deployed depending on scenario. Sectors that merit millimeter wave deployment in New T-Mobile's model have 200/400/1,000 MHz deployed depending on scenario.

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Zarakas, *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, December 4, 2018.