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REDACTED—FOR PUBLIC INSPECTION

May 20, 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:

DISH hereby responds to T-Mobile's April 22, 2019 letter regarding the use of millimeter wave spectrum in the Applicants' engineering model.[1] As the D.C. Circuit stated in *Anthem*: "If merging companies could defeat a Clayton Act challenge merely by offering expert testimony of fantastical cost savings, Section 7 would be dead letter."[2] This is precisely what the Applicants are trying to do here, except their claimed savings are not only fantastical, but easily disproved.

The Applicants have finally recognized the relevance of future millimeter wave acquisitions to their claimed merger efficiencies. But the Applicants come up with yet another contortionist revision of their much-revised model in an effort to show that these acquisitions do not siphon away most of the merger's benefits. They thus radically change the way in which

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[1] *See* Letter from Nancy Victory, T-Mobile Counsel, to Marlene Dortch, WT Docket No. 18-197 (April 22, 2019) ("T-Mobile April 22 Letter").

DISH has denoted with **{{BEGIN HCI END HCI}}** information that is deemed to be Highly Confidential Information pursuant to the Protective Order and **{{BEGIN SUPP HCI END SUPP HCI}}** information that is deemed to be Supplemental Highly Confidential Information pursuant to the Supplemental 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); Applications of T-Mobile US, Inc. and Sprint Corporation for Consent to Transfer Control of Licenses and Authorizations, *Supplemental Protective Order*, WT Docket No. 18-197, DA 19-80 (Feb. 13, 2019).

[2] *United States v. Anthem, Inc.*, 855 F.3d 345, 364 (D.C. Cir. 2017).

their initial model accounted for millimeter wave frequencies. But, under the guise of refining the model, they make it less accurate: they artificially confine millimeter wave frequencies to **{{BEGIN HCI END HCI}}** users located within a mere **{{BEGIN HCI END HCI}}** meters of a macro cell. This is akin to deploying millimeter wave frequencies without the most essential building block of microwave deployment architecture—small or "micro" cells. The model consigns most of the available millimeter wave capacity to sitting fallow, as in their model that capacity would only be used to serve a small fraction of the expected traffic.

This is no "minor refinement."[3] You refine your apartment when you rearrange the furniture to achieve better use of the space. You do not refine it when you declare most of it off-limits and announce you will henceforth only use an area of a few square feet around the microwave oven.

This cordoning-off of millimeter wave frequencies is not only unreasonable; it is also inconsistent with the treatment of millimeter waves in other portions of the *same* revised version of the model, which has become a Frankenstein's Monster of incongruous thoughts cobbled together. Millimeter wave spectrum is treated differently based on whether it has already been acquired or will be acquired in the future and (if the latter) on which of the two companies will acquire it.

It is no wonder, then, that the addition of millimeter wave frequencies into the model leads to results at which the Applicants' experts themselves marvel: Compass Lexecon calls them **{{BEGIN HCI END HCI}}**[4] Under the revised model, the acquisition of millimeter wave spectrum by each company may make them need each other more, not less, as it would supposedly increase the merger's marginal cost savings in some cases. It is legitimate to debate different views on how beneficial these frequencies will be and to what extent they will dilute the benefits of the merger. But the Applicants' model's prediction that each company's ability to acquire spectrum independently is a net negative that makes the merger *more* necessary proves the model to be worthless.

In light of these numerous errors, it is also not surprising that the Applicants' model is contradicted by their internal documents. Indeed, one email exchange about the radius of millimeter wave transmissions shows an effort by T-Mobile to suppress information for fear that it may be inconsistent with the company's statements to the Commission. Other documents and

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[3] Declaration of Ankur Kapoor ¶ 4 (Attachment A to T-Mobile April 22 Letter) ("Kapoor Declaration").

[4] Mark Israel, Michael Katz, and Bryan Keating, *The Conclusion That the Proposed Merger of Sprint and T-Mobile Will Increase Consumer Welfare Holds Even If the Standalone Companies Would Otherwise Obtain Licenses to mmWave Spectrum*, at 8 (Attachment B to T-Mobile April 22 Letter) ("April 22 Compass Lexecon Declaration").

public statements by the companies show that, of course, they both plan to deploy millimeter wave spectrum by installing many small cells within a macro cell area.

And, these contradictions are not isolated. They are part of a pattern of self-inflicted impeachment on the part of the Applicants, ranging from porting data, through the need of the merger for 5G deployment, to Sprint's financial condition. Even if these contradictions do not totally undermine the Applicants' credibility, they cannot be resolved except through the adversarial process of a hearing and cross-examination of company witnesses and experts.

I. THE ACQUISITION OF MILLIMETER WAVE FREQUENCIES DISQUALIFIES THE APPLICANTS' MERGER SAVING CLAIMS

A. The Standard for Crediting Efficiencies as an Offset to Anti-Competitive Effects is Exacting.

The Applicants would not be successful in proving sufficient efficiencies to counter-balance the merger's competitive effects even if the applicable standard to evaluate the Applicants' claimed efficiencies were that the Applicants should be given the benefit of the doubt and the Commission should err in their favor.[5] But this it is not the appropriate test, since the burden of proof is placed squarely on the Applicants' shoulders.[6] As the D.C. Circuit has stated in the context of the Clayton Act, Supreme Court precedent may in fact foreclose the consideration of efficiencies as a "viable legal defense to illegality" in the presence of serious anti-competitive effects expected to result from a merger. The D.C. Circuit quoted from the (never overruled) *Procter & Gamble* decision: "Congress was aware that some mergers which lessen competition may also result in economies but it struck the balance in favor of protecting competition."[7] This is consistent with the merger evaluation standard used by the Commission: "*If* the Commission has determined that a transaction raises no public interest harms or any such

[5] *See, e.g.*, Reply of DISH Network Corporation, WT Docket No. 18-197, at 51-56 (Oct. 31, 2018); Petition to Deny of DISH Network Corporation, WT Docket No. 18-197, at 10-12 (August 27, 2018).

[6] *See* Applications of Comcast Corporation, General Electric Company and NBC Universal, Inc. for Consent to Assign Licenses and Transfer Control of Licensees, *Memorandum Opinion and Order*, 26 FCC Rcd. 4238, 4247 ¶ 22 (2011) ("The Applicants bear the burden of proving, by a preponderance of the evidence, that the proposed transaction, on balance, serves the public interest. If we are unable to find that the proposed transaction serves the public interest for any reason, or if the record presents a substantial and material question of fact, we must designate the Application for hearing.").

[7] *Anthem*, 855 F. 3d at 353 (quoting *FTC v. Procter & Gamble Co*., 386 U.S. 568, 580 (1967)).

harms have been ameliorated by narrowly tailored conditions, the Commission next considers a transaction's public interest benefits."[8]

That does not mean that efficiencies are irrelevant if they can in fact be proven to lessen a merger's anti-competitive effects. For that reason, the *Anthem* court acknowledged the "widespread acceptance of the potential benefit of efficiencies as an economic matter,"[9] and assumed (despite its doubts) the availability of an efficiencies defense. But the court admonished that such showings are put to an exacting test. The efficiencies must be merger-specific. They do not suffice if they are "vague, speculative, or otherwise cannot be verified by reasonable means."[10] As in *Anthem*, the Applicants have "estimated an astronomical amount of savings, so even if that amount were wildly overstated," the result "would be large" "as an unknown fraction of a large number."[11] And their claims are not only "fantastical," but readily disproven—"fall[ing] to pieces in a stiff breeze."[12]

B. The Applicants' Revised Model Would Leave Most Millimeter Wave Capacity Unused

The Applicants have finally recognized that any model predicting their future must account for the acquisition of millimeter wave frequencies, both by each stand-alone company and, in the case of a merger, by New T-Mobile.

The Applicants implicitly admit that, if millimeter wave frequencies were introduced in their model in the same way in which their model accounted for the millimeter wave frequencies now licensed to T-Mobile, the claimed marginal cost savings flowing from the model would be reduced by more than half. The Applicants do not criticize Brattle at all for the way in which it implemented the Applicants' model to account for millimeter wave frequencies to be acquired in the future. Compass Lexecon does fault DISH for making an "unfounded assumption" that Sprint and T-Mobile will acquire "large blocks of mmWave spectrum."[13] But this is a case of the Applicants asking their experts to do their factual work for them because they cannot do it

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[8] Applications of Level 3 Communications Inc. and CenturyLink, Inc. for Consent to Transfer Control of Licenses and Authorizations, *Memorandum Opinion and Order*, 32 FCC Rcd. 9581, 9585 ¶ 10 (2017) (emphasis added). *See also FTC v. Universal Health*, 938 F.2d 1206, 1222 n.29 ("Of course, once it is determined that a merger would substantially lessen competition, expected economies, however great, will not insulate the merger from a [S]ection 7 challenge.").

[9] *Anthem*, 855 F.3d at 353.

[10] *Id*. at 359 (quoting Horizontal Merger Guidelines § 10).

[11] *Id*. at 365.

[12] *Id*. at 364.

[13] April 22 Compass Lexecon Declaration at 1.

themselves. Surely, if the assumption were unfounded, it would be up to the Applicants' percipient witnesses—their own officers and employees—to refute it. They have never done so for an obvious reason: they plan **{{BEGIN HCI END HCI}}** Internal documents show that both Applicants plan **{{BEGIN HCI END HCI}}**[14] Indeed, while the results of Auctions 101 and 102 are not yet known to the public,[15] they are known to the Commission. The Commission can simply compare them to Brattle's assumed scenarios (such as the acquisition of 200 MHz of millimeter wave spectrum by each company), in order to validate the relevance of millimeter wave spectrum acquisitions by the two companies to the projection of marginal costs and any savings.

Compass Lexecon also criticizes Brattle for "incorrectly assum[ing] that mmWave spectrum can be deployed for free," and invokes costs for "additional radios, power, and truck rolls" that Brattle has not taken into account.[16] But this criticism, too, is belied by T-Mobile's public statements. As T-Mobile's CTO Neville Ray stated, "the actual cost to come back on the small cell and add millimeter wave capability will be actually very small."[17]

As they cannot effectively refute either the amount of millimeter wave frequencies used by Brattle or Brattle's method for incorporating that spectrum into the Applicants' model, the Applicants set out to shoot the messenger. But, as the messenger is using their own model, they abandon the model, too, changing it one more time. The Applicants are effectively saying to DISH's experts: you are wrong because you relied on our model, which was wrong.

Under the guise of "refining" the model, however, the Applicants make it less accurate. The prior model *did* recognize the more limited propagation of millimeter wave frequencies by imposing a substantial propagation penalty (a full **{{BEGIN HCI END HCI}}**) on the capacity contributed by millimeter waves compared to the mid-band frequencies. Subject to that penalty, the original model then assumed that the millimeter wave frequencies would be available throughout the area covered by a node, co-terminously with lower frequencies. That assumption was reasonable because it reflected a reality that everyone involved with millimeter

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[14] *See* Letter from Pantelis Michalopoulos, DISH Counsel, to Marlene Dortch, FCC, WT Docket No. 18-197, at 3 (Feb. 27, 2019).

[15] Kelly Hill, *Auction 101 Wraps Up, Raising $702 Million*, RCR Wireless News (Jan. 24, 2019), https://www.rcrwireless.com/20190124/policy/auction-101-wraps-up-raising-million; John Eggerton, *That's a Wrap: 24 GHz Auction Draws Almost $2 Billion*, Broadcasting + Cable (Apr. 17, 2019), https://www.broadcastingcable.com/news/thats-a-wrap-24-ghz-auction-draws-almost-2-billion.

[16] April 22 Compass Lexecon Declaration at 6.

[17] Transcript, T-Mobile Q2 2017 Earnings Call, Fair Disclosure Wire (July 19, 2017) ("T-Mobile Q2 2017 Earnings Call").

waves is aware of: precisely because of their limited propagation, millimeter waves need to be deployed from micro cells within the main macro cell's area.

The prior model did not specifically recognize the cost of these micro cells. But it penalized the millimeter wave frequencies' capacity, which compensated for that omission. All in all, the combination of the propagation penalty imposed on millimeter wave capacity and the assumption that millimeter waves, for all their more limited propagation, would be available throughout a node seems to be a reasonable "shorthand" approximation of actual deployment decisions.

Astonishingly, the revised model does deploy micro cells as incremental solutions for mid-band spectrum. But where it does so, it assumes that the small cell will not be used for millimeter wave frequencies, even though it is available and even more suitable for millimeter wave spectrum than for mid-band spectrum.

The supposed "refinement" of the model is not a reasonable approximation, because it assumes that the Applicants will *not* deploy any micro cells for the purpose of using millimeter wave frequencies.[18] This is akin to saying that the companies will use millimeter wave frequencies without adopting the millimeter wave cellular architecture universally recognized as necessary.

As explained by Brattle in the attached declaration, a European Union 5G architecture working group has published a paper premised on the expectation that 5G deployment will include millimeter wave spectrum and have "heterogeneous and dense deployments."[19]

Here in the U.S., Verizon has begun deploying 5G using millimeter wave spectrum and small cells in cities such as Chicago and Minneapolis.[20] While coverage remains sparse in these nascent networks, it would be practically non-existent if Verizon were to only deploy the spectrum on its macro cell sites. The millimeter wave deployment as represented in the network engineering models is simply not a realistic expectation.

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[18] *See* Kapoor Declaration ¶ 16 ("The model then implements additional solutions (small cells, etc.) for the low-/mid-band portion given the reduced traffic level, as needed. *No additional solutions are required for the mmW portion* . . . .") (emphasis added).

[19] 5G PPP Architecture Working Group, *View on 5G Architecture*, European Union, at 10, 48 (July 2016), https://5g-ppp.eu/wp-content/uploads/2014/02/5G-PPP-5G-Architecture-WP-For-public-consultation.pdf.

[20] Kendra Chamberlain, *mmWave 5G Real-World Deployments Will Require Very Dense Networks*, Fierce Wireless (April 23, 2019), https://www.fiercewireless.com/5g/real-world-deployments-millimeter-wave-5g-will-require-very-very-dense-networks-report.

The selective disavowal of micro cell deployment for millimeter wave frequencies begets absurd results. The Applicants change the model to confine the impact of millimeter wave frequencies to **{{BEGIN HCI END HCI}}** locations within a tiny ring of **{{BEGIN HCI END HCI}}** meters around each macro cell.[21] This means in simple terms that most of the capacity goes to waste and its impact on the standalone companies' 5G capabilities is enormously diluted.

Making things worse, the Applicants further constrain the use of millimeter wave frequencies by an artificial deployment rule, whereby no millimeter wave is deployed, even where available, if the traffic falling within **{{BEGIN HCI END HCI}}** meters of a macro cell is less than **{{BEGIN HCI END HCI}}** of total projected traffic for a node.[22] There is zero support for such a rule in the Applicants' internal discussions of millimeter wave deployment—it comes out of thin air. In fact, its arbitrariness is highlighted by the fact that almost half of the sites for which the millimeter wave spectrum would be deployed under the previous model would fail to attract any millimeter wave deployment because they would fall below that threshold.[23]

The arbitrariness of the new model can also be illustrated by a simple comparison between Verizon's actual plans and the Applicants' supposed ones for the city of Los Angeles. Verizon plans to deploy roughly **{{BEGIN HCI END HCI}}** number of 5G nodes in *just downtown* Los Angeles in the near future as the Applicants supposedly plan to deploy in *the entire* Los Angeles metropolitan statistical area in 2024, according to the revised network model.[24] To hear the Applicants, significant portions of downtown Los Angeles would not have any planned millimeter wave coverage in 2024, including Dodger Stadium, a venue ripe for millimeter wave coverage. That makes no sense.

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[21] While first stating that **{{BEGIN HCI END HCI}}** meters is "the appropriate distance from the cell site from recent field measurements of mmW deployments," Mr. Kapoor in the next paragraph switches to **{{BEGIN HCI END HCI}}** meters with no explanation. Kapoor Declaration ¶¶ 11-12.

[22] Kapoor Declaration ¶ 13.

[23] Coleman Bazelon, Jeremy Verlinda, and William Zarakas, *Response to Israel, Katz, and Keating April 22, 2019 Declaration and Kapoor April 22, 2019 Declaration* at 18 (Attachment B to this letter).

[24] Verizon plans to deploy roughly 3,000 5G nodes in downtown Los Angeles. *CA Assembly SB-649 June 28 Testimony*, Scientists for Wired Technology (June 29, 2017), https://scientists4wiredtech.com/2017/06/ca-assembly-sb-649-june-28-testimony. New T-Mobile, for its part, supposedly plans to deploy millimeter wave frequencies on just **{{BEGIN HCI END HCI}}** nodes in the greater Los Angeles Area. *See* Brattle Backup.

The Applicants do not even treat all millimeter wave frequencies uniformly: the revised model itself is internally inconsistent—a hastily assembled bric-a-brac inventory of different ideas for how to treat millimeter wave frequencies. Here is the dizzying array of treatments that the Applicants mete out for the same frequencies *within the same revised version of their model*:

- Millimeter wave spectrum that T-Mobile has already acquired and that had been previously chosen for deployment in the model remains part of T-Mobile and New T-Mobile's baseline capacity and is not considered an incremental solution. For that spectrum, the major change from the prior treatment is that its availability is restricted to **{{BEGIN HCI END HCI}}** users located within **{{BEGIN HCI END HCI}}** meters of a macro cell.
- By contrast, millimeter wave spectrum to be acquired by T-Mobile is used only as an incremental solution.[25]
- For spectrum to be acquired by Sprint, the treatment is different yet again: while that spectrum is used for incremental solutions rather than baseline capacity, the model allows its use on micro cells and does not confine it to "offloaded" traffic.

Why is the spectrum acquired by T-Mobile treated differently than that *to be* acquired by T-Mobile, and the spectrum to be acquired by Sprint is treated differently yet again?

The flaws of the model are demonstrated by the results: in some cases, the changes absurdly lead the Applicants to assume that the acquisition of millimeter wave frequencies, which should make the Applicants *less* dependent on each other and the merger *less* necessary, actually increases the marginal cost savings to flow from the merger.

Specifically, as a result of consigning future millimeter wave acquisitions to handle only the limited "offload" traffic, the Applicants suggest that the use of millimeter wave frequencies by T-Mobile, a non-merger specific opportunity, will result in larger merger-specific gains. This result has surprised Compass Lexecon itself, which labels it **{{BEGIN HCI END HCI}}**[26] In contrast, because the model does not cordon off millimeter wave frequencies for Sprint, adding those frequencies still shows a decrease in marginal cost savings.

A non-merger-specific good cannot logically expand a merger-specific benefit. The revised model puts the millimeter wave frequencies to such inefficient use that they become a drain rather than the benefit that they manifestly are.

[25] This treatment also extends to spectrum already acquired by T-Mobile but not previously chosen for deployment in the model.

[26] April 22 Compass Lexecon Declaration at 8.

C. The Applicants' Disuse of Most Millimeter Wave Spectrum Would Significantly Impair Any Prospect of an In-Home Broadband Offering.

The Applicants claim their in-home broadband offering is not dependent on millimeter wave spectrum. As discussed in Brattle's March 28, 2019 declaration, this is not true because the Applicants' capacity to provide in-home broadband is highly correlated with the availability of millimeter wave spectrum.[27] Under the revised network model, there is no analysis of New T-Mobile's in-home broadband offering. Brattle observes that such an analysis would likely show a diminished offering because, now that the sector-level throughput in the New T-Mobile network is broken out into a millimeter wave layer and a low or mid-band layer, there is less excess capacity on these non-millimeter wave frequencies available to provide home broadband. This available capacity is smaller because, outside of the small area around the macro sites, all traffic is carried on the low and mid-band spectrum, and no traffic is carried by the millimeter wave frequencies. That is, now that sector level throughput is not the blended capacity provided by all spectrum including millimeter wave, the low and mid-band frequencies have to carry all {**{{BEGIN HCI END HCI}}** traffic and all traffic further than **{{BEGIN HCI END HCI}}** meters from the macro site. Consequently, there is less excess capacity available to provision the in-home broadband product in most of the areas covered by the network.

D. The Revised Model's Underutilization of Millimeter Wave Capacity is Inconsistent with the Applicants' Documents

In the April 22 letter, the Applicants used **{{BEGIN HCI END HCI}}** meters as an "aggressive estimate" for millimeter wave coverage radius.[28] But the attached email exchange shows that T-Mobile's internal testing supported much larger propagation distances of more than **{{BEGIN SUPP HCI END SUPP HCI}}**, and that T-Mobile has tried to suppress that finding for fear it was inconsistent with its statements to the Commission.

As explained by T-Mobile's Vice President of Radio Network Technology, **{{BEGIN SUPP HCI**

END SUPP HCI}}[29] This was in the context of an internal discussion about **{{BEGIN SUPP HCI**

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[27] Coleman Bazelon, Jeremy Verlinda, and William Zarakas, *Response to Compass Lexecon February 20, 2019 Declaration and Mark McDiarmid March 6, 2019 Declaration*, at 30 (Attachment A to DISH Comments in Response to Public Notice, WT Docket No. 18-197 (Mar. 28, 2019)).

[28] Kapoor Declaration ¶ 7; *id.* ¶ 11 ("We reconfirmed that approximately **{{BEGIN HCI END HCI}}** would be the appropriate distance from the cell site.").

[29] TMUS-FCC-07980602 at TMUS-FCC-07980604 (included as Attachment A to this letter).

END SUPP HCI}}[30] The draft press release stated that **{{BEGIN SUPP HCI**

END SUPP HCI}}[31]

When apprised of this fact, **{{BEGIN SUPP HCI END SUPP HCI}}** was concerned that the **{{BEGIN SUPP HCI END SUPP HCI}}** estimate diverged from what T-Mobile had told the Commission just the day before:

{{BEGIN SUPP HCI

END SUPP HCI}}[32]

In a response to **{{BEGIN SUPP HCI END SUPP HCI}}** distinguishes between **{{BEGIN SUPP HCI END SUPP HCI}}** and **{{BEGIN SUPP HCI END SUPP HCI}}**[33] This is a potentially valid distinction, but **{{BEGIN SUPP HCI END SUPP HCI}}** view as to the right median distance is not clear. Just as important, such a distinction was not a factor in T-Mobile's earlier expressed preference for suppressing an inconvenient fact. T-Mobile wanted the greater distance suppressed not on the ground that it was wrong, but on the ground that if T-Mobile were to state **{{BEGIN SUPP HCI END SUPP HCI}}** in public, **{{BEGIN SUPP HCI END SUPP HCI}**} Other T-Mobile documents also directly contradict the model's limiting of millimeter wave use to a distance of **{{BEGIN HCI END HCI}}** meters from the base station. In a presentation to T-Mobile's Board **{{BEGIN HCI**

END HCI}}[34] A planning

[30] *Id.* at TMUS-FCC-07980606.

[31] *Id.* at TMUS-FCC-07980604, 07980606.

[32] *Id.* at TMUS-FCC-07980604 (referring to Notice of November 8, 2018 Ex Parte Meeting, WT Docket No. 18-197 (Nov. 13, 2018)).

[33] *Id.*

[34] TMUS-FCC-07942268 at TMUS-FCC-07942306.

document for New T-Mobile sent to Mr. Kapoor showed that **{{BEGIN HCI**
END HCI}}[35] as shown in the following chart from the document:

{{BEGIN HCI

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The Applicants' prior statements and documents confirm that limiting millimeter wave to macro cells is not only unrealistic but also contrary to what both T-Mobile and Sprint had planned in the ordinary course of business. T-Mobile's Neville Ray publicly stated that mmWave deployment would depend in part on the use of small cells: "the actual cost to come back on the small cell and add millimeter wave capability will be actually very small."[36] Similarly, Sprint's John Saw said "small cells is also the future and the foundation for 5G for the industry. You're not going to put a millimeter wave radio on towers because there are [propagation] limitations, right? In order to benefit from the large bandwidth, high speeds, low latency you need small cells . . . ."[37]

[35] TMUS-FCC-07978523 at TMUS-FCC-07978530. **{{BEGIN HCI**
END HCI}}

[36] T-Mobile Q2 2017 Earnings Call.

[37] Transcript, Sprint Corp. at Barclay's Global Technology Conference, Fair Disclosure Wire (Dec. 7, 2016).

And the Applicants' documents contain frequent references to **{{BEGIN HCI** **END HCI}}** For example, a table discussing **{{BEGIN HCI** **END HCI}}**[38] Another deck **{{BEGIN HCI** **END HCI}}**[39] And another presentation **{{BEGIN HCI** **END HCI}}**[40] Sprint's **{{BEGIN HCI** **END HCI}}**[41]

These plans make a mockery of the model. How can T-Mobile project with a straight face that it will use microwave spectrum only within a distance of a few meters from a macro cell node when it is planning to install more than a hundred small cells in a number of macro cell areas?

This is one more contradiction in a pattern of self-impeachment on the Applicants' part. The Applicants say that porting data are unsuitable to assess competition, yet their executives turn first and foremost to porting data for that purpose. They say to the Commission that they need each other for 5G, even as, to "different audiences," they say that each can go it alone, with a "flick [of] the switch."[42] Sprint says that, without the merger, it would face dire financial straits, even as it tells investors and its parent that "Sprint will be here to compete whether we merge with T-Mobile or not"[43] and that Sprint **{{BEGIN HCI** **END HCI}}**[44]

Resolution of these contradictions is impossible without the adversarial process of cross-examination and a hearing before the Commission's administrative law judge. Under the Communications Act, "if a substantial and material question of fact is presented or the Commission for any reason is unable to make the finding specified in such subsection, it shall

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[38] *See* TMUS-FCC-01121968, TMUS-FCC-01121967.

[39] TMUS-FCC-00051566 at TMUS-FCC-00051590.

[40] TMUS-FCC-02058530 at slides 7-13.

[41] SPR-FCC-11890728 at SPR-FCC-11890746.

[42] Transcript, Sprint Presentation at Deutsche Bank Leveraged Finance Conference, S&P Global (Oct. 2, 2018).

[43] *See* Letter from Pantelis Michalopoulos, DISH Counsel, to Marlene Dortch, WT 18-197 at 10 (May 13, 2019).

[44] SPR-FCC-06716192 at 3 (slide notes).

formally designate the application for hearing."[45] The Commission has previously designated transactions for a hearing in the presence of similar outstanding questions of fact.[46]

II. CONCLUSION

The Applicants' revised model does not use millimeter wave frequencies in the way the Applicants actually plan to use them. If it did, it would show that the acquisition of millimeter wave frequencies eliminates more than half of the Applicants' claimed marginal cost savings.

Respectfully submitted,

/s
Pantelis Michalopoulos
Counsel to DISH Network Corporation

[45] 47 U.S.C. § 309(e). A "substantial and material" question is raised when "the totality of the evidence arouses a sufficient doubt" as to whether grant of the application would serve the public interest. *Serafyn v. FCC*, 149 F.3d 1213, 1216 (D.C. Cir. 1998) (quotations omitted); Applications of Tribune Media Company and Sinclair Broadcast Group, Inc. for the Transfer of Control of Tribune Media Company and Certain Subsidiaries, WDCW(TV) et al., *Hearing Designation Order*, 33 FCC Rcd. 6380 (2018).

[46] *See e.g.*, Applications of AT&T Inc. and Deutsche Telekom AG for Consent to Assign or Transfer Control of Licenses and Authorizations, *Order*, 26 FCC Rcd. 16184, 16185 ¶ 4 (2011) ("[T]he staff also explains that the economic and engineering models on which the Applicants rely to show consumer benefits are, in the staff's assessment, unreliable and, at a minimum, raise substantial and material questions of fact.").

Attachment A

Attachment B

Response to Israel, Katz, and Keating April 22, 2019 Declaration and Kapoor April 22, 2019 Declaration

Coleman Bazelon
Principal, The Brattle Group

Jeremy Verlinda
Principal, The Brattle Group

and

William Zarakas
Principal, The Brattle Group

May 20, 2019

Table of Contents

I. Introduction

On April 22, 2019, T-Mobile submitted a filing containing two declarations responding to criticisms of how millimeter wave spectrum is deployed in their network model.[1] The first, submitted by Ankur Kapoor, focuses on a purported "refinement" of the millimeter wave deployment in the network model.[2] The second, submitted by Mark Israel, Michael Katz, and Bryan Keating ("Compass Lexecon"), presents consumer welfare calculations driven by marginal costs and marginal cost savings as calculated based on output from the revised network model.[3] As discussed below, these new network models are not mere "refinements" of previous work, in that they do not represent small or incremental changes, but rather constitute substantial changes to how millimeter wave spectrum deployments are modeled.

We have examined both declarations and have concluded the following:

1. The Applicants' primary criticism of our millimeter wave showing is that we followed the Applicants' own model.
2. In response, the Applicants have revised their network model. The Applicants' filing accepts the premise that Sprint and T-Mobile will acquire additional millimeter wave

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[1] *See,* for example, 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, Appendix IV, (henceforth "Brattle October 31 Declaration") and Response to Compass Lexecon and Mark McDiarmid of Coleman Bazelon, Jeremy Verlinda, and William 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, March 28, 2019 (henceforth "Brattle March 28 Declaration"),

[2] Ankur Kapoor, "Declaration of Ankur Kapoor", *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, April 22, 2019, (henceforth "Kapoor April 22 Declaration").

[3] Mark Israel, Michael Katz, and Bryan Keating, "The Conclusion that the Proposed Merger of Sprint and T-Mobile will Increase Consumer Welfare Holds Even if the Standalone Companies would Otherwise Obtain Licenses to mmWave Spectrum", *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, April 22, 2019, (henceforth "Compass Lexecon April 22 Declaration").

Continued on next page

spectrum.[4] The revised network model presents an unrealistic millimeter wave deployment that is in fact less accurate than the Applicants' previous network models:

a. The previous version of the Applicants' network model used a "penalization" approach for millimeter wave spectrum in recognition of propagation characteristics and the additional costs of deploying millimeter wave spectrum compared to low- and mid-band spectrum. In other words, the model assumed that millimeter wave frequencies have as little as **{{BEGIN HCI END HCI}}** of the capacity of mid-band spectrum.[5] Subject to that penalty, millimeter wave deployment extended throughout each node area. This is consistent with the realities of universally accepted millimeter wave architecture where the higher demand areas within each macro cell would be served through micro-cell deployments by millimeter wave frequencies.

b. The revised version of the model includes deployment of already owned and a subset of potentially acquired millimeter wave spectrum, but it deploys this spectrum only to **{{BEGIN HCI END HCI}}** users located in areas near macro-cells (within as short a distance as **{{BEGIN HCI END HCI}}** meters). In their model construction, all millimeter wave bandwidth that is not used by this "offloaded" traffic is simply wasted. What is more, if the artificially constrained offloaded traffic does not exceed **{{BEGIN HCI END HCI}}** of total projected traffic for a node, the model is not supposed to deploy any millimeter wave spectrum.

c. Because of the artificially limited millimeter wave deployment in the revised network model, the Applicants' modeled millimeter wave cell deployment would occur at less than half of the sites that would likely be covered by to-be-acquired millimeter wave spectrum. Furthermore, the deployment at those sites would cover only a fraction of the total area that a realistic millimeter wave deployment would cover.

d. The revised version of the network model thus produces unrealistic representations of network performance and marginal costs. The prior version of the network model, which the Applicants submitted in their February 20, 2019 filing, provided for a more reasonable approximation of the effects of millimeter wave deployment than the current, revised network model.

e. As we have shown, the deployment of additional millimeter wave frequencies consistent with the prior version of the Applicants' network model would substantially dilute the Applicants' claimed marginal cost savings:[6]

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[4] As noted below, it would be economical for the Applicants to purchase additional millimeter wave spectrum.

[5] This penalty is applied to the capacity calculated after other differences between bands, such as bit rates, are taken into account.

[6] *See* Brattle March 28, 2019 Declaration at Table 3, p. 14.

i. Whereas Compass Lexecon claimed network marginal cost savings for T-Mobile of **{{BEGIN HCI END HCI}}** in 2021 and **{{BEGIN HCI END HCI}}** in 2024, we found that accounting for likely millimeter wave spectrum acquisitions reduced these cost savings to just **{{BEGIN HCI END HCI}}** in 2021 and **{{BEGIN HCI END HCI}}** in 2024.

ii. Whereas Compass Lexecon claimed network marginal cost savings for Sprint of **{{BEGIN HCI END HCI}}** in 2021 and **{{BEGIN HCI END HCI}}** in 2024, we found that accounting for likely millimeter wave spectrum acquisitions reduced these cost savings to just **{{BEGIN HCI END HCI}}** in 2021 and **{{BEGIN HCI END HCI}}** in 2024.

3. The approach to millimeter wave deployment in the Applicants' revised network model distorts the calculation of incremental solutions.

   a. The revised network model includes the same baseline deployment as previous models for T-Mobile/New T-Mobile for T-Mobile's millimeter wave spectrum owned as of 2018 (in a limited subset of cities), but assumes that any newly acquired millimeter wave spectrum will be deployed only for incremental solutions.

   b. This disparate treatment leads to inconsistent spectrum deployment. For example, in areas with baseline deployment of millimeter wave spectrum, T-Mobile deploys (baseline plus incremental solutions) **{{BEGIN HCI END HCI}}** millimeter wave cells, or approximately **{{BEGIN HCI END HCI}}** of cells in higher density areas that would likely be deployed for millimeter wave in the original network model's baseline deployment.[7] In contrast, in areas where T-Mobile did not own millimeter wave spectrum in 2018, and therefore did not have baseline deployment, the incremental solutions-based deployment leads to only approximately **{{BEGIN HCI END HCI}}** millimeter wave cells, or just **{{BEGIN HCI END HCI}}** of cells that would likely be deployed under the original network model's baseline deployment.[8]

   c. Likewise, for standalone Sprint, which owns no millimeter wave spectrum today but is likely to acquire millimeter wave spectrum in the future, all of its millimeter wave deployments are modeled as incremental solutions. Furthermore, Sprint's millimeter wave deployments continue to be modeled under the older modeling assumptions of a **{{BEGIN HCI END HCI}}** propagation discount, but serving demand throughout a node's service area, introducing significant inconsistencies between how the Sprint and T-Mobile networks are modeled in the revised network model.

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[7] In our earlier filings, we described a basic deployment rule for millimeter wave cells for newly acquired spectrum that approximately mirrors the baseline deployment for spectrum owned in 2018 in the Applicants' original network model. This deployment rule for new millimeter wave spectrum is used to determine the set of candidate millimeter wave cells.

[8] *See* Table 2.

d. Modeling millimeter wave to only serve very limited amounts of offloaded traffic severely understates the effect of millimeter wave on the Applicants' networks, especially in the revised network model where the choice of *where* demand is offloaded is driven by preexisting macro node locations, not by any planning around where millimeter wave capacity is most needed.

4. The revised network model produces inflated and unrealistic results regarding marginal cost savings:

    a. Of the **{{BEGIN HCI END HCI}}** millimeter wave cells deployed in the baseline model (in areas where millimeter wave spectrum was owned as of 2018), almost half do not qualify for millimeter wave deployment under the Applicants' proposed **{{BEGIN HCI END HCI}}** traffic offloading rule for incremental solutions.[9] This means that the millimeter wave spectrum that T-Mobile will likely acquire (or may have acquired already in Auctions 101 and 102) would not be deployed at all in thousands of areas where T-Mobile had decided to deploy it according to the original model. In addition to other problems with the revised network model, simply deploying millimeter wave spectrum on far fewer sites will lower the amount of capacity contributed by millimeter wave frequencies, increasing the incremental (and marginal) costs of meeting demand with mid- and low-band frequencies.

    b. The revised network model predicts that marginal cost savings for T-Mobile, which faces relatively steeper marginal cost estimates in the network model due to relatively greater spectrum capacity constraints, are invariant to the amount of millimeter wave spectrum acquired. This invariance is driven by the modeling assumption that any amount of millimeter wave spectrum is sufficient to serve any amount of "offload" traffic. The millimeter wave frequencies are always consigned exclusively to the limited amount of offloaded traffic, no matter how much extra millimeter wave capacity is available to serve additional traffic.

    c. The revised network model predicts that marginal cost savings for T-Mobile *increase* when it acquires millimeter wave spectrum, notwithstanding that millimeter wave spectrum should be expected to reduce T-Mobile's spectrum capacity constraints.

5. Finally, the revised network model indicates that the Applicants' home broadband offering would be even less valuable than originally propounded.

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[9] *See* Table 1.

II. The Applicants' Revised Network Model Presents an Unrealistic Millimeter Wave Deployment

On April 22, the Applicants submitted yet another revision to their network engineering model, their fifth since the merger review proceeding began.[10] The latest update, intended to address issues with how millimeter wave spectrum is deployed in the network model, does not provide an accurate representation of the networks of New T-Mobile or of Sprint and T-Mobile as standalone entities.

A. The Millimeter Wave Adjustments to the Network Model

In his April 22, 2019 Declaration, Mr. Kapoor describes supposed "refinements" to the Applicants' network model, purportedly to more realistically address the propagation characteristics of millimeter wave frequencies. But the model is artificially and unrealistically constrained because it only deploys the 5G millimeter wave spectrum on existing macro towers, with no incremental 5G millimeter wave small cell deployments. Although the model does include the possibility of incremental small cells, it restricts those small cells to only deploying low- and mid-band spectrum. It does not model what is at the core of millimeter wave deployments—the addition of small cells using millimeter wave frequencies to address congestion in high traffic areas.[11] By only deploying millimeter wave spectrum on macro cells and restricting small cells to lower frequencies, the Applicants have provided a network model that is the opposite of what a millimeter wave deployment would be.

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[10] The first simplified version was submitted on August 1, 2018. The second, submitted on September 17, 2018, reflected significant updates on the first version to incorporate congestion and congestion relief. The third, submitted on February 21, 2019, incorporates 2019 and 2020 ("the integration years") as well as other alterations to the model. The fourth, submitted on March 6, 2019, includes alleged in-home broadband service. This is the fifth version of the network model, reflecting an entirely new deployment method for millimeter wave spectrum.

[11] 5G PPP Architecture Working Group, "View on 5G Architecture," European Union, July 2016, accessed April 25, 2019, https://5g-ppp.eu/wp-content/uploads/2014/02/5G-PPP-5G-Architecture-WP-For-public-consultation.pdf.

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Mr. Kapoor describes two key adjustments to the previous network models. The first is that, for the T-Mobile models, traffic at the sector level is now broken out into two layers—one servable by millimeter wave spectrum and another served exclusively by the low- and mid-band frequencies.[12] The traffic that is servable by millimeter wave spectrum is confined to {{BEGIN HCI END HCI}} users located only within {{BEGIN HCI END HCI}} meters of the macro node on which it would be deployed.[13] In other words, {{BEGIN HCI END HCI}} traffic near the macro site is available to be "offloaded" to the millimeter wave spectrum, which is then cordoned off and put to no other use. Rather than applying a {{BEGIN HCI END HCI}} propagation penalty to millimeter wave capacity and then projecting that this penalized capacity will nonetheless be deployed across the entire coverage area of a sector, as in the prior versions of the network model, Mr. Kapoor's revised modeling of millimeter wave's propagation characteristics takes into account the limited percentage of traffic on a node that is {{BEGIN HCI END HCI}} and within {{BEGIN HCI END HCI}} meters of the macro cell and the millimeter wave deployments are restricted to only serving that subset of traffic.[14] This changes the effective propagation penalty of millimeter wave to vary by site based on the amount of traffic that fits these narrow qualifications, and not taking into account either the available supply of millimeter wave spectrum or the ability to extend coverage throughout a macro-cell node by building micro-cells.[15] No such adjustment of propagation or segmentation of capacity between 'near and {{BEGIN HCI END HCI}}' and 'farther away and {{BEGIN HCI END HCI}}' is provided for the Sprint network model. This creates a stark difference between how the T-Mobile and Sprint networks are modeled. This mixing of modeling techniques across the network models leads to results that Compass Lexecon itself characterizes as {{BEGIN HCI END HCI}}.[16]

The second fundamental change to the network model is that a millimeter wave overlay has been added as an incremental solution to relieve congestion. That is, for some of the macro cell sites for which millimeter wave spectrum is not deployed in the baseline network, congestion on the

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[12] Compass Lexecon April 22 Declaration Backup Materials.

[13] Kapoor April 22 Declaration, p. 5.

[14] Kapoor April 22 Declaration, p. 6.

[15] Note that this adjustment is made for the T-Mobile and New T-Mobile network engineering models, but not for the Sprint model. Sprint retains the {{BEGIN HCI END HCI}} propagation adjustment for millimeter wave, and is available to serve all traffic within the coverage area of a node. *See* Compass Lexecon April 22 Declaration Backup Materials.

[16] Compass Lexecon April 22 Declaration, p. 8.

low/mid-band layer can be addressed by deploying recently or soon to be acquired millimeter wave spectrum. Again, however, any such congestion relief is available only for narrowly circumscribed traffic – **{{BEGIN HCI END HCI}}** users within **{{BEGIN HCI END HCI}}** meters of the macro-cell site. Moreover, as we explain below, the Applicants' modeling of baseline millimeter wave deployments and the macro cell sites available for the incremental millimeter wave solutions is irrational.

B. The Applicants' Millimeter Wave Deployment is Unrealistic

In the Kapoor April 22 Declaration, the discussion of millimeter wave deployment revolves entirely around macro cell deployment.[17] A comprehensive 5G millimeter wave deployment would not rely only on macro nodes. Rather, any reasonable 5G deployment of millimeter wave spectrum would include a significant number of small cells to fill in gaps in coverage in dense urban areas.[18] It is unreasonable that a millimeter wave deployment would be restricted by the placement of mostly legacy macro cell sites that were not chosen to support a millimeter wave deployment.

The Applicants' newly proposed limitation of millimeter wave deployment only to macro nodes goes against the most fundamental premise of millimeter wave deployment architecture. 5G networks are expected to be much denser than existing 4G networks.[19] A European Union 5G architecture working group published a paper echoing the expectation that 5G deployment will include millimeter wave spectrum and have "heterogeneous and dense deployments."[20]

Actual 5G deployment invariably follows this architecture. Verizon, for example, has begun deploying 5G using millimeter wave spectrum and small cells in cities such as Chicago and

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17 Kapoor April 22 Declaration, pp. 1 – 7.

18 We recognize that some areas will not merit millimeter wave deployment and that coverage will not be ubiquitous given the propagation characteristics, but we find it non-credible that there would not be any additional small cells deploying millimeter wave spectrum.

19 CA Assembly SB-649 June 28 Testimony, Scientists for Wired Technology (June 29, 2017), https://scientists4wiredtech.com/2017/06/ca-assembly-sb-649-june-28-testimony.

20 5G PPP Architecture Working Group, "View on 5G Architecture," European Union, July 2016, accessed April 25, 2019, https://5g-ppp.eu/wp-content/uploads/2014/02/5G-PPP-5G-Architecture-WP-For-public-consultation.pdf.

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Minneapolis.[21] While coverage remains sparse, it would be practically non-existent if Verizon were to only deploy the spectrum on its macro cell sites.

The role of small cells in deploying millimeter wave for 5G is not lost on the Applicants, as revealed by their own documents. For example, a table discussing **{{BEGIN HCI**

END HCI}}.[22] A company presentation **{{BEGIN HCI**

END HCI}}[23] Yet another T-Mobile deck **{{BEGIN HCI**

END HCI}}[24] And Sprint's **{{BEGIN HCI**

END HCI}}[25]

The millimeter wave deployment as represented in the revised network engineering models is simply not a realistic expectation. Figure 1, below, shows a map of the millimeter wave deployment (which is only on macro nodes) in 2024 in the greater Los Angeles Area and the many, small, disjointed areas where a customer would be able to access the millimeter wave frequencies.

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21 Kendra Chamberlain, "millimeter wave 5G real-world deployments will require very dense networks: report," *Fierce Wireless*, April 23, 2019, accessed April 25, 2019, https://www.fiercewireless.com/5g/real-world-deployments-mmwave-5g-will-require-very-very-dense-networks-report

22 *See* TMUS-FCC-01121968, TMUS-FCC-01121967.

23 *See* TMUS-FCC-02058530 at slides 7-13. **{{BEGIN HCI**

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24 *See* TMUS-FCC-00051566 at TMUS-FCC-00051590.

25 *See* SPR-FCC-11890728 at SPR-FCC-11890746.

Figure 1: New T-Mobile millimeter wave Deployment and Coverage, Greater Los Angeles, 2024

{{BEGIN HCI

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Sources: Google Maps, "35. Site and sector coordinates.xlsx", Revised Network Engineering Model.

Notes: Each circle represents the alleged coverage area of a macro cell site flagged for millimeter wave deployment in 2024 based on a **{{BEGIN HCI END HCI}}** meter coverage distance.

Figure 2, below, shows this same information for downtown Los Angeles. It is clear that the Applicants' millimeter wave deployment is neither dense nor heterogeneous. To make a simple comparison, Verizon plans to deploy roughly {{BEGIN HCI END HCI}} number of 5G nodes in *just downtown* Los Angeles in the near future as the Applicants supposedly plan to deploy in *the entire* Los Angeles metropolitan statistical area in 2024, according to the revised network model.[26] And, according to the Applicants' model, significant portions of downtown Los Angeles

[26] Verizon plans to deploy roughly 3,000 5G nodes in downtown Los Angeles. *See* Nina Beety, "How many 5G cell towers are coming to our communities? Verizon discloses the huge numbers," *What is 5G*, January 2018, accessed April 25, 2019, https://whatis5g.info/5g/2018/01/how-many-5g-cell-towers-coming-verizon-discloses-numbers/. In contrast, according to the revised network model, the

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would not have any millimeter wave coverage in 2024, including Dodger Stadium, a venue ripe for such coverage. That architecture does not make sense.

Figure 2: New T-Mobile mmWave Deployment and Coverage
Downtown Los Angeles, 2024

{{BEGIN HCI

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Sources: Google Maps, "35. Site and sector coordinates.xlsx", Revised Network Engineering Model.

Notes: Each circle represents the alleged coverage area of a macro cell site flagged for millimeter wave deployment in 2024 based on a **{{BEGIN HCI END HCI}}** meter coverage distance.

Indeed, the supposed sparseness of millimeter wave deployment is even contradicted by the Applicants' own internal documents, where {{BEGIN HCI

Applicants purport now to plan to deploy millimeter wave spectrum on approximately {{BEGIN HCI END HCI}} nodes in the *entire* Los Angeles MSA, and approximately just {{BEGIN HCI END HCI}} nodes in downtown Los Angeles, as represented in Figure 1. *See* Brattle Backup.

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END HCI}}.[27] Moreover, the modeled network deployment is even more sparse in cities where (unlike Los Angeles) T-Mobile did not happen to own millimeter wave spectrum as of 2018 (e.g., Houston, shown in Figure 4). As shown in Table 2, below, when all millimeter wave deployments are incremental solutions (none in baseline), even less of the city is served by these frequencies.

C. The Applicants' Prior Modeling of Millimeter Wave Deployment is More Reasonable

The revised network model is less realistic than the Applicants' prior modeling of millimeter wave deployments. The prior model recognized the more limited propagation of millimeter wave frequencies by imposing a substantial propagation penalty of **{{BEGIN HCI END HCI}}** on the capacity contributed by millimeter waves compared to low- and mid-band frequencies. Subject to that penalty, the model then assumed that the millimeter wave frequencies would be available throughout the area covered by a node, consistent with the lower frequencies. That assumption was a reasonable "shorthand" for millimeter wave spectrum being deployed from micro-cells within the main macro-cell's area. It recognized that capacity served by millimeter wave frequencies would be distributed as needed throughout the area served by a node.

The Applicants' revised network model is unrealistic because the areas served by millimeter wave spectrum are not the set of all high traffic areas where millimeter wave spectrum could be usefully deployed, but rather are only high traffic areas that are, by happenstance, within **{{BEGIN HCI END HCI}}** meters of the existing macro nodes. The inconsistency between the old and new models is further highlighted by the analysis, presented below, that the decision rule used in the earlier models to determine where to deploy millimeter wave spectrum (referred to as baseline deployments in those models) includes many more nodes than the revised deployment rule for incremental millimeter overlays in the revised network model. The prior modeling provided a more realistic view of where millimeter wave spectrum will be deployed and the effect of those deployments on meeting customer demand.

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[27] *See* TMUS-FCC-02058530 at slides 9.

III. The Deployment of Millimeter Wave Spectrum in the Applicants' Revised Network Model Distorts the Calculation of Incremental Solutions and Marginal Cost Savings

A. The Applicants' Baseline Deployment is Incorrect and Distorts the Calculation of Incremental Solutions

As an initial matter, if Sprint and T-Mobile had access to spectrum nationwide, they would be likely, if not certain, to deploy it in a baseline network in most cities across the nation. It is very likely that Sprint and T-Mobile will acquire millimeter wave frequencies. Among other evidence: a large number of internal documents discuss their plan to do so; they have stated their intent to participate in millimeter wave auctions;[28] and they would also have the incentive in cost savings to do so.[29] Consequently, their baseline network's use of millimeter wave frequencies would be much more widespread than in their revised network model. But whether it is modeled in the baseline network or as an incremental solution, or both, it should be modeled consistently, not haphazardly as it is in the revised network model.

In their revised network model, the Applicants fail to address our criticism of their deployment of millimeter wave spectrum. We had indicated that their network model should reflect the addition of millimeter wave spectrum because they are very likely to acquire this spectrum across the country (if they have not already made such acquisitions in Auctions 101 and 102). Their revised network model does not address this concern. In the original and revised versions of the network model, the baseline deployment of millimeter wave spectrum is largely determined by where T-

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[28] *See*: Letter from Nancy Victory to Marlene Dortch, AU Docket No. 18-85, July 23, 2018, at 3. Sprint Corp., Petition for Expedited Declaratory Ruling or Waiver Regarding Joint Bidding and Request for Limited Waiver of Auction Form Rules, AU Docket No. 18-85, August 6, 2018, at 1-2.

[29] It would likely be profitable to purchase additional millimeter wave spectrum. Under a spectrum price of $0.009/MHz-Pop (the average price paid in Auction 102 as per the Auction's web page, https://auctiondata.fcc.gov/public/projects/auction102), the cost of 200 MHz of national millimeter wave spectrum would be about $570 million. This cost is far overshadowed for each brand by the savings from incorporating additional millimeter wave spectrum, even just examining the capex savings in 2024. The capex savings are about **{{BEGIN HCI END HCI}}** for Sprint and **{{BEGIN HCI END HCI}}** for T-Mobile. These figures are estimated by comparing capex to accommodate expected traffic in the September 20th, 2018 model submission, with and without the 200 MHz millimeter wave adjustment. *See* backup materials for calculations.

Mobile owned millimeter wave spectrum in 2018. For example, T-Mobile will deploy millimeter wave spectrum in its baseline network in **{{BEGIN HCI END HCI}}** where, in 2018, it owned spectrum. In deploying spectrum in the baseline model, the cost of that baseline deployment is "removed" from marginal cost calculations because those deployments are fixed in the baseline network and not needed as an incremental solution. But it is only modeled in the baseline network, and therefore removed from the marginal cost calculations, in areas where they happened to own millimeter wave frequencies as of 2018.

The revised network model allows for incremental solutions outside of areas where T-Mobile currently owns spectrum and deploys it in its baseline model, but inexplicably limits these incremental overlay deployments only to areas where we suggested they would be likely to deploy millimeter wave spectrum in our analysis showing the potential effect of additional millimeter wave deployments.[30] This is nonsensical for at least two reasons. First, if T-Mobile or Sprint had access to additional millimeter wave frequencies—as they assume in this revised network model testing the effect of additional millimeter wave spectrum—they would build some amount of it into their baseline network across the nation, not simply in the areas where they happened to own millimeter wave spectrum as of 2018. But they don't do that. Rather, they model all additional millimeter wave spectrum not owned as of 2018 as available only for incremental overlay solutions.

Second, and equally baffling, the Applicants model the addition of millimeter wave spectrum as if they only acquired access to millimeter wave frequencies for the nodes where we had suggested they would deploy those frequencies *in a baseline network*. This demonstrates a remarkable misunderstanding of our analysis. We modeled a situation where Sprint and T-Mobile would have access to millimeter wave spectrum everywhere and then projected where it would be deployed in their baseline model based on approximating where they did deploy millimeter wave spectrum in their baseline network when they had access to such spectrum. We use a simple rule for where the millimeter wave spectrum would be deployed—nodes in Census Tracts with at least 700 people and a population density of 200 people per square mile—that was supposed to represent the decisions that Sprint and T-Mobile would make about where to deploy those frequencies in their baseline model.[31] It was never intended, as T-Mobile has now used it, as a factor limiting where millimeter wave spectrum could be deployed. In fact, it is irrational for the Applicants to not

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[30] In this new model, they assume that additional millimeter wave spectrum is only available to deploy on the nodes that have the Brattle deployment flags. *See* Compass Lexecon April 22 Declaration Backup Materials.

[31] *See* Brattle October 31 Declaration, at pp. 57-58.

deploy millimeter wave frequencies on nodes when their own modeling may suggest it is needed to relieve congestion.

The Applicants' new approach to millimeter wave deployments distorts the calculation of incremental solutions. This is illustrated by the observation that adding millimeter wave spectrum to the Applicants' revised network model leads to increased marginal cost savings for T-Mobile and decreased marginal costs savings for Sprint. The Applicants' revised network model inconsistently assigns millimeter wave spectrum to the baseline T-Mobile network in some areas but not others, and models millimeter wave as an offload that shows larger savings than without the millimeter wave frequencies. According to Compass Lexecon itself, this result is **{{BEGIN HCI END HCI}}**[32] In contrast, adding millimeter wave frequencies to the Sprint network, which models millimeter wave as an incremental solution, but without the traffic segmentation and offloading assumptions included in the revised T-Mobile models, still shows a decrease in marginal cost savings. The fact that adding millimeter wave spectrum to the two separate networks produces the opposite effects on marginal costs savings demonstrates the unreliability of using these models at all.

B. Baseline and Incremental Solutions are Inconsistently Modeled

Baseline deployment of millimeter wave spectrum in the Applicants' revised network model is limited to T-Mobile and New T-Mobile for the subset of areas where T-Mobile owned millimeter wave spectrum as of 2018, and is inconsistent with the incremental overlays in areas outside of their baseline deployments. According to Mr. Kapoor, "if [millimeter wave] could provide at least a **{{BEGIN HCI END HCI}}** traffic offload at a macro cell site, then it would be a viable solution for congestion relief."[33] Mr. Kapoor claims this **{{BEGIN HCI END HCI}}** was selected given the cost and capacity gains associated with other incremental solutions.[34] Yet the Applicants' baseline millimeter wave deployment for the T-Mobile networks does not follow this rule, as more than **{{BEGIN HCI END HCI}}** of the millimeter wave nodes in the baseline deployment do not meet this deployment condition. Table 1 shows the percentage and counts of millimeter wave sites that are deployed in the baseline New T-Mobile network and the percentage

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[32] Compass Lexecon April 22 Declaration, p. 8.

[33] Kapoor April 22 Declaration, p. 6.

[34] Kapoor April 22 Declaration, p. 6.

that do not meet the {{BEGIN HCI END HCI}} capacity offload criteria. In 2024, millimeter wave spectrum would fail to qualify as an incremental solution for nearly half of the nodes where New T-Mobile deploys it.

Table 1: New T-Mobile Baseline millimeter wave Deployment Coverage

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Sources: Compass Lexecon Backup Materials, Revised Network Engineering Models.

Because areas with baseline deployment are not constrained in the same way as the incremental solutions deployment, millimeter wave spectrum is deployed inconsistently. Table 2, below, illustrates this inconsistency by contrasting the revised millimeter wave deployment to the likely deployment that we described in our earlier adjustments to the Applicants' network models, as informed by the Applicants' own baseline deployment of T-Mobile's millimeter wave spectrum holdings as of 2018.[35]

[35] In our earlier filings, we described a basic deployment rule for millimeter wave cells for newly acquired spectrum that approximately mirrors the baseline deployment for spectrum owned in 2018 in the Applicants' original network model. This deployment rule for new millimeter wave spectrum is used to determine the set of candidate millimeter wave cells.

Table 2: Revised New T-Mobile Network Model Millimeter Wave Deployment versus Brattle Identification of "Likely Node Deployment", by Tract Type in 2024
{{BEGIN HCI

END HCI}}

Sources: "35. Site and sector coordinates.xlsx", FCC API census block data, Revised Network Engineering Model.

Notes: "Baseline" tracts have at least one node with baseline millimeter wave deployment. "Incremental Only" tracts have at least one node with incremental solution millimeter wave deployment, but no nodes with baseline deployment. "None" tracts have no nodes with baseline or incremental millimeter wave deployment in the revised network model. The "Non-Baseline" row provides the sum of nodes from "Incremental Only" and "None" rows. The row "All" accumulates the node counts across the entire United States. Nodes that could not be mapped to counties were dropped. When multiple census block IDs matched a node location, the first is used. When nodes have multiple locations, they are split into separate nodes if separated by a distance greater than **{{BEGIN HCI END HCI}}** meters and consolidated to a single node by choosing the first if separated by less than **{{BEGIN HCI END HCI}}** meters.

As shown in the table, in 2024, the revised network model deploys millimeter wave spectrum at {{BEGIN HCI END HCI}} of the likely nodes in census tracts where baseline millimeter wave would be expected to be deployed. However, in census tracts where T-Mobile did not own spectrum in 2018 (and therefore no millimeter wave spectrum is deployed in the baseline model), the revised network model only deploys millimeter wave spectrum at {{BEGIN HCI END HCI}} of the likely nodes. Over {{BEGIN HCI END HCI}} of these likely nodes have no millimeter wave deployment at all. A graphical representation of the millimeter wave deployment inconsistency is shown in the maps of Los Angeles and Houston, below.

Figure 3: New T-Mobile Millimeter Wave Baseline vs Incremental Deployment in Los Angeles

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END HCI}}

Sources: Google Maps, "35. Site and sector coordinates.xlsx", Revised Network Engineering Model.

Notes: Each circle represents the alleged coverage area of a macro cell site flagged for millimeter wave deployment in 2024 based on a **{{BEGIN HCI END HCI}}** meter coverage distance.

As shown in Figure 3, in Los Angeles, where T-Mobile owned millimeter wave spectrum in 2018, a majority of New T-Mobile's millimeter wave nodes are deployed as a result of the baseline model.

Figure 4: New T-Mobile Millimeter Wave Baseline vs Incremental Deployment in Houston
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Sources: Google Maps, "35. Site and sector coordinates.xlsx", Revised Network Engineering Model.

Notes: Each circle represents the alleged coverage area of a macro cell site flagged for millimeter wave deployment in 2024 based on a **{{BEGIN HCI END HCI}}** meter coverage distance.

In contrast, Figure 4 shows that, in Houston, where T-Mobile did not own millimeter wave spectrum in 2018, incremental solutions-based deployment accounts for 100% of the millimeter wave deployment. This difference results in starkly divergent deployments in the two cities: in Los Angeles the revised network model deploys millimeter wave cells at approximately {{BEGIN HCI END HCI}} of likely millimeter wave deployment nodes, while in Houston the revised network model deploys millimeter wave cells at just {{BEGIN HCI END HCI}} of likely millimeter wave deployment nodes.[36]

[36] Houston is defined as the Houston-The Woodlands-Sugar Land, TX Metropolitan Statistical Area, which includes Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller

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C. The Revised Network Model Produces Inflated and Unrealistic Marginal Cost Savings Predictions

As shown in Table 1, above, of the **{{BEGIN HCI END HCI}}** millimeter wave cells deployed in the baseline model for millimeter wave spectrum owned as of 2018, nearly half adhere to the Applicants' proposed **{{BEGIN HCI END HCI}}** traffic offloading rule for incremental solutions. This inconsistency in treatment of baseline versus incremental solutions deployment increases the Applicants' estimates of marginal costs associated with the deployment of any newly acquired millimeter wave spectrum. That is, the use of millimeter wave spectrum to offload capacity at macro nodes in cities such as Los Angeles, where T-Mobile owned millimeter wave spectrum in 2018, is treated as a sunk cost. In contrast, in cities such as Houston, where all millimeter wave deployment is via incremental solutions, all capacity offloading is treated as marginal costs and no portion of the offloaded capacity is treated as sunk.

The Applicants further assume that any millimeter wave deployment will provide so much capacity that it is not necessary to check if it can serve all of the targeted offload traffic.[37] This implies that the millimeter wave deployments must be overkill for the traffic they are serving. As an initial matter, this suggests that the millimeter wave deployments are not being rationally or realistically modeled. But it also leads to nonsensical results. The standalone T-Mobile network is modeled by the Applicants to have relatively steeply increasing marginal costs. This should imply that anything that alters the need for incremental solutions, such as adding millimeter wave spectrum to the model, would have an effect on marginal costs. But this is not the case. The revised network model predicts that marginal cost savings for T-Mobile are invariant to the amount of millimeter wave spectrum acquired, as illustrated in Figure 5, below.

counties. Los Angeles is defined as the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area, which includes Los Angeles and Orange counties. The counties included in each city are from the revised metropolitan, micropolitan, and combined statistical areas from the Census Bureau, updated October 2018. *See* "CBSAs, metropolitan divisions, and CSAs, Sep. 2018," United States Census Bureau, accessed May 16, 2019, https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/delineation-files.html. The calculations of share of likely millimeter wave deployment nodes for Los Angeles and Houston are provided in our Backup Materials.

[37] *See* Kapoor April 22 Declaration at p. 7.

Figure 5: T-Mobile 2024 Network Marginal Cost Savings by Millimeter Wave Spectrum Acquisition Level, 2024
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Sources: Compass Lexecon Backup Materials, Revised Network Engineering Models.

As shown in the figure, the Applicants' revised network model calculates that marginal cost savings for T-Mobile from the merger are constant, regardless of the amount of millimeter wave spectrum acquired. This occurs because the millimeter wave capacity is used exclusively for the 'offloaded' traffic, no matter how much extra capacity this leaves, leaving no room for variations driven by differing amounts of millimeter wave spectrum deployed.

Yet more unrealistically, the revised network model predicts that marginal cost savings for T-Mobile *increase* when it acquires millimeter wave spectrum, notwithstanding that millimeter wave spectrum should be expected to reduce T-Mobile's spectrum capacity constraints. For example, Compass Lexecon estimates that, with no additional acquisitions of millimeter wave spectrum, T-Mobile experiences network marginal cost savings of {{BEGIN HCI END HCI}}

in 2021 and **{{BEGIN HCI END HCI}}** in 2024.[38] However, Compass Lexecon then estimates that, if the standalone networks each acquire 200 MHz of millimeter wave spectrum and New T-Mobile 400 MHz, then the estimated network marginal cost savings *increase* to **{{BEGIN HCI END HCI}}** in 2021 and **{{BEGIN HCI END HCI}}** in 2024.[39] Although Compass Lexecon admits that this result is **{{BEGIN HCI END HCI}}**,[40] it provides no explanation of how a relaxation of T-Mobile's spectrum constraints causes it to face a steeper network marginal cost curve.

IV. The Home Broadband Offering is Likely Diminished

The Applicants claim that their in-home broadband offering is not dependent on their millimeter wave spectrum. As discussed in our March 28 declaration, this is not true because the Applicants' capacity to provide in-home broadband is highly correlated with the availability of millimeter wave spectrum.[41] Under the revised network model, there is no analysis of New T-Mobile's in-home broadband offering. Such an analysis would likely show a diminished offering because, now that the sector-level throughput in the New T-Mobile network is broken out into a millimeter wave layer and a low-/mid-band layer, there is less excess capacity on these non-millimeter wave frequencies available to provide home broadband. This available capacity is smaller because outside of the small area around the macro sites all traffic is carried on the low- and mid-band spectrum without some of that capacity assumed to be carried by the millimeter wave frequencies. That is, now that sector level throughput is not the blended capacity provided by all spectrum including millimeter wave, the mid- and low-band frequencies have to carry all **{{BEGIN HCI END HCI}}** traffic and all traffic beyond than **{{BEGIN HCI END HCI}}** meters from the macro site. Consequently, there is less excess capacity available to provision the in-home broadband product in most of the areas covered by the network.

Table 3 shows how average all-hour user throughput after incremental solutions on the low- and mid-band layer in the revised network model compares to average all-hour user throughput as

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38 *See* Compass Lexecon April 22 Declaration at p. 8, Table 2.

39 *Id.*

40 *See* Compass Lexecon April 22 Declaration at p. 8.

41 *See* Brattle March 28 Declaration at pp. 29-34.

presented in the in-home broadband network model, for sectors that will both allegedly serve in-home broadband and will have millimeter wave spectrum deployed on them. The millimeter wave adjustment to the network model has resulted in a decrease, on average, of approximately {{BEGIN HCI END HCI}}. This previously available capacity no longer exists on the network to provide in-home broadband service. As recently as May 3, 2019 the Applicants were presenting analysis based on the prior network models.[42]

Table 3: New T-Mobile In-Home Broadband Average Throughput (Mbps)
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Sources: In-Home Broadband Network Model, Revised Network Model.

Notes: Average throughputs reflects average all-hour user throughput after incremental solutions on sectors that New T-Mobile alleges it will provide in-home broadband in a given year and have millimeter wave deployed.

[42] Letter from Nancy Victory to Marlene Dortch, Attachment B, *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, May 3, 2019.

V. Appendix

Figure 6: {{BEGIN HCI

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Sources: TMUS-FCC-02058530 at Slide 9. **{{BEGIN HCI END HCI}}**.