ORAL ARGUMENT NOT YET SCHEDULED
No. 20-1190
(consolidated with Nos. 20-1216, 20-1272, 20-1274, 20-1281, 20-1284)

United States Court of Appeals for the District of Columbia Circuit

AT&T SERVICES, INC.,

Petitioner,

v.

FEDERAL COMMUNICATIONS COMMISSION; UNITED STATES OF AMERICA,

Respondents.

APPLE INC., BROADCOM INC.; CISCO SYSTEMS INC.; GOOGLE LLC; HEWLETT PACKARD ENTERPRISE CO.; INTEL CORP.; MICROSOFT CORP.; NCTA – THE INTERNET & TELEVISION ASSOCIATION; WI-FI ALLIANCE,

Intervenors for Respondent.

ON PETITIONS FROM THE FEDERAL COMMUNICATIONS COMMISSION

BRIEF FOR CABLE TELEVISION LABORATORIES, INC. AS *AMICUS CURIAE IN* SUPPORT OF RESPONDENTS

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February 23, 2021

CERTIFICATE AS TO PARTIES, RULINGS, AND RELATED CASES

Pursuant to Circuit Rule 28(a)(1), the undersigned counsel certifies the following:

A. Parties and *Amici*

Parties and *Amici*: Except for the following, all parties, intervenors, and *amici* appearing in this Court are listed in the Initial Joint Brief of Petitioners: *amici* Cable Television Laboratories, Inc. ("CableLabs") in support of Respondents and Southern Company Services, Inc. ("Southern Company") in support of Petitioners.

B. Ruling Under Review

Reference to the ruling at issue appears in Petitioners' Initial Joint Brief.

C. Related Cases

Other than these consolidated cases, counsel is not aware of any related cases within the meaning of Circuit Rule 28(a)(1)(C).

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CORPORATE DISCLOSURE STATEMENT

As required by Federal Rule of Appellate Procedure 26.1 and D.C. Circuit Rule 26.1, *amicus curiae* CableLabs certifies that it has no parent corporation and no publicly held corporation owns 10% or more of its stock.

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GLOSSARY

APA	Administrative Procedure Act
BAS	Broadcast auxiliary service
dB	Decibels
dBm	Decibel milliwatts
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FS	Fixed source
GHz	Gigahertz
I/N	Interference to noise
JA	Joint Appendix
LIDAR	Light detection and ranging
LPI	Low-power indoor
MHz	Megahertz
Order	Report and Order, *Unlicensed Use of the 6 GHz Band, Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, 35 FCC Rcd. 3852 (2020)

INTEREST OF *AMICUS CURIAE*[1]

Amicus curiae CableLabs is a not-for-profit innovation and research and development lab whose membership consists of fixed and mobile broadband providers across the world. For over 30 years, CableLabs has worked to develop and improve network technologies for the secure delivery of high-speed data, video, voice, and other next-generation services, and it has a central role in conformance testing and ensuring the interoperability of network equipment.

CableLabs strongly supports the *Order* authorizing unlicensed devices to operate in the 6 GHz band, including in particular allowing the use of low-power indoor access points, such as Wi-Fi routers, across the band. Report and Order, *Unlicensed Use of the 6 GHz Band, Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, 35 FCC Rcd. 3852 (2020) ("*Order*") (JA ___). This decision will foster innovation and improve consumer welfare without causing harmful interference to incumbent licensees. Indeed, the FCC established extremely conservative power limits and other safeguards that will not only prevent "harmful interference," as the Commission defines that term, but likely avoid *any* material impact on licensed operations. Because the FCC's *Order* relied on technical studies

[1] This brief was not authored in whole or in part by counsel for a party. No person or entity other than CableLabs, its members, or its counsel made a monetary contribution to the preparation or submission of this brief. All parties have consented to the filing of this brief.

conducted by CableLabs, CableLabs has a particular interest in defending the validity of those studies, which utilize modern methods of probabilistic risk-informed interference analysis.

INTRODUCTION AND SUMMARY OF ARGUMENT

Unlicensed devices that connect to Wi-Fi—including laptops, tablets, and smartphones—have become an indispensable means for consumers to access the Internet. Given their ever-faster speeds and the convenience of wireless connectivity, home Wi-Fi networks support an enormous volume and percentage of global Internet traffic. And the demand for Wi-Fi connectivity continues to grow at a phenomenal pace. *Order* ¶ 2 (JA ___). Globally, the economic value of Wi-Fi is expected to grow from $3.3 trillion this year to $4.9 trillion in 2025. *See Value of Wi-Fi, The Wi-Fi Alliance*, https://www.wi-fi.org/discover-wi-fi/value-of-wi-fi. As last-mile broadband connections into the home are offering greatly improved capacity to meet the demands of increasingly bandwidth-intensive applications, Wi-Fi connections to consumer devices must keep pace or risk becoming a bottleneck that could diminish the Internet experience for consumers and businesses.

The FCC's *Order*, which expands Wi-Fi capacity by authorizing access to the 6 GHz band, is critical to meeting this burgeoning demand. As the FCC explained, the 6 GHz band is particularly well suited to support the next generation of Wi-Fi networks because it accommodates wide channels. *See Order* ¶¶ 18, 98, 205 (JA

___, ___, ___). And few, if any, near-term alternatives exist for enabling Wi-Fi connectivity at speeds necessary to keep up with demand. By clearing the way for more robust and reliable Wi-Fi connectivity, the *Order* will unleash a torrent of additional investment and innovation, including new technology such as "transformative" virtual reality. *Id.* at 139 (Statement of Commissioner Carr) (JA ___). Overall, allowing unlicensed devices to access the 6 GHz band is expected to contribute more than $83 billion to the GDP annually. *Id.* at 138 (Statement of Commissioner O'Rielly) (JA ___). Such improvements would be important in any circumstances, but they take on heightened significance in the face of the COVID-19 pandemic—as Americans are being forced to work, learn, and access healthcare services remotely. *Id.* at 141 (Statement of Commissioner Rosenworcel) (JA ___).

The FCC acted well within its authority by considering these public interest benefits. Congress directed the FCC "to promote spectrum policy that makes available on an unlicensed basis radio frequency bands to address consumer demand for unlicensed wireless broadband operations," 47 U.S.C. § 1507(a)(3), and to "encourage the larger and more effective use of radio in the public interest," *id.* § 303(g). The FCC's unanimous *Order* faithfully carried out that mandate.

To be sure, as the FCC seeks to encourage innovative new uses of spectrum, it must also ensure that incumbent licensees in these shared frequencies are protected from harmful interference. But Petitioners gloss over the critical points that

spectrum resources are finite—so incumbent users frequently must accommodate new uses in the same or adjacent bands—and all spectrum operations invariably experience *some* degree of "interference" (or "noise") from other users. That is why the FCC's rules prohibit only *harmful* interference, which is defined as interference that "endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service." 47 C.F.R. § 2.1(c). Nor is a remote possibility of harmful interference legally cognizable; additional protections for incumbents are warranted only when new uses present a "*significant potential* for causing harmful interference." *Order* ¶ 146 (quoting *Am. Radio Relay League, Inc. v. FCC*, 524 F.3d 227, 234-35 (D.C. Cir. 2008) (emphasis added)) (JA ___). Blocking new uses based on remote threats of minimal interference "would rule out virtually all services and unlicensed operations," unjustifiably stymieing innovation and harming consumers. *Id.*

The FCC carefully examined the record, including numerous technical studies, and appropriately determined that low-power indoor Wi-Fi operations in the 6 GHz band will not cause harmful interference. Indeed, the FCC adopted very conservative power limits and imposed other restrictions that satisfy Petitioners' own standard for assessing the threat of potential interference-related outages. The FCC's cogent explanation of its rulings and detailed responses to Petitioners'

proposals were at the very least "reasonable" and easily satisfy review under the APA, especially given the deference this Court accords to technical decisions.

In particular, the FCC was justified in giving weight to CableLabs' studies and probabilistic risk analysis more generally. Probabilistic risk analysis allows regulators to examine the broadest range of possible consequences and evaluate the likelihood and magnitude of any potential harm that might be caused by a new rule. The benefits of this risk-evaluation process are confirmed by the many agencies that rely on it to obtain reliable models of potential risk in high-stakes, but hard-to-measure, contexts. The multiple studies CableLabs submitted in the record applied this probabilistic methodology to model thousands of scenarios—including billions of permutations of variables—using a combination of real-world measured distributions and industry-standard statistical ranges. CableLabs' analyses consistently showed that—even applying the ultra-conservative standards advocated by incumbent 6 GHz licensees—there is no substantial likelihood that incumbents will suffer harmful interference. Contrary to Petitioners' suggestions, the assumptions and methodological choices underlying these studies were both reasonable and available in the record. The FCC's reliance on these studies, along with a substantial body of other parties' technical submissions and the agency's own expert analyses, was entirely appropriate and warrants deference.

ARGUMENT

I. PROBABILISTIC RISK ANALYSIS PROVIDES A REASONABLE—INDEED OPTIMAL—BASIS FOR DETERMINING WHETHER AUTHORIZING USE OF LOW-POWER INDOOR DEVICES IN THE 6 GHZ BAND IS LIKELY TO CAUSE HARMFUL INTERFERENCE

The FCC is tasked with advancing the public interest by enabling new and more efficient spectrum uses, while at the same time preventing harmful interference with licensed operations by incumbents. Probabilistic risk analysis, which uses statistical modeling to measure complex interactions among numerous input variables that make simple calculations difficult, provides an optimal tool for assessing whether new spectrum uses are likely to cause harmful interference in real-world conditions. CableLabs' initial study, a probabilistic model of the likelihood of substantial interference with a fixed microwave link in New York City from the operation of low-power indoor Wi-Fi devices in the 6 GHz band, provided the FCC with strong evidence that no harmful interference would occur, even given several conservative assumptions regarding risk factors. And CableLabs' subsequent analyses confirmed that conclusion through simulation of additional scenarios and incorporation of more conservative assumptions. The FCC's reliance on CableLabs' submissions was, at the very least, reasonable.

A. Probabilistic Analysis Is a Useful Analytical Tool To Help Agencies Weigh the Likelihood and Magnitude of Risks in the Face of Uncertainty

Probabilistic risk analysis, including Monte Carlo analysis in particular, is ideally suited to enabling regulators to assess whether a new policy is likely to result in real-world harms.[2] It conveys several advantages over static modeling. First, by generating a huge number of outcomes, probabilistic risk analysis provides a broader and more accurate picture of the effects that a proposed regulation will have—especially when it incorporates measured real-world data—which in turn can serve as a common framework for comparing different scenarios and assessments. In addition, probabilistic risk analysis helps avoid the under- and over-inclusiveness that static-value, and especially worst-case, analysis fosters. Often, a worst-case scenario reflects "unrealistic or contrived situation[s]," rather than actual problems. *Order* ¶ 150 (JA ___). Ultimately, probabilistic risk analysis provides a more

[2] Monte Carlo studies are a form of probabilistic analysis widely used to model outcomes of any process that is influenced by a range of variables that interact in complex and dynamic ways. In this context, Monte Carlo analysis can identify the potential increase in interference from Wi-Fi access points to a fixed link receiver by statistically modeling a range of variables—including the location of access points, distribution of their energy across antenna patterns, their selection of channels, signal attenuation through walls and other environmental clutter, the temporal nature of transmissions, and the angles of and distance between the access-point and fixed-link antennas. By contrast, a static analysis uses a fixed set of parameter values (often setting each parameter to the worst possible value) to calculate the interfering power at the receiver and does not account for the distribution of values for each parameter. As a result, a static analysis often does not provide meaningful insight into the actual risk of harmful interference.

complete view of potential outcomes and their associated likelihoods, increasing the transparency and reliability of the regulatory process.

Probabilistic risk analysis has long been used by federal agencies to help evaluate and regulate potential threats to public safety. Since the 1970s, the Nuclear Regulatory Commission has used probabilistic risk analysis to guide the development of nuclear power plant regulations, finding that it "assur[es] that resources are correctly focused on those matters that have the highest safety significance." *Reclaiming the Promise of Risk-Informed Decision-Making* 1 (Nuclear Energy Institute, Dec. 19, 2013), http://pbadupws.nrc.gov/docs/ML1335/ML13354B997.pdf. Similarly, the Environmental Protection Agency uses probabilistic risk analysis to assess the nature and magnitude of public health and environmental risks from chemical contaminants and other stressors. *See generally An Examination of EPA Risk Assessment Principles & Practices* (EPA, Staff Paper, Mar. 2004), https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=100045MJ.TXT.

Spectrum allocation and interference assessments are equally amenable to probabilistic analysis. The Spectrum and Receiver Performance Working Group of the FCC's Technological Advisory Council proposed in 2015 that the Commission use probabilistic analysis to assess the potential for harm caused by changes in radio service rules. *See A Quick Introduction to Risk-Informed Interference Assessment*

(Apr. 1, 2015), https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting4115/Intro-to-RIA-v100.pdf. And academic research supports that recommendation. *See, e.g.*, Jean Pierre De Vries, *Risk-Informed Interference Assessment: A Quantitative Basis for Spectrum Allocation Decisions*, TELECOMMUNICATIONS POLICY (Jan. 4, 2017) (reviewing case study on signal reception from polar-orbiting satellites and concluding that, compared to a worst-case approach, probabilistic risk analysis "provided a more comprehensive hazards analysis").

The FCC has embraced probabilistic analysis in other proceedings based on these advantages. For example, in the context of analyzing whether mobile transmitters would disrupt fixed TV receivers, the Commission explained that this kind of statistical modeling is "the most appropriate method to analyze the random nature of [] interference." *State of New York*, Order, 22 FCC Rcd. 22195, 22204 (2007); *see also Cty. of L.A.,* Order, 23 FCC Rcd. 18389, 18407 n.113 (PSHSB 2008) (endorsing Monte Carlo simulations).

The FCC re-emphasized the benefits of probabilistic analysis in the *Order*. It explained that any technical study pertaining to spectrum sharing should take into account the complexity of the system rather than relying on static values that do not accurately represent the probabilities associated with the myriad characteristics that factor into the possibility of harmful interference. *See Order* ¶ 116 (JA ___). The Commission specifically validated CableLabs' use of probabilistic analysis, finding

its initial study "persuasive because it uses actual airtime utilization data for hundreds of thousands of Wi-Fi access points along with a statistical model for building entry loss." *Order* ¶ 118 (JA ___). By using probability distributions instead of static numbers, the FCC concluded, the CableLabs study "more accurately model[ed] the variability" of the factors at issue. *Id.*

B. The CableLabs Studies Provided the FCC with Exhaustive and Reliable Probabilistic Risk Information, as Well as Substantial Static Input Data

Petitioners' brief makes clear that the heart of their challenge is ultimately to the FCC's use of probabilistic risk analysis itself, not merely specific aspects of the CableLabs studies. Petitioners repeatedly complain that the FCC paid too little attention to worst-case scenarios, implying that the mere possibility of harm—no matter how remote—should have been enough to defeat the proposal to allow low-power indoor Wi-Fi operations throughout the 6 GHz band. *See, e.g*, Brief for Petitioners ("Pet. Br.") at 27-30, 35-37. *Amicus* Southern Company similarly argues that the FCC should have given more credence to its static-value, worst-case analysis. Br. *Amicus Curiae* of Southern Company Services, Inc. in Support of Pet'rs at 22-23.[3] But as the *Order* recognizes, the "harmful interference" standard

[3] Southern Company also seeks to rely on a study it submitted in November 2020, long after the FCC issued its *Order*. *Id.* at 26-30. But review of agency action is limited to the record before the agency at the time of its decision. *See Hill Dermaceuticals, Inc. v. FDA*, 709 F.3d 44, 47 (D.C. Cir. 2013). In any event,

demands more than a showing that such harms are remotely possible, and probabilistic analyses that use full distributions of input data to account for the many complexities of modeling spectrum transmissions and interference provide a "more accurate[] model[]" for assessing the likelihood of such harms than the static, worst-case analyses provided by Petitioners and Southern Company. *Order* ¶¶ 116, 118 (JA ___, ___).

CableLabs' probabilistic studies not only provided a more accurate model of the potential consequences of expanding access to the 6 GHz band, they did so under very conservative assumptions to ensure that incumbent spectrum users—especially public safety operations—would be adequately protected from harmful interference. These studies include (1) CableLabs' "NYC Study," which considered whether a fixed service link in New York City would experience any significant interference—as measured by incumbents' preferred standard, an interference-to-noise ("I/N") ratio of -6 dB[4]—from any of ~800,000 indoor Wi-Fi access points projected to be in

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Southern Company's belated study replicated the errors of its earlier analysis, again analyzing a single situation that used unrealistic settings and a combination of factors that is unlikely to occur in the real world. *See generally* NCTA 1/11/2021 Letter (providing an in-depth rebuttal of Southern Company's post-*Order* testing) (JA ___).

[4] As discussed below, *infra* p. 22 n.6, relying on an I/N ratio reveals only when interference reaches a particular threshold—not whether such interference actually would result in a service outage or other impairment to an incumbent service. Thus, even if interference above the -6 dB level were to occur from low-power indoor Wi-

use throughout the city; (2) a "Link Study," which focused on AT&T's selection of five microwave links and responded to its objections to certain aspects of the NYC Study; and (3) a "Broadcast Auxiliary Study" addressing potential interference with broadcast auxiliary service operations. Each of CableLabs' studies and subsequent sensitivity analyses confirmed that there was no material possibility of harmful interference to incumbent services in the 6 GHz band from low-power indoor Wi-Fi devices, as the FCC appropriately concluded. *Order* ¶¶ 113, 118, 119, 163, 166 (JA ___, ___-__, ___-__).

1. The NYC Study

CableLabs' initial study performed a Monte Carlo simulation that used real-world data to generate 1,500 iterations of Wi-Fi activity across New York City. *See* 6 GHz Low Power Indoor (LPI) Wi-Fi / Fixed Service Coexistence Study at 7-8 ("NYC Study"), attached to CableLabs 12/20/2019 Letter (JA ___). In each iteration, CableLabs measured the aggregated emissions from ~800,000 access points and found that no harmful interference to a representative fixed service (incumbent) link in Manhattan would occur.

Fi transmissions, which CableLabs showed is highly unlikely, it would not necessarily impact incumbents' operations. That is why CableLabs advocated for the use of other technical metrics, including system availability and signal-to-interference-plus-noise ratio, to better identify actual signal impairment from interference.

a) Methodology and Inputs

The NYC Study combined real-world data measurements with industry-accepted statistical ranges to generate its predictive model. For almost every variable in the study, weighted distributions mapped the range of possible values each Wi-Fi access point could have. In each iteration of the study, random values from each range were assigned to each access point, resulting in a city-wide simulation of what, if any, interference to the fixed link resulted from the aggregated ~800,000 Wi-Fi access points.

To determine the number of devices to simulate, the study began with a survey of the total number of Internet users in New York City, then applied third-party projections of 6 GHz device sales to arrive at ~800,000 6 GHz-capable access points. *See* NYC Study at 17 (JA ___). In each iteration, the study additionally accounted for the probability that an access point would utilize the 6 GHz band rather than the alternatively available 2.4 and 5 GHz unlicensed bands where Wi-Fi access points also operate. *See id.*

The study next modeled the location of each of the ~800,000 access points within the city, relying on real-world LIDAR data—obtained from the United States Geological Survey—to generate the probability range of possible heights for each access point. *Id.* at 8, 19 (JA ___, ___). For horizontal placement, the study

uniformly distributed access points throughout the city to ensure that a representative number of access points were in range of the incumbent link in each iteration.

Because Wi-Fi access points transmit intermittently, the study again relied on real-world measurements to generate the range of "activity factor" values reflecting how often an access point is actively in use. Specifically, the study relied on activity-factor data from operational broadband networks that measured the activity of ~500,000 real access points throughout the United States every 15 minutes for 10 days, resulting in more than *450 million* usable data points. *See* NYC Study at 4-6 (JA ___-__). The results showed that 99% of access points were active less than 7% of the time, and the weighted average activity factor across the entire data set was 0.4%. *Id.* at 4 (JA ___). Rather than simply applying the weighted average, however, the NYC Study used the entire distribution range of possible activity factors.

Once CableLabs mapped the number, locations, and activity factors of 6 GHz–capable access points, it applied industry-accepted statistical distributions and models to account for the power and direction of each transmission, the probability that the channels used might overlap with those used by the incumbent's link, and the amount of signal attenuation that each transmission would experience from buildings and other obstacles between the access appoint and the link. The direction and power of each access point transmission were modeled using the distribution

range provided in a report from the European Conference of Postal and Telecommunications Administrations Electronic Communications Committee ("European Conference Report 302"), a consensus-based coordinating body for spectrum regulation among 48 member countries in Europe. That report provides power levels (known as "effective isotropic radiated power") and antenna patterns that reflect actual Wi-Fi products. CableLabs 2/14/2020 Letter 6 (JA ___).

CableLabs also drew Wi-Fi channel selection data from the European Conference Report 302, providing a proportional distribution of selected channel sizes from 20 to 160 MHz. *Id.* In each iteration, the NYC Study applied that distribution to randomly assign to each modeled access point a channel size and channel location within the 6 GHz band. The Study then randomly assigned the incumbent link a standard 25 MHz–wide channel somewhere in the 6 GHz band to enable mapping of any access point transmissions that overlapped the incumbent link's channel (a necessary prerequisite for interference).

Having established the power, direction, and channel of each modeled transmission, the NYC Study proceeded to determine how much signal power was lost before any access point's transmission would arrive at the incumbent link's receiver. Starting with building entry loss—the typical reduction in signal strength due to passing through the walls or windows of the building where the access point is located—the study used a distribution range of values between 10 and 30 dB,

derived from predictive calculations published by the Radiocommunication Sector of the International Telecommunication Union, the spectrum-management arm of the United Nations. NYC Study at 20 (citing Recommendation P.2109, *Prediction of building entry loss*) (JA ___). The study conservatively assumed that all buildings would be constructed from traditional, rather than energy-efficient, materials, even though many buildings are constructed from the latter, which cause higher signal loss and thus would result in lower interference. CableLabs 2/14/2020 Letter 6 (JA ___). Next, the Study applied the widely accepted WINNER II urban macrocell non-line-of-sight path loss model, which predicts the loss of the over-the-air path between the two locations. *See Order* ¶ 65 (noting that "the WINNER II model is one of the most widely used and well-known channel models in the world") (JA ___). Finally, the Study considered polarization mismatch (which occurs when the orientation of the Wi-Fi access point and fixed-link receiver antennas are misaligned, thereby reducing power transfer); link antenna pattern (which likewise reduces power when the direction of an access point's transmission is misaligned with the narrow focus of the incumbent link's antenna), and feeder loss (power reduction that occurs when the signal is diminished in wired connections between the incumbent link's antenna and the ultimate receiver).

Accounting for all of these factors results in a measurement of power (the potential for interference) at the incumbent link's receiver. NYC Study at 8 (JA

___). For each of its 1,500 iterations, the NYC Study randomly selected values from the distribution ranges of each factor for each of the ~800,000 simulated access points, calculated the power of each transmission at the incumbent link's receiver, and then aggregated those powers to determine the total interference to which the incumbent link could be subject. Because each of the 1,500 iterations independently modeled each of the ~800,000 access points, the Study ultimately simulated more than *1.2 billion* unique access points, all of which were capable of causing interference.

To determine whether harmful interference was likely to occur, the NYC Study weighed the aggregated interference from each iteration against an I/N power ratio of -6 dB, which several incumbent 6 GHz licensees advocated as "the appropriate metric." *Order* ¶¶ 69, 117-18 (JA ___, ___-__). Other parties maintained, and the FCC agreed, that an I/N ratio of -6 dB is a conservative measure because it does not limit the analysis to interference with *potentially disruptive effects*. *See Order* ¶¶ 69, 71 (JA ___-__). Nevertheless, the Study applied that I/N metric out of an abundance of caution.

b) Results and Follow-on Analyses

The results of the NYC Study were unequivocal: Out of 1,500 iterations, each measuring interference from ~800,000 access points, *none* resulted in aggregated interference exceeding the -6 dB I/N threshold—indeed, the results remained "far

below" that conservative measure of interference. *Order* ¶ 117 (JA ___); NYC Study at 9 (JA ___).

CableLabs then went further by performing a sensitivity analysis that assumed as much as a 20 dB noise increase—100 times the interference level proffered by the incumbents. NYC Study at 11 (JA ___). Even with that unrealistically high assumption, the analysis showed that a fixed link would not drop below 99.999% ("five nines") availability[5] when applying the activity factor of 0.4%, *id.* at 12, derived from the 4.5 million real-world measurements utilized in the NYC Study, *id.* at 4-5 (JA ___-__). As before, this analysis was decidedly conservative; it did not consider factors like fixed-link frequency and antenna diversity, transmission timing, redundancies, and incumbent link utilization below 100%—all variables that would further lessen predicted interference if included. *Id.* at 11, 13 (JA ___, ___).

CableLabs later performed a second sensitivity analysis to address Petitioners' claim that it should have used only antenna patterns capable of achieving the highest peak power (30 dBm). In response, CableLabs reran the NYC Study, except that instead of using the full distribution range of effective isotropic radiated power values given by the European Conference Report 302, it used only the antenna

[5] As with the -6 dB I/N ratio, the "five nines" availability standard was proffered by incumbents as the appropriate reliability metric. *Order* ¶ 114 (JA ___). It allows a system to be inoperable no more than .001% of the time, limiting outages to approximately 5 minutes per year.

pattern of a high-performance gaming router with 30 dBm peak power. CableLabs 3/19/2020 Letter 2 (JA ___). Even with this additional conservative assumption, the results again confirmed that no interference above the -6 dB I/N threshold occurred.

2. The Link Study

CableLabs next presented its Link Study, which performed the same kind of probabilistic Monte Carlo simulation, but as applied to five real-world fixed service links that AT&T presented as likely candidates to experience harmful interference from low-power indoor Wi-Fi devices operating in the 6 GHz band. CableLabs 1/17/2020 Letter 2 (JA ___). The Link Study analyzed the very scenarios that Petitioners now wrongly claim the FCC "assumed [] away" (including the links pictured in Petitioners' Brief). Pet. Br. at 27-30. The Link Study generally relied on the same data and assumptions as the NYC Study but adopted several of the "worst-case" characteristics that AT&T presented, including the location and orientation of the incumbent links and the fixed presence of a Wi-Fi access point along each incumbent link's line of sight and very close to the link receiver.

Unlike AT&T's reliance on static values, however, CableLabs' Link Study used full distributions—which included the static values proffered by AT&T along with the entire range of possible alternative values—and simulated billions of interactions to accurately map the probability of each outcome. Low Power Indoor (LPI) Wi-Fi Will Not Cause Harmful Interference or Impact Availability of 6 GHz

Fixed Service (FS) Incumbents at 4 ("Link Study"), attached to CableLabs 1/17/2020 Letter (JA ___). As the FCC confirmed, AT&T's reliance on static, worst-case values vastly overstated the risk of harmful interference, whereas the Link Study's application of probabilistic ranges, based on real-world measurements and industry standards, made its findings significantly more "persuasive." *Order* ¶¶ 124, 130 (JA ___, ___).

The results of the Link Study confirmed that low-power indoor devices would not cause harmful interference to any of AT&T's proffered links. Specifically, the Study showed that, over billions of iterations, there was at most a 0.014% chance that the incumbent links in question would experience interference above even the conservative -6 dB I/N threshold. Further, the Study demonstrated that the presence of low-power indoor Wi-Fi did not cause any of AT&T's proffered links to drop below the incumbents' proffered "five nines" availability standard. Link Study at 5 (JA ___).

As with the NYC Study, CableLabs performed a sensitivity analysis of the Link Study in which it reran the simulation with the additional fixed limitation that all access points utilized the antenna design capable of reaching a peak power of 30 dBm. Wi-Fi Power Sensitivity Analysis Shows No Harmful Interference from Low-Power Indoor Wi-Fi to FS and BAS in 6 GHz ("Link and Broadcast Auxiliary Study Sensitivity Analyses"), attached to CableLabs 3/9/2020 Letter (JA ___). CableLabs

found that the absolute impact remained de minimis, with the links maintaining "five nines" and "six nines" reliability. *Id.* at 6 (JA ___).

3. The Broadcast Auxiliary Study

CableLabs' third study again involved a Monte Carlo simulation, this time to examine the risk of harmful interference to broadcast auxiliary service operations, such as the communications links used by news trucks. 30 dBm Low Power Indoor (LPI) Wi-Fi Will Not Cause Harmful Interference to Broadcast Auxiliary Systems (BAS) in 6 GHz ("Broadcast Auxiliary Study"), attached to CableLabs 2/21/2020 Letter (JA ___). CableLabs made a number of adjustments to the NYC Study's methodology to make this Broadcast Auxiliary Study even more conservative. In particular, the activity factor distribution with a weighted average of 0.4%—obtained by making more than 450 million measurements of 500,000 access points—was artificially magnified tenfold to simulate particularly heavy activity during a newsworthy event, and the building loss range floor was lowered from 10 to 0 dB (i.e., no loss at all) to allow further for artificially aggressive modeling. *Id.* at 23 (JA ___).

The results of the Broadcast Auxiliary Study yet again confirmed that unlicensed low-power indoor devices were extraordinarily unlikely to cause any substantial interference, let alone harmful interference. The study found that there was at most a 0.0009% chance that link quality would drop below the conservative

metric used in the study.[6] CableLabs 2/21/2020 Letter 4 (JA ___). Again, as with the NYC and Link studies, CableLabs performed a sensitivity analysis in which it reran the simulation using only the Wi-Fi antenna design capable of reaching a peak power of 30 dBm. Link and Broadcast Auxiliary Study Sensitivity Analyses at 2 (JA ___). CableLabs found that the absolute impact remained de minimis, with only a 0.0068% chance that link quality would drop below desired levels. *Id.* at 5 (JA ___).

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The FCC reasonably relied on each of these studies to conclude that incumbents' links "will have an insignificant chance of experiencing harmful interference from indoor low-power unlicensed operations." *Order* ¶ 141 (JA ___). And, while CableLabs' simulations showed that approving low-power devices at the 8 dBm/MHz compromise limit would be fully protective of incumbent transmissions, the FCC took the additional "precaution" of limiting low-power devices to 5 dBm/MHz and seeking further comment on the use of an 8 dBm/MHz level. *Order* ¶ 110 (JA ___). Though the FCC had a more than sufficient basis to

[6] Rather than measuring whether interference surpassed the -6 dB I/N threshold used in the other CableLabs studies, the Broadcast Auxiliary Study measured whether the signal-to-interference-plus-noise ratio dropped below 10 dB. The latter metric provides a more accurate measure of whether potential interference would disrupt the actual functioning of an incumbent signal, and empirical testing (submitted in the record by Broadcom) confirmed that 10 dB was a strongly conservative threshold. Broadcom, Inc. 2/28/2020 Letter 2 (JA ___).

approve the more appropriate 8 dBm/MHz limit—an issue that the FCC is now considering—its caution is further evidence that the *Order* was carefully reasoned and should be upheld.

II. PETITIONERS' SPECIFIC COMPLAINTS ABOUT THE CABLELABS STUDIES ALL MISS THE MARK

Just as Petitioners' efforts to undermine probabilistic analysis as a general matter are unavailing, their specific attacks on the methodology and inputs used by CableLabs all miss the mark. Petitioners raise two types of arguments: first, that CableLabs provided the FCC with a "black box" without sufficient underlying data; and second, that CableLabs' input values and other methodological choices understated the risks of interference. Both are wrong.

A. CableLabs' Studies Provided the FCC with Sufficient Information About Their Assumptions and Underlying Data To Justify the FCC's Reliance

Petitioners accuse CableLabs of not providing sufficient underlying data for its NYC Study, leaving the FCC and interested parties with nothing more than "conclusory talking points" and a "black box." Pet. Br. at 40-41. To the contrary, CableLabs described its methodology and findings in sufficient detail to justify the FCC's reliance. *See* CableLabs 1/23/2020, 2/14/2020, and 3/13/2020 Letters (JA ___, ___, ___). Indeed, other parties could have used the information provided by CableLabs to reproduce each study if they so desired. CableLabs' submissions provided more than enough information to justify the FCC's reliance on its studies.

See Am. Trucking Associations, Inc. v. EPA, 283 F.3d 355, 372 (D.C. Cir. 2002) (explaining that "requiring agencies to obtain and publicize the data underlying all studies on which they rely would be impractical and unnecessary").

None of Petitioners' specific transparency critiques holds water. First, they complain that there is no way to know where the ~800,000 access points were located in CableLabs' model of New York City. Pet. Br. at 41-42. But CableLabs' submission explained that the study used real-world LIDAR data, obtained from the United States Geological Survey, to model access point height; it further explained how it distributed access points throughout the city, which helped ensure that incumbent links would encounter a representative map of access points in each iteration. NYC Study at 3, 8, 19 (JA ___, ___, ___). CableLabs' use of available real-world data created a sufficiently accurate model for the FCC to rely on.

Second, Petitioners complain that they "do not know critical facts about how CableLabs derived an 'activity factor' for its modeled 6 GHz devices." Pet. Br. at 42-43. But again, CableLabs clearly disclosed the provenance of that information in its methodology presentation: "500,000 Wi-Fi access points" with a "[w]ide geographic representation" were measured in "15-minute [] intervals, hourly, 24 hours/day over 10 days." NYC Study at 4 (JA ___). Petitioners do not even identify any specific problem they have with the data, so their purported concerns are unclear; in any event, they could have, but did not, offer alternative real-world data

if they wanted the FCC to consider it. *See Order* ¶ 121 (JA ___). Petitioners are left arguing that the FCC and CableLabs should have ignored the only available real-world Wi-Fi activity data before the Commission because the incumbents have unspecified doubts about it. But disregarding that data would have been arbitrary and capricious; relying on it was certainly appropriate.

Finally, Petitioners raise questions about the nature and significance of the 1,500 iterations that comprised the NYC Study. Pet. Br. at 43-44, 47-49. Though Petitioners now suggest that running 1,500 iterations (which generated *1.2 billion* access point models for analysis) was not enough to produce reliable results, this argument was not raised until October 13, 2020—several months after the FCC issued its final order, *see* AT&T Services 10/13/2020 Letter 3-4 (JA ___-__), precluding them from relying on it before this Court. *See Omnipoint Corp. v. FCC*, 78 F.3d 620, 635 (D.C. Cir. 1996). In any event, this argument is meritless. Each iteration in the NYC Study is a comprehensive snapshot of the likelihood of interference—individual or aggregated—by the ~800,000 simulated access points in NYC. This is more than enough data to establish statistical significance.

B. The CableLabs Studies' Input Values and Methodological Choices Did Not Understate the Risks of Harmful Interference

Petitioners also criticize the FCC and CableLabs for what they claim are unrealistic input values and unsound methodological choices. For starters, these arguments fundamentally misapprehend the nature of the multi-variable analyses

that CableLabs undertook: Even assuming that a particular input should have been higher or lower, a change in any one factor's range would not likely alter the ultimate conclusion, because spectrum interference depends on the complex interaction of many different variables. *See Order* ¶ 122 n.317 (explaining that "[t]here are many probabilistic factors that must be considered when assessing the risk of harmful interference and several, if not all, of these factors must all tend towards worst case situations for an actual harmful interference event to occur") (JA ___). And CableLabs performed multiple sensitivity analyses precisely to demonstrate that altering particular input values in the manner advocated by Petitioners would not change the predictive conclusions that CableLabs and the FCC reached.

Further, even when focusing (inappropriately) on isolated input values, Petitioners misunderstand, and in some cases simply ignore, the data and explanations that CableLabs offered in the record to support its studies. Petitioners argue that the NYC Study is unreliable because it used a distribution range of building entry loss values that excluded values below 10 dB and above 30 dB. Pet. Br. at 45. As noted, the 10–30 dB range was based on credible data from the International Telecommunication Union and CableLabs' conservative assumption that every building was constructed of traditional materials that deflated building entry loss values and correspondingly increased the predicted incidence of interference. CableLabs 2/14/2020 Letter 1 (JA ___). And that range was more

conservative than the 10.4 to 46.9 dB range employed by incumbent AT&T in its "worst-case" analysis of its own fixed service links. *See* CableLabs 1/31/2020 Letter 1-2 (JA ___-__).

In any event, the FCC accounted for the range of values that CableLabs used. *Order* ¶ 122 (JA ___). Based on its own independent analysis, the FCC concluded that this range "was not different enough" from the range advocated by Petitioners to materially affect the results of the study. Because the NYC Study included the additional conservative assumption that all buildings were traditionally constructed, its building loss values were comparable to the FCC's full range of values that assumed a mixture of 70% traditional and 30% thermally efficient buildings. *Order* ¶ 117 & n.297 (JA ___). The FCC's reasoned determination that this methodological distinction made no ultimate difference justified its broader reliance on the NYC Study.

CableLabs' Broadcast Auxiliary Study provided additional support for the FCC's reliance on CableLabs' input. That study expanded the building loss range to include values as low as 0 dB—the equivalent of an outdoor transmission that loses no signal power and thus presents a much higher risk of interference. CableLabs 2/21/2020 Letter 4 (JA ___). As with the earlier NYC Study, and

consistent with the FCC's analysis, this independent analysis concluded that no harmful interference was likely to occur.[7]

Finally, Petitioners argue that the FCC ignored scenarios with little or no clutter loss—loss caused by any obstacles, such as trees, in the path between the access point and the fixed-link receiver. Pet. Br. at 33-35. But Petitioners ignore CableLabs' Link Study, offered in response to this objection (among others), which ran full Monte Carlo simulations for the very scenarios that Petitioners claim would result in harmful interference. In that study, CableLabs conservatively applied the WINNER II Line of Sight path loss model, which assumes no path obstructions between the access point and link. As discussed above, *supra* pp. 19-21, the Link Study confirms that, applying the incumbents' own preferred measure of a -6 dB I/N ratio, no harmful interference would occur even in these low-clutter-loss corner cases. Link Study at 2 (JA ___).

[7] Not surprisingly, a second link study conducted by CableLabs after the FCC's *Order* was issued again confirmed the FCC's conclusion: Even when analyzing potential interference to AT&T's proffered "worst-case" links, this time applying the full range of building entry loss values, link availability stayed above "five nines" in all cases. *See* NCTA 8/17/2020 Letter 10-11 (JA ___-__).

CONCLUSION

The Court should deny the Petitions for Review.

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Respectfully submitted,

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