Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and	)	ET Docket No. 14-165
	)	GN Docket No. 12-268
Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap	)	
Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions	)	

To: The Commission

CONSOLIDATED REPLY OF GE HEALTHCARE

GE Healthcare ("GEHC") hereby submits this Consolidated Reply to the Oppositions filed by Google Inc. ("Google") and Microsoft Corp. ("Microsoft") on February 29, 2016 in the above-captioned proceeding.[1] Google and Microsoft ask the Commission to reject GEHC's Petition for Reconsideration of the *Part 15 R&O*,[2] but provide little reason to do so. In particular, Google and Microsoft fail to rebut the persuasive showing that GEHC and other parties have made that changes are required necessary to protect primary, safety-of-life wireless medical telemetry operations from harmful interference.

For example, GEHC's petition demonstrates that the separation distances and procedures

[1] Google, Opposition to Petitions for Reconsideration, ET Docket No. 14-165, GN Docket No. 12-268 (filed Feb. 29, 2016) ("Google Opposition"); Microsoft, Response and Opposition to Petitions for Reconsideration, ET Docket No. 14-165, GN Docket No. 12-268 (filed Feb. 29, 2016) ("Microsoft Opposition").

[2] *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, et al.,* Report and Order, 30 FCC Rcd 9551 (2015) ("*Part 15 R&O*").

established in the *Part 15 R&O* to protect Wireless Medical Telemetry Service ("WMTS") operations from harmful interference were arbitrary and capricious because, among other things, the Commission used a faulty methodology to calculate the distances.[3] The Commission also failed to address concerns raised by GEHC and others about the dependability of TVWS devices and the geolocation-database scheme as a whole.[4] GEHC's petition also demonstrates that the Commission should create an Institutional Review Board ("IRB") to oversee the trial deployment of TVWS devices on Channel 37 (a deployment first announced in the *Part 15 R&O*).[5] Google and Microsoft simply fail to address many of these points or, when they do, utterly fail to rebut them. The Commission should dismiss their oppositions and grant GEHC's petition.

I. Google And Microsoft Failed To Rebut GEHC's Substantive Points.

Google and Microsoft do not even attempt to respond to a number of the key substantive arguments raised in GEHC's petition. For example, neither Google nor Microsoft address GEHC's points that the Commission neglected to include a factor for the Signal to Noise Ratio ("SNR") required by WMTS radios and wrongly assumed that the Commerce Spectrum Management Advisory Committee ("CSMAC") did not account for variation about the median signal strength when modeling interference between safety-of-life services.[6]

Similarly, Microsoft does not mention GEHC's showing that the Commission's use of height above average terrain ("HAAT") will lead to absurd results in many cases, and Google attempts to sweep the point away by asserting incorrectly that the Commission already "fully considered and properly rejected" it.[7] In fact, the Commission neither considered nor properly rejected this point in the *Part 15 R&O*. Instead, the Commission "misunderstood GEHC's

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[3] *See* GEHC, Petition for Reconsideration, GN Docket No. 12-268, ET Docket No. 14-165, at 4-36 (filed Dec. 23, 2015) ("GEHC Petition").
[4] *See id.* at 4-6, 36-43.
[5] *See id.* at 4-6, 43-44.
[6] *See id.* at 4, 16-19, 23-24; *see also* Google Opposition; Microsoft Opposition.
[7] *See* Google Opposition at 20; Microsoft Opposition.

concerns" and, based on this misapprehension, neglected to address them.[8]

Even where Google and Microsoft attempt to address the substantive points raised in GEHC's petition, they fail to rebut those points. For example, Microsoft asserts that the Commission correctly assumed WMTS receive antennas are at a height of no greater than 10 meters because only "a small number of systems are above [that height]."[9] However, the record in this proceeding demonstrates that **most** hospitals are taller than 10 meters and deploy at least some WMTS antennas above the third floor.[10] Microsoft's further statement that "WMTS receivers are distributed across all of the floors of a hospital, and not concentrated at the top" reveals a continued failure to appreciate that, for the DAS-based WMTS systems GEHC has repeatedly described, even if only some of a WMTS system's antennas are on high floors, interference impinging on those antennas can compromise patient monitoring on all floors because the DAS and a centralized pool of receivers serve all floors.

Microsoft also reasons incorrectly that "[i]t is highly unlikely that a WSD will ever have line of sight to a single component antenna of a distributed antenna system, let alone multiple antennas, as would be required for the system to amplify a full-power WSD signal" and that "it will be common for WMTS antenna systems to aggregate desired signals."[11] In fact, WMTS transmitters are very low power short range devices, and DAS antennas are spaced so that the desired WMTS signal is usually only received strongly at only one DAS antenna at a time.[12] By contrast, relatively high power TVWS devices located at distances many times greater than the DAS antenna spacing can generate nearly equal field strength at two or more DAS antennas

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[8] *See* GEHC Petition at 8-12.
[9] *See* Microsoft Opposition at 4-5.
[10] *See, e.g.*, GEHC, Comments, ET Docket No. 14-165, GN Docket No. 12-268, at 21-22 (filed Feb. 4, 2015) (providing a histogram of the maximum heights of WMTS deployments).
[11] Microsoft Opposition at 8.
[12] *See, e.g.*, GEHC, Comments, WT Docket No. 12-268, at 39 (filed Jan. 25, 2013); Letter from Ari Q. Fitzgerald, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-268 at 5 (filed Mar. 7, 2014).

simultaneously, which does not require line-of-sight. Google's claim that "3 dB assumption [for DAS aggregation] is overly conservative, as it is extremely unlikely that multiple WMTS receive antennas would all receive multiple unlicensed signals at exactly the same time" also fails to comport with basic engineering principles.[13] In fact, 3 dB is a rather optimistic assumption that requires only a *single* TVWS device to be received equally at only *two* antennas.[14]

With respect to GEHC's distinct concern about aggregation of multiple TVWS device signals, Microsoft claims that it is "unlikely" that multiple TVWS devices will simultaneously contribute interference to a single WMTS receiver, especially since the IEEE 802.11 protocol's "politeness mechanism" prevents devices from transmitting at the same time.[15] Microsoft again fails to appreciate that interference can be aggregated whenever multiple TVWS devices are received simultaneously by *any* WMTS antennas because most WMTS systems use DAS. The politeness mechanism will not prevent aggregated interference when multiple TVWS devices are significantly separated (*e.g.*, at different azimuth angles from the hospital) so as to be unable to "hear" each other yet are all still received by at least one WMTS DAS antenna.[16]

Similarly, Google and Microsoft's attempts to explain away stark discrepancies between the WMTS protection distances and those for other services do not withstand scrutiny.[17] Their statements fail to consider that, while the distances of the WMTS links are shorter than for DTV or LTE, WMTS transmitters are also radiate dramatically lower power.[18] Like the other services, WMTS signals must also be received very faintly just above receiver sensitivity. Microsoft also

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[13] Google Opposition at 3.
[14] There are limitless other scenarios that also result in 3 dB of aggregation (*e.g.*, three antennas where field strength at two antennas is 3 dB below the dominant antenna, four antennas where field strength at three antennas are 4.8 dB below the dominant antenna, etc.).
[15] *See* Microsoft Opposition at 8-9.
[16] L. Boroumand et al., *A Review of Techniques to Resolve the Hidden Node Problem in Wireless Networks*, Smart Computing Rev. (Apr. 2012), *available at* http://bit.ly/1YrWprr (analyzing the "hidden node problem").
[17] *See, e.g.*, Google Opposition at 7-8; Microsoft Opposition at 3.
[18] WMTS transmitters typically radiate much less than one-thousandth the power of LTE transmitters and as little as one-millionth the power of DTV transmitters.

states that "there are no WMTS receivers to be protected at the WMTS site perimeter" and that "WMTS receivers will be separated from this outer perimeter by at least an exterior wall."[19] But WMTS interests have explained that WMTS antennas are often located near windows or glass walls and have demonstrated that building penetration in such cases often approaches 0 dB.

With respect to the decision to dramatically relax Channel 37 OOBE limits that the White Spaces Coalition—including Google and Microsoft—once supported,[20] Google states that GEHC's concerns should be dismissed because "[t]he NPRM clearly set forth the Commission's proposal to remove the OOBE limit **for Channels 36 and 38**"[21] and "a full six megahertz guard band separat[es] those operations from Channel 37." But GEHC's concerns relate to spurious emissions that will be allowed **in Channel 37** for which any "guard band" between Channel 37 and the TVWS fundamental emission is irrelevant.[22]

Google and Microsoft also dismiss GEHC's concerns about the dependability of TVWS devices and the geolocation database scheme as a whole. Google suggests that these concerns are outside the scope of this proceeding because the Commission recently released the *TVWS Database NPRM*.[23] Microsoft asserts that "the Commission has already considered arguments that ***databases*** are not sufficiently reliable to protect WMTS, and found them meritless."[24] Both of these arguments miss the mark. First, the greatest risks likely stem not from the databases per se, but rather from the **device software** on which the geolocation/database scheme equally depends[25] as the Commission has now partially (with respect to the security and integrity of

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[19] *Id.*
[20] *See* Letter from Edmond Thomas, Counsel, White Spaces Coalition, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 04-186 (filed July 11, 2008).
[21] Google Opposition at 9 (emphasis added).
[22] *See* GEHC Petition at 14-16.
[23] Google Opposition at 22; *see also Amendment of Part 15 of the Commission's Rules for Unlicensed White Space Devices*, Notice of Proposed Rulemaking, FCC 16-23 (rel. Feb. 26, 2016) ("*TVWS Database NPRM*").
[24] Microsoft Opposition at 11 (emphasis added).
[25] *See* GEHC Petition at 36-39.

device-provided location information) acknowledged in the *TVWS Database NPRM*.[26] This device software will be much more challenging to properly certify and control than the central databases.[27] Second, neither the *Part 15 R&O* nor the *TVWS Database NPRM* considers GEHC's concerns about the *reliability* of the geolocation/database functionality that resides within TVWS devices,[28] which is a separate issue compared to device *security*. Microsoft also accuses WMTS interests of overlooking "the fact that the Commission has already made rules to guarantee the integrity of WSD software." But, in its petition, GEHC cited those very rules to make the point that the Commission's current device certification regime rather than "guaranteeing" conformance to device security rules has actually *failed* to keep unsecure, violative devices from reaching the market.[29]

Additionally, some of Microsoft's claims are simply false or misleading. For example, Microsoft suggests that the thin hand railings of an outdoor balcony would prevent harmful interference to WMTS systems from personal/portable devices operating at greater than three meters HAAT.[30] Microsoft also asserts that TVWS devices must use a highly directional antenna to generate the 6 dBi gain required to operate at the maximum 40 mW radiated power allowed by the Commission's rules.[31] Yet this is incorrect.[32] Additionally, Microsoft asserts that "there are

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[26] *TVWS Database NPRM* at ¶¶ 12, 17.
[27] *See* GEHC Petition at 41-43.
[28] The *Part 15 R&O* contained a single footnote addressing device *security* but did not acknowledge any of the concerns raised by the Coalition or others regarding *reliability,* which is a distinct system property. *Reliability* is the ability of a system to function correctly for a specified period of time under expected usage conditions whereas *security* is the ability to continue to function correctly under malicious attack.
[29] *See* GEHC petition at 41-42 (citing currently-certified TVWS devices' failure to secure their professional installer interface, as required by section 15.709(a)(6) of the Commission's rules, so that any end user cannot tamper with location configuration and circumvent geolocation/database channel restrictions.
[30] *See* Microsoft Opposition at 5-6 ("The reason for [additional building loss at the TVWS device] is simple: building codes and common sense both prevent architects and builders from erecting tall structures where nothing stands between a building occupant and a likely fatal drop to the street below.").
[31] *See id.* at 24.

no substantiated database reliability concerns" because instances of interference associated with inaccurate database information or a database malfunction have yet to be reported. However, the Commission's experience with the database scheme is still quite limited: only about six hundred TVWS devices are registered in the databases; they are all fixed devices; and they include fewer than 10 unique models. Once TVWS devices have been fully deployed, the databases will be used by millions of fixed and personal-portable devices, as Google observes in its opposition.[33] These devices will undoubtedly represent much greater diversity of vendors, design and quality than the ones currently registered in the databases. Also, harmful interference to incumbent services may have already occurred but gone unreported. The absence of interference reports does not prove the absence of interference.[34]

Finally, GEHC argued in its petition that the Commission inappropriately chose and then misapplied the TM 91-1 propagation model when calculating the separation distances needed to protect WMTS.[35] A number of other parties support GEHC's position on this issue or make similar arguments in their own petitions. For example, CTIA "agrees with [GEHC]" and calls the use of the TM 91-1 model to calculate separation distances "highly problematic."[36] CTIA also notes that GEHC identified a number of material errors in the Commission's application of the TM 91-1 model and urges the Commission to reconsider its use "[i]n light of the issues identified by [GEHC]."[37] Meanwhile, the WMTS Coalition not only agrees with many of these

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[32] Omnidirectional UHF band antennas with 6 dBi of gain or more are not only possible but are readily available in the market today. *See, e.g.*, Antenna Products, White Space Antenna 470-698 MHz 6 dBi Omni, http://antennaproducts.com/product/0470ws06-n/ (last visited Mar. 9, 2016).
[33] *See* Google Opposition at 18.
[34] National Association of Broadcasters, Reply, RM-11745, at 4 (filed May 18, 2015).
[35] *See* GEHC Petition at 21-27.
[36] *See* CTIA®, Opposition and Reply to Petitions for Reconsideration, ET Docket No. 14-165, GN Docket Nos. 14-166, 12-268, at 11 (filed Feb. 29, 2016).
[37] *See id.*

points as well, but also raises them in its petition for reconsideration.[38]

II. Google And Microsoft's Procedural Arguments Are Unfounded.

Google and Microsoft claim that some of GEHC's arguments are procedurally barred because they were previously considered and rejected by the Commission or were raised for the first time in its petition.[39] As discussed above, however, many of these claims misconstrue either the arguments raised in GEHC's petition or the Commission's prior decision(s). Additionally, to the extent GEHC raised an argument for the first time in its petition, it relied on facts that were introduced for the first time in the *Part 15 R&O*.[40]

For example, Google and Microsoft argue that GEHC's proposal to create an Institutional Review Board ("IRB") to oversee the investigational trial deployment of TVWS devices on Channel 37 comes "too late" and should have been raised earlier in this proceeding.[41] Google and Microsoft ignore the fact that neither the Commission nor any party in this proceeding had previously suggested using such trial deployments as "an additional measure" to ensure that WMTS systems remain protected from harmful interference under the new rules. Because parties to this proceeding did not have an opportunity to comment on the trial deployments prior to the *Part 15 R&O*, this proposal was appropriately raised in GEHC's petition.[42]

Google and Microsoft's substantive critiques of the IRB proposal also miss the mark. As explained in GEHC's and the WMTS Coalition's petitions, creating an IRB would help ensure patient safety during these unprecedented investigational trials.[43] Unlike GEHC's and the WMTS Coalition's field tests, these trials will not be carefully devised to prevent any possibility

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[38] *See* WMTS Coalition, Petition for Reconsideration, ET Docket No. 14-165, GN Docket No. 12-268 (filed Dec. 23, 2015) ("WMTS Coalition Petition").
[39] *See, e.g.*, Google Opposition at 2-3; Microsoft Opposition at 1.
[40] See 47 C.F.R. § 1.429(2).
[41] *See* Google Opposition at 1; Microsoft Opposition at 9-10.
[42] *See* 47 C.F.R. § 1.429(b). Moreover, even if parties had been able to comment on this topic earlier in the proceeding, the Commission is free to consider new arguments raised in petitions for reconsideration where such consideration is in the public interest. *See id.*
[43] *See* GEHC Petition at 43-44; WMTS Coalition Petition at 29.

of disrupting patient monitoring.[44] Instead, the Commission anticipates that harmful interference to "critical WMTS systems" may occur during the trials and vows to "if needed, adjust our approach."[45] Meanwhile, Google's suggestion that the Commission would be "ceding its authority in spectrum policy matters" by creating an IRB ignores the fact that the Commission would both retain control over the use of Channel 37 and exercise this control by responsibly protecting the rights and welfare of patients consistent with the U.S. Common Rule.[46]

III. A "Fast-Polling" Approach Including Channel 37 Would Be Beneficial.

Currently, most TVWS devices can operate for up to two days while disconnected from the TVWS database.[47] This undermines the effectiveness of any approach that relies on a logical one-way "push" of control commands from the database to the devices, such as the one adopted in the *Part 15 R&O* because, in practice, the latency and reliability of the "push" depend on the update rate of the underlying two-way connection that must be maintained.[48] Google requests that, instead, the Commission designate a limited number of "fast-polling" channels that require white space devices to check the database every 20 minutes.[49]

The Commission should adopt Google's proposal only if it designates Channel 37 as one of the fast-polling channels. Any approach that does not include Channel 37 as one of these channels would only increase the risk of harmful interference to WMTS systems because TVWS device operators who seek to avoid the fast-polling channels could choose to operate on Channel

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[44] GEHC's and the WMTS Coalitions' field tests, by contrast, involved only WMTS frequencies that were not being used for monitoring actual patients and employed directional transmit antennas to prevent significant interference energy from being radiated towards other hospitals. Although the Commission adopted Google and Microsoft's criticism of the use of directional antennas as part of its rationale for discounting the tests' results, the tests had reduced the conducted transmit power to properly adjust for the transmit antenna gain and accurately simulate TVWS device radiated power spectral density.
[45] *Part 15 R&O* ¶ 221.
[46] Google Opposition at 12; *see also* 45 C.F.R. pt. 46; GEHC Petition at 43-44.
[47] *See, e.g.*, 47 C.F.R. § 15.711(b).
[48] *See, e.g.*, *Part 15 R&O* ¶ 273-74.
[49] *See* Google, Petition for Reconsideration, ET Docket No. 14-165, GN Docket No. 12-268 (filed Dec. 23, 2015).

37 instead. However the polling interval for Channel 37 should be 10 minutes for fixed devices and one minute for personal/portable devices (given how far they could move in a short time).[50] The 20 minute interval proposed by Google may be appropriate for wireless microphones, but it is not appropriate for safety-of-life WMTS systems.

A fast-polling approach, including Channel 37, could offer multiple benefits. Foremost, it would prevent TVWS devices from operating in a potentially harmful way for up to two days while disconnected from the TVWS database and limit the latency to disable or re-channelize devices in the case of harmful interference. It would also be easy to implement and allow the Commission significant flexibility going forward. For example, the database could provide each TVWS device with the current polling times for each available channel at its location. Then, the polling times for particular channels could be changed without modifying the Commission's rules, the design of the database, or the designs of TVWS devices.

IV. Conclusion.

GEHC respectfully requests that the Commission dismiss Google and Microsoft's oppositions and reconsider the *Part 15 R&O* as set forth in its Petition for Reconsideration and this Consolidated Reply.

Respectfully submitted,

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[50] *See, e.g.*, GEHC Petition at 40.

CERTIFICATE OF SERVICE

I hereby certify that on March 10, 2016, a true and correct copy of the foregoing Consolidated Reply of GE Healthcare was provided via first class mail to each of the following:

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