

**Before the  
Federal Communications Commission  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For	)	GN Docket No. 14-177
Mobile Radio Services	)	
	)	
Establishing a More Flexible Framework to	)	IB Docket No. 15-256
Facilitate Satellite Operations in the 27.5-28.35	)	
GHz and 37.5-40 GHz Bands	)	
	)	
Amendment to Parts 1, 22, 24, 27, 74, 80, 90, 95,	)	WT Docket No. 10-112
and 101 To Establish Uniform License Renewal,	)	
Discontinuance of Operation, and Geographic	)	
Partitioning and Spectrum Disaggregation Rules	)	
and Policies for Certain Wireless Radio Services	)	
	)	
Allocation and Designation of Spectrum For	)	IB Docket No. 97-95
Fixed Satellite Services in the 37.5-38.5 GHz,	)	
40.5-41.5 GHz and 48.2-50.2 GHz Frequency	)	
Bands; Allocation of Spectrum to Upgrade Fixed	)	
and Mobile Allocations in the 40.5-42.5 GHz	)	
Frequency Band; Allocation of Spectrum in the	)	
46.9-47.0 GHz Frequency Band for Wireless	)	
Services; and Allocation of Spectrum in the 37.0-	)	
38.0 GHz and 40.0-40.5 GHz for Government	)	
Operations	)	

To: The Commission

**COMMENTS OF HUAWEI TECHNOLOGIES CO., LTD.**

Huawei Technologies Co., Ltd, (hereinafter “Huawei”)<sup>1</sup> respectfully submits these comments to the Federal Communications Commission (“FCC” or “Commission”) in response to the *2nd Further Notice of Proposed Rulemaking* (“2<sup>nd</sup> FNPRM”) in the above-captioned

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<sup>1</sup> Huawei Technologies Co., Ltd. is a leading global provider of information and communications technology (“ICT”) solutions, products, and services to network operators, enterprises and consumers in more than 170 countries and regions—including in North America—serving over one-third of the world’s population. See <http://www.huawei.com/en/>.

proceedings.<sup>2</sup> Huawei commends the FCC for taking another critical step toward making available fifth generation or “5G” wireless broadband by including mobile services within the scope of operations for the 24 GHz band (24.25-24.45 / 24.75-25.25 GHz bands) and the 47 GHz band (47.2-48.2 GHz band).<sup>3</sup> As stated in earlier Huawei comments in this proceeding, the FCC’s forward-looking and expeditious action on the millimeter wave (“mmW”) frequency bands, with now an aggregate of approximately 13 gigahertz available for mobile services, is crucial to “the development and deployment of high-performance mobile systems and services.”<sup>4</sup> Huawei also notes that this action aligns with international efforts to designate these bands for International Mobile Telecommunications (“IMT”) 2020, thus facilitating global harmonization and with it, greater economies of scale, global roaming and increased spectrum efficiencies, among other benefits.

Huawei believes that the commonality of mobile radio licensing, service and operating rules across the mmW frequency bands will ensure the rapid and economical application of expanded mobile 5G services. Further, enabling flexible use licenses under the new Part 30 Upper Microwave Flexible User Service (“UMFUS”) for these bands will “allow the business judgments of individual applicants and licensees in these bands to shape the nature of the services offered pursuant to their license”<sup>5</sup> and, Huawei believes, to ensure that the spectrum is

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<sup>2</sup> See *In the Matter of Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, GN Docket No. 14-177, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, FCC 17-152 (Rel. Nov. 22, 2017) (*Spectrum Frontiers 2<sup>nd</sup> FNPRM*).

<sup>3</sup> See *id.* at ¶¶ 15-59.

<sup>4</sup> See Comments of Huawei, *In the Matter of Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, Further Notice of Proposed Rulemaking, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 2 (“Huawei FNPRM Comments”).

<sup>5</sup> See *In the Matter of Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, GN Docket No. 14-177, Report & Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8077 ¶ 167 (2016) (*Spectrum Frontiers R&O and FNPRM*).

available for its most beneficial uses.

In response to the Commission’s call for additional public comment in the 2<sup>nd</sup> FNPRM, Huawei offers the following views, narrowly focused on a performance requirement metric for Internet of Things (“IoT”)-type deployments or other innovative services; and an operability requirement in the 24 GHz band.<sup>6</sup> Huawei also offers brief comment on the FCC’s decision to refrain at this time from authorizing mobile use in the 71-76 and 81-86 GHz bands (“70/80 GHz band” or “E-Band”) as set forth in the Memorandum Opinion and Order.<sup>7</sup>

## **I. PERFORMANCE REQUIREMENTS—GEOGRAPHIC AREA METRICS**

In the 2<sup>nd</sup> FNPRM, the Commission has requested additional comment on, among other issues, the adoption of performance metrics tailored to IoT-type deployments or other innovative services for which traditional metrics are not a good fit; and its proposal to require that any mobile or transportable equipment capable of operating in either portion of the 24 GHz band must be capable of operating “on all frequencies in both band segments” or across the 24 GHz band.<sup>8</sup> Huawei offers the following general comments on these issues below.

### **I. Performance Requirements – Geographic Area Metric**

The twin goals to “create a regulatory scheme that promotes the rapid and widespread deployment of wireless broadband” and that satisfies the Commission’s statutory obligation to promote investment in new technologies and services have been achieved over the years through the adoption and enforcement build-out and coverage requirements.<sup>9</sup> But the existing area and

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<sup>6</sup> See *Spectrum Frontiers 2<sup>nd</sup> FNPRM* at ¶¶ 98-104; and ¶¶ 107-108, respectively.

<sup>7</sup> *Id.* at ¶¶ 193-207.

<sup>8</sup> See *id.* at ¶¶ 98-104; and ¶ 108.

<sup>9</sup> See *id.* at ¶ 60.

population based performance requirements for UMFUS licenses would preclude deployment of many new IoT-type applications and services as the FCC itself acknowledges in this proceeding.<sup>10</sup> The current metric which measures performance based on percentages of the population covered by a licensee in a license area will be problematic for most future IoT service scenarios and jeopardizes the attendant economic benefits of such innovations.<sup>11</sup> This measurement method will be particularly impractical for mmW radio links that may be only a few meters in coverage area. For example, high density/intensity usage across a factory or industrial site may not meet an area or population-based performance metric if the site is a small fraction of a larger geographic area or it encompasses only a small population concentration.

Looking at this challenge from a different perspective, it seems inappropriate to evaluate the performance of communications for the Internet of “things” using the same metrics that have been used in the past for communications services designed for “people.” In many future deployment models, the (service) areas of/for “people” may be disjointed, or orthogonal, to the service areas of/for “things.” For example, some IoT services may be developed specifically to operate in areas with limited public access. Thus, a population based build-out metric would be inappropriate. Similarly, an IoT factory control system may operate in a defined space that constitutes a small fraction of a geographic license area. A build-out performance requirement based solely on an area or percentage of the population services likewise would be unsuitable. Huawei believes that new IoT services will not be well served if either a “percentage of area” or “percentage of population” metric is adopted given that such metrics would be antithetical to the goal as noted above, i.e., to promote the rapid and widespread deployment of wireless broadband

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<sup>10</sup> See *id.* at ¶ 99.

<sup>11</sup> See *Spectrum Frontiers R&O and FNPRM* at 8090-91 ¶¶ 206-210.

and promote investment in new technologies and services.

Huawei appreciates that defining a licensing regime for new services that have yet to be deployed, or perhaps not even envisioned and invented, in a manner that satisfies the aforementioned goal is extremely challenging. Huawei believes that an appropriate performance measure for new IoT services and deployment models may require some adaptation of the existing form of the wide area general service license performance metrics. The short (local) communications range for many IoT applications and “people” based communications services, particularly in the mmW bands, suggests that licensing, and the associated performance metric, should be for areas commensurate with a planned service area, locations or type of IoT service.

Huawei ascribes to the views expressed by commenters earlier in this proceeding that IoT technologies are not yet sufficiently developed in order for the Commission to establish a reasonable performance metric.<sup>12</sup> However, the Commission acknowledges in its 2<sup>nd</sup> Report and Order that, despite the lack of a sufficiently-developed record, that it did receive a “concrete proposal complete with suggested levels of required use” by CTIA.<sup>13</sup> Rather than have the FCC adopt a separate performance metric for IoT services, CTIA proposed that such services “can and should be evaluated under the fixed, mobile, and/or hybrid frameworks that the Commission has already adopted.”<sup>14</sup>

Thus, CTIA’s proposal identified a representative “safe harbour” list of flexible

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<sup>12</sup> See Comments of CTIA, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 16-17 (“CTIA Comments”); Comments of CCA, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 7-8; Comments of Ericsson, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 18; Comments of Verizon, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 8; Comments of TIA, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 17-18; Reply Comments of Intel, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95 at 7.

<sup>13</sup> See *Spectrum Frontiers 2<sup>nd</sup> FNPRM* at ¶ 63.

<sup>14</sup> See Comments of CTIA at 18.

performance options that included: a combination of coverage and links that are met; an average number of connections; an average of IP sessions; and deployment of 500 fixed and mobile access points per 50,000 in population.<sup>15</sup> Huawei believes that such an approach will, as CTIA notes, “best reflect the millimeter wave bands’ ability to host a variety of services and complement more traditional spectrum uses.”<sup>16</sup> Huawei supports this approach to enable IoT service deployments to begin in these bands, and re-evaluation of performance metrics for IoT services by the FCC at a later date.

## **II. Operability in 24 GHz**

Huawei strongly supports the FCC view that operability across a designated full band or band-set is necessary to enable low cost, general purpose equipment for both service providers and end users.<sup>17</sup> Such operability is essential in order to satisfy user expectations and to simplify national service band planning.<sup>18</sup> From the practical technical standpoint of mobile equipment RF engineering, however, device operability across multiple band segments can become very difficult and costly to construct if the services in the intervening portions of the band are incompatible with the mobile service.<sup>19</sup> If the intervening service, for example, involves high

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<sup>15</sup> *Id.*

<sup>16</sup> *Id.*

<sup>17</sup> See *Spectrum Frontiers R&O and FNPRM* at 8061 ¶ 114 (noting the adoption of an operability requirement that will enable equipment to operate across the entire 37-42 GHz band, driving scale for equipment development and use).

<sup>18</sup> Huawei notes that the desirability of operability across an entire band is generally not limited to only the 24 GHz band as other bands may also be split among a number of disparate services and locations.

<sup>19</sup> See Comments of Huawei, GN Docket No. 14-177, IB Docket No. 15-256, RM-11664, WT Docket No. 10-112, IB Docket No. 97-95, Notice of Proposed Rulemaking at 27-28 (Jan. 28, 2015). At the NPRM stage of this proceeding, Huawei noted the technical challenge of interoperability of equipment in the mmW bands. We indicated that the “dynamic adaptive capability of radio systems and the variety of services and levels of technological complexity that may be operating in the mmW bands should be taken into account in the applicable service rules.” See *id.* at 28.

power signals, these may be impossible to sufficiently filter out to enable full sensitivity in the remaining parts of the band for other services such as mobile devices.

Sub-band filters typically must be developed for a specific band and signal but such filters will introduce some reduced level of performance for the desired band. This may include for example, a raised noise floor and additional signal losses. Huawei notes that there are significant cost and space requirements for such filters within compact mobile devices. It may be impossible to provide a suitable set of filters if there are multiple differing operating subsets of a band in different service areas. A different filter set may be required for each local band usage and each service area. Such multiple filter sets may become prohibitive in terms of performance loss, cost and space in the mobile device if there is more than one combination. Each filter and the switches necessary to select the necessary frequency may introduce significant loss in the radio receiver. The intervening service in some areas may also require additional RF filtering of the signals from the mobile service equipment to prevent (co-channel and adjacent channel/band) interference to the services in the intervening (non-mobile) portions of the overall band.

This specific filtering is especially difficult in the mobile devices that are designed to be small, and may need to operate in an environment of strong signals from unrelated local equipment and weak signals from the distant service provider. Strong local signals that are not part of the mobile system may cause loss of sensitivity in the mobile receiver. In this situation, a strong local signal may block reception of the distant weaker service provider. Such RF filtering is typically done in analog format as a strong local signal may overload the digital sampling circuitry. Although digital filtering is a powerful tool, its success is rooted in the linearity of the radio equipment's RF stages and A/D converters for all the signals reaching the antenna. The

combined signal must be very accurately sampled to enable the digital filtering to properly detect the very weakest signals in the composite, as well as the strong signals. If the conglomeration of signals has too large a dynamic range, the strong signals will mask the recovery of weaker signals.

Compatibility across the full band can only be assured when the radio signals in all parts of the band are compatible, i.e., they have commensurate signal strengths. Requiring full band compatibility is thus constrained in practice by the nature of the signals in all bands within the front end of the mobile device receiver. Assuring compatibility of multiple services in various parts of the band requires similarity of signal strengths, especially in the mobile environment.

Huawei further submits that the addition of multiple (front end RF) filters is undesirable due their additional loss and the consequent loss of sensitivity or increased noise and the space required within handsets. In many practical receivers currently in service, close to half of the desired signal power is lost in filters, connectors and switches (designed to enable band selection and adjacent channel rejection) before it reaches the actual radio receiver circuits. These filtering losses negatively impact the system performance in terms of throughput, range, weight, battery life and size.

Therefore, Huawei believes that while full band compatibility for equipment is an important objective, it must be introduced with due regard to the compatibility of the mixture of signals in the combined bands. All of the signals seen by the mobile or other service receivers must be of comparable strength. This may require some common regulation for all services sharing the band with common service areas.



## II. 70/80 GHZ BAND

As reflected in earlier comments submitted in this proceeding, Huawei believes that the 70/80 GHz band or E-band is extremely suitable for high-density mobile services and offers the best speed to end users and sharing by operators for backhaul and access needs, as well as indoor/outdoor sharing due to shielding effects of building materials and geography.<sup>20</sup> Illustration of this belief and our effort to enable the E-band to be used for 5G services can be noted in the many trials and demonstrations between Huawei and its global mobile operator customers with respect to the band.<sup>21</sup> We also invite the Commission to note the numerous study items in the International Telecommunications Union-Radiocommunication, or ITU-R, Task Group (“TG5/1) responsible for evaluating the feasibility of spectrum sharing and compatibility of IMT systems with other existing services.

However, Huawei acknowledges that the Commission has decided in the Memorandum Opinion and Order to refrain from authorizing mobile use in the E-band due to insufficient information on methods to ensure the coexistence between fixed links and mobile operations. Huawei is encouraged that the FCC has expressed its intent to remain open to further consideration of possible future mobile operations in the band within the context of the Wireless Backhaul proceeding.<sup>22</sup>

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<sup>20</sup> See Huawei FNPRM Comments at 9.

<sup>21</sup> See Press Release, “Huawei to Bring 73 GHz mmWave Mu-MIMO Live Demo to Deutsche Telekom” (Feb. 18, 2016), Huawei Technologies, Ltd., *available at*: <http://www.huawei.com/en/news/2016/2/73GHzmm-Wave-Mu-MIM-live-demo>; Press Release, “5G: Huawei and Vodafone Achieve 20Gbps for Single-User Outdoor at E-Band” (July 16, 2016), Huawei Technologies, Ltd., *available at*: <http://www.huawei.com/en/news/2016/7/huawei-vodafone-5g-test>; *Proximus and Huawei Hit 70Gbps in Live Belgian 5G Trial*, MOBILE EUROPE, Nov 15, 2016, <https://www.mobileeurope.co.uk/press-wire/proximus-and-huawei-hit-70gbps-in-live-belgian-5g-trial>; Press Release, “Telenor and Huawei Jointly Announce First 5G Demo in Norway” (March 30, 2017), Huawei Technologies, Ltd., *available at*: <http://www.huawei.com/en/news/2017/3/Huawei-Telenor-First-5G-Demo-Norway>; *Turkcell, Huawei Jointly Achieve 5G mmWave Speed of 70 Gbps*, CABLING INSTALLATION & MAINTENANCE, July 6, 2016, <http://www.cablinginstall.com/articles/2017/07/turkcell-huawei-5g.html>.

<sup>22</sup> See *Spectrum Frontiers 2<sup>nd</sup> FNPRM* at ¶¶ 193-201, 206-207.

### III. CONCLUSION

Huawei again applauds the Commission's expeditious action to open additional mmW spectrum bands for mobile broadband services and appreciates its intention to continue to explore the 70/80 GHz band, as well as other mmW, mid-band and low-band spectrum. Such actions go a long way to ensuring that "the U.S. continues to lead in 5G and to enable wireless consumers to benefit from these technologies sooner rather than later."<sup>23</sup>

5G networks will leverage the availability of spectrum across these layers and enable ultra-fast speeds, low latency and excellent reliability for connecting massive numbers of devices. Very different connectivity requirements will be necessary for IoT services, including industrial applications, advanced logistics and utility networks. Huawei supports the FCC's interest in considering alternative performance metrics for IoT and believes the representative safe harbor list of performance metrics as proposed by CTIA should, at least initially, satisfy FCC's goal to promote investment and the rapid and widespread deployment of IoT services. Further, while operability across the 24 GHz band is an important goal, full band compatibility for equipment must be introduced with due regard for the compatibility of the mixture of signals in the combined bands.

Respectfully submitted,

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<sup>23</sup> See Ajit Pai, Chairman, Fed. Comm. Comm'n., Speech at the Mobile World Congress Americas Conference, at 5 (Sept. 12, 2017), *available at*: [https://apps.fcc.gov/edocs\\_public/attachmatch/DOC-346666A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/DOC-346666A1.pdf).

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