

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)
)
Spectrum Horizons) **GN Docket No. 18-21**

To: The Commission

PETITION FOR PARTIAL RECONSIDERATION

Robert Bosch LLC (Bosch), by counsel and pursuant to Section 1.429 of the Commission's Rules (47 C.F.R. §1.429), hereby respectfully submits this Petition for Partial Reconsideration with respect to the *First Report and Order*, FCC 19-19, 84 Fed. Reg. 25685 *et seq.*, released in the captioned proceeding March 21, 2019 (First R&O).¹ The First R&O amended in certain respects, among other regulations, the Commission's Part 15 rules applicable to certain of the bands above 95 GHz, in order to accommodate the development of, and to enable new innovative services and technologies. Overall, the actions taken in the First R&O will provide new opportunities for innovators and experimenters to push technological boundaries in wireless communications, and facilitate the development of new equipment and applications using unlicensed RF systems in some segments of spectrum between 95 GHz and 3 THz. However, the Commission did not make internationally harmonized spectrum available in the band 123-140 GHz for unlicensed operation, and it did not address the merits of the arguments provided by Bosch in favor of doing so. Nor were studies conducted in the United States specifically in order to ascertain the compatibility between unlicensed use of this *additional*

¹ Because the *First Report and Order* in this proceeding was published in the Federal Register on June 4, 2019, this Petition is filed timely pursuant to Section 1.429(d) of the Commission's Rules.

spectrum and that of incumbent licensees and authorized entities.² The authorization of this additional spectrum for unlicensed use would be entirely consistent with the Commission's commitment to permit enhanced experimental licensing and unlicensed applications within the bands above 95 GHz, and with its overall commitment "to identify and make available unused and underused spectrum regardless of the frequency range."³ Thus, for the same reasons that the Commission made additional bands available for such use in the First R&O, Bosch respectfully requests that the Commission revisit its decision to not consider (either in the First R&O or via a Further Notice of Proposed Rule Making in this proceeding) internationally harmonized, unlicensed use of the band 123 GHz to 140 GHz in support of manufacturing and other applications. As good cause for this Petition for Partial Reconsideration (and in the interests of manufacturers in a flexible, yet internationally harmonized regulatory environment that will further facilitate the development and availability of products in the millimeter-wave bands), Bosch states as follows:

² This is not to suggest that there were not compatibility calculations conducted relative to the actions taken in the First R&O relative to incumbents using the bands made available for unlicensed operation, including the band 116-123 GHz. The calculations which were done relative to that band provide guidance relative to the additional, internationally harmonized band 123-140 GHz. They illustrate that there can be expected a high level of compatibility between incumbent licensed services in the band 123-140 GHz and unlicensed facilities in that same range. At paragraph 17 of the First R&O, for example, the Commission discussed the compatibility between unlicensed facilities and the Earth Exploration Satellite Service, noting that the Commission prohibits unlicensed devices above 95 GHz from operating on aircraft. To assess whether unlicensed devices can co-exist with the Earth exploration-satellite service, the Commission determined how many unlicensed devices would produce aggregate emissions that would exceed the harmful interference protection threshold, as set forth in ITU-R RS.2017, for the 174.8–182 GHz and 185–190 GHz bands. This analysis showed that up to 42,704 outdoor unlicensed devices can operate simultaneously at maximum power per square kilometer and still meet the protection levels for a vertical satellite scan of an Earth exploration satellite and 96.5 million unlicensed devices can operate simultaneously at maximum power per square kilometer for an angle scan without causing harmful interference. Based on these large device densities, the Commission concluded that the potential for harmful interference to Earth exploration satellite operations is negligible. The Commission noted that the same analysis is also applicable to the 116–122 GHz band but would result in an even lower likelihood of harmful interference because that band is subject to 20 dB higher atmospheric attenuation than the 174.8–182 GHz and 185–190 GHz bands. The same conclusion would inevitably be applicable to the band 123-140 GHz.

³ First R&O, at ¶ 1.

1. In its comments filed in response to the *Notice of Proposed Rule Making and Order* in this proceeding,⁴ Bosch generally supported the proposals contained therein. Bosch noted that currently, the bands in this frequency range that are of most interest for the development of unlicensed devices regulated pursuant to Rule Part 15 [or, as more generically identified in Europe, “Short-Range Devices” (SRD)] were 122-123 GHz and 244-246 GHz. In the First R&O, the Commission properly made the bands 116-123 GHz and 244-246 GHz available for unlicensed operation, removing them from the large amount of spectrum included heretofore in the Part 15 “restricted bands” pursuant to Section 15.205(a) of the Commission’s rules. This was justified by the fact that the bands in this range inherently have extensive frequency re-use possibilities; typically short communications path lengths; and create many opportunities for products with low radiated emission levels which inherently have a low or negligible interference potential such as radiodetermination.

2. Bosch argued that there is a substantial degree of frequency reuse possible in bands near 122-123 GHz due to the high level of attenuation of signals at that frequency range,⁵ and therefore many opportunities exist for spectrum overlays.⁶ International Footnote 5.138 to the

⁴ *Notice of Proposed Rule Making and Order*, 33 FCC Rcd. 2438 (2018); 83 Fed. Reg. 13888, released February 28, 2018 (the Notice).

⁵ The Commission noted at Paragraph 22 of the *Notice* as follows:

The propagation of millimeter wave radio signals is limited when compared to that associated with lower-frequency radio signals. Signals in millimeter wave bands are significantly affected by the presence of oxygen and water vapor within the atmosphere, although the amount of signal attenuation due to oxygen and water vapor varies with frequency and other factors. Attenuation caused by oxygen is significant throughout the millimeter wave spectrum, but increases dramatically around 60 GHz, 120 GHz, and 183 GHz.

⁶ See, for example, CEPT Electronic Communications Committee (ECC) Document ECC Report 90 entitled *Compatibility between Short-Range Devices (SRD) and EESS (passive) in the 122 to 122.25 GHz band* (approved May 2013).

Table of Allocations⁷ states that ISM devices centered at (among other bands) 122.5 GHz and 245 GHz should be authorized by administrations by special authorization in agreement with other administrations whose radiocommunication services might be affected. There is no indication in the record, however that *any* incumbent radio services would be harmed by authorizing short range radiodetermination devices operating on an unlicensed basis in the range 116-140 GHz or the bands near 245 GHz utilizing the operating parameters adopted in the First R&O and those applicable from the remainder of the Part 15 regulations.

3. There are many innovative applications that would be available right now which would operate in the band 123-140 GHz, but for the inclusion of the band 123-138 GHz among the Part 15 restricted bands for intentional radiators. These applications include radiodetermination applications such as foreign object detection; living object (i.e. physical presence) detection; vehicle driver state sensors (which can reveal driver medical conditions or the position of the driver); gesture control and recognition for use inside vehicles; and home automation systems. Such sensors within the millimeter-wave range can also be used for such industrial applications as high-resolution obstacle detection for autonomous systems (such as industrial robots); displacement measurement (for example, fuel injection diameter changes or thickness measurements) and flow measurement, to name just a few examples. Inclusion of the band 123-140 GHz in the bands available for unlicensed operation in the United States would permit a very significant expansion of industrial, commercial and personal products and applications using

⁷ That Footnote reads as follows:

5.138 The following bands:

122-123 GHz (centre frequency 122.5 GHz), and

244-246 GHz (centre frequency 245 GHz)

are designated for industrial, scientific and medical (ISM) applications. The use of these frequency bands for ISM applications shall be subject to special authorization by the administration concerned, in agreement with other administrations whose radiocommunication services might be affected. In applying this provision, administrations shall have due regard to the latest relevant ITU-R Recommendations.

these bands for radiodetermination purposes, *due to the international harmonization that would greatly facilitate the economics of manufacturing such devices*. Generally speaking, the above use cases are permitted in Europe now due to more flexible regulatory provisions than exist under current Commission rules. According to ETSI System Reference Document TR 103 498 – v.1.1.1.⁸:

(The use of microwaves provides) a very robust measuring principle which is preferred when high accuracy is required and environmental conditions, such as temperature, pressure, etc., may vary. Some of the main advantages of microwave technology for all kinds of sensors are therefore:

- high measurement accuracy,
- high repeatability,
- robust measuring performance in a variety of environmental- and process conditions,
- high reliability,
- minimum or even no maintenance requirements and wear as a result of no moving parts,
- easy installation,
- non-contact measuring principle provides a high independency of ambient conditions or process properties,
- superior long-term stability resulting from self-calibration mechanisms since devices have always stable internal references which are independent of temperature or humidity,
- efficient handling of many devices due to the support of different interfaces, the antenna or the radome is usually very robust against contamination with dust, dirt or other adverse environmental influences.

All these factors combined provide a technology that over time has proven to bring improvements in environmental protection, human safety, accident prevention and avoidance as well as a more efficient and sustainable use of natural resources and higher quality of end-products in different manufacturing industries.

4. It is understood that the Commission decided to allow unlicensed operation in the 122-123 GHz and the 244-246 GHz bands because they are already designated ISM bands which host devices that are not subject to emissions limits. In fact, the Commission went further, and

⁸ This system reference document is titled *Short Range Devices (SRD) using Ultra Wide Band (UWB); Transmission characteristics; Radiodetermination applications within the frequency range 120 GHz to 260 GHz*. It provides an excellent recitation of the potential use cases for millimeter wave spectrum generally.

flexibly determined that the 116-123 GHz and 244-246 GHz bands should be removed from the list of restricted bands in Section 15.205, and thus made available for unlicensed operation.

Bosch, however, had also urged that the Commission adopt internationally harmonized rules for unlicensed devices generally in these bands (most urgently for radiodetermination purposes, but to permit a wide variety of other applications as well). Bosch argued that the bands made available for unlicensed operation in this proceeding should be, *to the greatest extent possible*, harmonized with those of CEPT. In order for such bands to be of utility to manufacturers and developers of new applications for these bands, international harmonization of the spectrum in which the devices and applications are intended to operate is critically important, as the economics of development of these new applications demands it. Finally, Bosch urged that the Commission should consider, in this proceeding or separately in the very near future, permitting Ultra-Wideband (UWB) device operation around 122 GHz (and in other bands) as proposed in ETSI System Reference Document TR 103 498 – v.1.1.1, in order to permit compatible spectrum sharing and efficiency.

5. It remains unclear why all frequencies above 38.6 GHz were included in the restricted bands in the first place,⁹ but it was apparently not based on interference concerns at all. The Commission in the First R&O noted that the band 116-122.25 GHz is allocated domestically on a co-primary basis to the Earth exploration satellite service (passive), space research (passive) and

⁹ The Commission confirmed at Paragraph 53 of the *Notice* in this proceeding that there was no interference-based reason for the initial inclusion of all of the bands above 38.6 GHz in the restricted bands other than administrative convenience and the absence of any impact of doing so (at the time) on equipment manufacturers:

The Commission designated the entire frequency range above 38.6 GHz as a restricted band in 1989 at a time when manufacturers were not producing equipment that transmitted in that frequency range and when there were no requirements in our rules to make measurements of RF emissions above 40 GHz because of limitations in measurement technology (footnote omitted). Designating the entire frequency range above 38.6 GHz as restricted, rather than restricting designated segments, was simply a matter of administrative convenience and had no impact on manufacturers.

the Inter-Satellite service. It is also available for ISM devices. The remainder, 122.25-123.0 GHz is allocated on a co-primary basis to the government and non-government fixed and mobile services and the Inter-Satellite service, and on a secondary basis to the Amateur Service and is available for use by ISM equipment. The applicable footnotes to the domestic and international table of allocations for this band provided no justification for the continued inclusion of the band 116-123 GHz in the restricted band. The band hosts a secondary Amateur Radio allocation which permits itinerant, unregulated operation in all parts of the allocation, using unspecified emission types and no specific power limitation relative to other bands, and with no operational restriction except a non-interference obligation with respect to the fixed, inter-satellite and mobile services per Section 97.303(p), as well as ISM devices. This allocation scheme provided a strong indication that there are no particularly sensitive uses of the band that would preclude the addition of Part 15 devices, if not generally then in certain specific categories. Given the high level of attenuation of signals at that frequency range, the Commission properly concluded that Part 15 devices generally could be included among the uses permitted in that frequency range. For the same reasons, the additional, internationally harmonized segment 123-140 GHz could be made available for unlicensed use.

6. ETSI System Reference document TR 103 498 V1.1.1 (2018) addresses UWB Radiodetermination applications within the frequency range 120 GHz to 260 GHz. In its introduction, it is noted that the document addresses requests for harmonized spectrum for sensor or radiodetermination applications using UWB technology within the frequency range 120 GHz to 260 GHz. Communications applications or hybrid applications including sensor and communications applications are not included within the scope of the document. Instead, it addresses the identified need for additional spectrum allocations for UWB radiodetermination

devices in order to cover measurement tasks which cannot be conducted adequately at the moment due to the limited bandwidth in the existing frequency allocations in the bands 122-123 GHz and 244-246 GHz. UWB technology is already available to address the need for accurate radiodetermination devices.¹⁰ The stated intention of ETSI TR 103 498 is to create a basis for the facilitation of the “market launch of new innovative and useful radio products while avoiding any harmful interference with other radio services and equipment.” This was and is precisely the goal of the Commission in the instant proceeding. Based on the ETSI request, there are now related studies ongoing within the CEPT/ECC¹¹ of radiodetermination applications in the 120-260 GHz range for a variety of sensor types. These studies take into account the findings of ETSI TR 103 498, referenced herein. The radiodetermination sensors fall into three types: Type A applications emit into free space outside a shielded environment or a housing without a restriction on the direction of the emission. These can be divided into outdoor and indoor use inside buildings or vehicles. In case of an indoor/in-vehicle application, additional indoor-to-outdoor attenuation can be taken into account.¹² Type B applications emit in a downward direction towards the ground outside a shielded environment or housing. These applications can also be configured for outdoor and indoor use.¹³ Type C applications emit inside a closed and highly shielded environment or housing. They can also be operated indoors or in contained

¹⁰ At page 22 of the ETSI Recommendation is the following explanation:

The provision of new frequency bands above 120 GHz for applications like those identified in [this recommendation] goes along with the utilisation of new semiconductor technologies. The ... necessary semiconductor technologies are already available but the currently available frequency regulation is not yet usable for most of the proposed applications. The 1 GHz available bandwidth in the 122 to 123 GHz ISM-band and the 2 GHz wide ISM band from 244 to 246 GHz are in most cases not sufficient to solve the specific measurement task. The manufacturers of sensor equipment face therefore the current situation where a missing regulation constrains the development of new sensors although the technology is ready.

¹¹ SE 24_71, *Radiodetermination applications within the frequency range 120 GHz to 260 GHz*.

¹² Type A applications include in-vehicle and surveillance vehicular radars and mobile radars for autonomous devices and robotics.

¹³ Examples of Type B sensors are include those for fixed surveillance and security applications.

vessels [such as tank level probing radars inside closed metallic tanks located (for example) inside a factory building]. For such applications, adequate installation requirements can be developed and made compulsory for the users and installers of the devices. The economics of the development of these applications is dependent upon internationally harmonized spectrum allocations.¹⁴ The outcome of the studies will be reflected in the amendment of the ETSI harmonized standard EN 305 550 or a sub-part thereof.

7. The Commission has consistently applied a conservative approach to any expansion of the rules governing UWB technology. However, the millimeter-wave bands are particularly well-suited to flexible deployment of UWB technology, with wide bandwidths and low power spectral densities inherent in the devices and systems. The Commission asked at paragraph 57 of the *Notice* in this proceeding whether there are any other bands above 95 GHz that would be suitable for unlicensed use in addition to the 15.2 gigahertz of spectrum identified in the *Notice*. Specifically, the Commission asked whether it should permit unlicensed use of the 116-122 GHz band in addition to the adjacent 122-123 GHz band so as to provide a contiguous band of spectrum available for unlicensed use. Bosch supported this proposal, but also suggested consideration of the band 123-140 GHz for unlicensed use in order to facilitate international harmonization of product development. Bosch agreed with the Commission's preliminary observation that unlicensed, and especially UWB radiodetermination applications in the 116-123 GHz band would not be inconsistent with incumbent passive services such as the EESS and SRS (passive) or the ISS. Radiodetermination in the band, and especially UWB radiodetermination

¹⁴ During the first European SE 24_71 drafting meeting it was decided to add a note that the limits (peak and mean power) are adopted from the United States. The final limits for Europe for the different device categories or use cases will be determined by the ongoing compatibility studies. However, the maximum peak power (e.i.r.p.) under discussion for all three types of sensors is +43 dBm, and the maximum mean power (e.i.r.p.) for all three would be +40 dBm. The frequency ranges under consideration, originally within the band 120-260 GHz are now under review and could be expanded downward to 116 GHz, such that, for Type A sensors, the available frequency ranges would include 116-130 GHz and 134-141 GHz, and for Type B sensors, the range would be 116-148.5 GHz among others. For Type C sensors the range would be the entire band 116-260 GHz.

would constitute a low density deployment and could be compatible with the high sensitivity of passive receivers, due to the low transmitted power levels, low power spectral density and the high level of propagation attenuation from atmospheric absorption. Therefore, sharing spectrum among radiodetermination unlicensed devices and incumbent allocated services (including active and passive services) is possible without causing interference. See also CEPT ECC Report 190, *Compatibility between Short-Range Devices (SRD) and EESS (passive) in the 122 to 122.25 GHz band*. (2013).

8. The problem with limiting the available frequency range for unlicensed applications near 122 GHz to 116-123 GHz is that there is very little overlap between the authorization of that band for unlicensed operation in the United States with the spectrum under consideration for the same purpose in Europe, which is 120-130 GHz and 134-141 GHz. This distinction is anomalous because largely, the international allocations for licensed radio services in all three ITU Regions in the range 120-141 GHz are identical. In the range 123-134 GHz the Domestic Table of Allocations is identical to the International Table. The band 134-141 GHz in the United States is allocated to the amateur, amateur-satellite and radioastronomy services. There is no indication that there would be any incompatibility whatsoever between unlicensed short-range devices, especially UWB devices and applications, in the band 123-140 GHz, and any combination of Fixed or mobile satellite downlinks, radionavigation or radionavigation-satellite services, amateur radio¹⁵ or radioastronomy¹⁶ facilities operating in this frequency range.¹⁷ Despite this,

¹⁵ See Paragraph 42 of the First R&O.

¹⁶ At Paragraph 31 of the First R&O, the Commission specifically concluded that there was no incompatibility between unlicensed operation in the bands above 95 GHz and Radioastronomy: “We find that unlicensed devices can co-exist with radio astronomy in the same and adjacent spectrum bands above 95 GHz because of factors such as the high atmospheric losses associated with these frequency bands and the use of highly directional antennas.”

¹⁷ The Commission stated categorically at paragraph 30 of the First R&O that compatibility between incumbent, licensed services in this frequency range and the addition of low-power unlicensed devices is assured by various factors: “Our discussion is informed by the characteristics of the frequencies above 95 GHz — in particular, the generally high propagation losses in these bands, the high losses due to atmospheric effects at specific frequencies,

the Commission did not address the merits of the proposal to expand the authority to operate unlicensed devices and systems in the band 123-140 GHz or the need for international harmonization. The Commission stated at paragraph 29 of the First R&O only that:

We will not, at this time, provide additional frequency bands for unlicensed device operation above 95 GHz beyond the 21.2 gigahertz designated above (footnote omitted). Our efforts in this First Report and Order provide a considerable amount of spectrum for unlicensed use in multiple bands that is sufficient to enable development of new unlicensed devices and applications. Moreover, the Commission may reassess the spectrum allocations based on how uses of this spectrum develop and revisit this issue at a later date.

The Commission noted in a footnote to that conclusion that Bosch was the only commenter suggesting that a specific band not addressed in the Notice be made available for unlicensed operation. It claimed that Bosch “did not provide sufficient detail for the proper consideration of its proposal” but noted that, at pages 9 and 10 of Bosch’s Comments, Bosch had suggested that the Commission authorize ultra-wideband radiodetermination use at 123-140 GHz in order to “facilitate international harmonization of product development.” There was no further analysis of the proposal.

9. It is respectfully suggested that Bosch *did* in fact provide a sufficient justification for consideration, in a Further Notice in this proceeding or in the First R&O, of the creation of an internationally harmonized allocation in the vicinity of 122 GHz. The issue of international harmonization of spectrum for unlicensed facilities in this range, to facilitate the economics of development of products and applications in this frequency range is exceptionally important as a means of ensuring that such development actually occurs. There are multiple applications that would be facilitated by the relief requested herein, including the automotive industry which has a strong need to have international spectrum harmonization for products in this range, to the

as well as the tendency of objects in the transmission path to block signals at these frequencies and prevent them from reaching and thus causing harmful interference to authorized service receivers.”

greatest extent possible. The same is true with manufacturing of sensor products operating in this range. The economics of these industrial needs are significant. By contrast, the Commission's sole proffer is that it has already made a "sufficient" allocation in the millimeter-wave bands for now. There has been only a small amount of internationally harmonized spectrum (at 120-123 GHz) within the 21.2 GHz of spectrum made available for unlicensed operation in the millimeter-wave bands in this proceeding thus far. While it might have been concluded that the band 120-140 GHz would have been a better choice than the band 116-123 GHz for unlicensed operation due to the international harmonization opportunities of the former segment, the Commission did not substantively consider the options, despite its earlier commitment "to identify and make available unused and underused spectrum regardless of the frequency range" expressed in the Notice in this proceeding. Moreover, there is no cognizable interference concern in authorizing unlicensed use of radiodetermination products and systems in the 123-140 GHz band by rule. Nor would the authorization of unlicensed devices and systems in the band 123-140 GHz preclude other applications, including licensed applications.

10. It is understood that the Commission intends to visit the issue of licensed spectrum in the millimeter-wave bands above 95 GHz at a later time. Doubtless, there are numerous opportunities to identify certain spectrum in that range for future licensed applications. However, in order to effectuate the Commission's intent to provide new opportunities for innovators and experimenters to push technological boundaries in wireless communications, and facilitate the development of new equipment and applications using unlicensed RF systems in some segments of spectrum between 95 GHz and 3 THz, Bosch suggests that the need for international harmonization in this frequency range is of greater urgency than the Commission has noted heretofore, and with respect to the band 116-140 GHz, the Commission should revisit the issue

and make flexible accommodation for internationally harmonized spectrum for unlicensed applications. To do so would facilitate, to a far greater extent than has been done in the First Report and Order, the development of new, innovative applications across a wide range of industries and manufacturing applications.

11. The Commission has been and is on the right track in this proceeding. Clearly, opening the millimeter-wave bands to expanded unlicensed operation, especially for radiodetermination applications, is timely and useful. The Commission has properly removed some of the bands above 95 GHz from the Part 15 restricted band list in Section 15.205(a) of the Commission's rules. The technical rules governing such unlicensed operation, especially those related to use of the 122-123 GHz and 244-246 GHz bands have largely been harmonized with those in place in Europe at the moment. Creating an opportunity for new applications in the band 123-140 GHz will permit a large number of new, innovative products for consumers and for industry in the United States and better fulfil the Commission's goals in this proceeding than has been done by means of the First R&O in its present form.

Therefore, the foregoing considered, Robert Bosch LLC respectfully requests that the Commission reconsider its decision to not consider the additional authorization of unlicensed operation in the band 123-140 GHz, and to issue a Memorandum Opinion and Order authorizing unlicensed operation in that range, using the same technical parameters that apply to the 116-123 GHz band adopted in this proceeding. If the Commission elects not to do so in this proceeding,

Bosch respectfully requests consideration of issuance of a Further Notice of Proposed Rulemaking incorporating the same proposed relief.

Respectfully submitted,

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July 1, 2019