

Before the
FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of)	
)	
Amendment of Rules Governing Ultra-Wideband)	RM -11844
Devices and Systems)	

To: The Chief
Office of Engineering and Technology
Via: ECFS

REPLY COMMENTS OF ROBERT BOSCH LLC

Robert Bosch LLC (Bosch), petitioner in the captioned proceeding,¹ by counsel and pursuant to Section 1.405(b) of the Commission’s Rules [47 C.F.R. § 1.405(b)], hereby respectfully submits its reply to the pleading styled *Opposition of the GPS Innovation Alliance* filed on or about August 19, 2019 (“the GPSIA Opposition”). The GPSIA Opposition comments negatively on the above-captioned *Petition for Rule Making* (the “Bosch Petition”). The Bosch Petition requests that the Commission initiate a comprehensive review of the Part 15, Subpart F regulations governing Ultra-Wideband (UWB) devices and systems, and asks that the Commission adopt modified rules for UWB operation as proposed in the Appendix thereto regarding UWB devices and systems. In continuing support for its Petition, and in response to arguments made in the GPSIA Opposition, Bosch states as follows:

¹ The Bosch Petition was placed on *Public Notice* by the Consumer and Government Affairs Bureau Reference Information Center on July 18, 2019 (see Report No. 3130). That *Public Notice* announced a 30-day comment period ending August 17, a Saturday. Pursuant to Section 1.4(j) of the Commission’s rules, Comments were actually due Monday, August 19, 2019. The GPSIA “opposition” pleading was in fact filed August 19, 2019. Thus, pursuant to Section 1.405(b) of the Commission’s rules, these Reply Comments are timely filed.

1. GPSIA unfairly characterizes the Bosch Petition at the outset of its pleading. What are proposed in the Petition are not what GPSIA refers to as “sweeping changes”² that would “eliminate carefully drawn technical restrictions and operating parameters with little consideration given to the significant interference impact on existing licensed and unlicensed services.”³ Nor does Bosch propose a “radical (sic) revision of the rules.”⁴ Quite the opposite: Adoption of the proposed modified rules will facilitate the development and provision of new, innovative UWB products in the United States marketplace by manufacturers, *without* creating the potential for interference to incumbent licensed and unlicensed services. The rules for UWB devices that were created seventeen years ago (and not substantially revisited since then) were not “carefully drawn” as GPSIA asserts. Rather, they were intentionally, overly conservative rules (the Commission’s own description) which were intended to create an initial, *but temporary, short term* regulatory environment that would allow experience to be gathered and then revised within six to twelve months afterward.⁵ The promised revisions never occurred,

² GPSIA Opposition, at 1.

³ *Id.*

⁴ *Id.*

⁵ In its *First Report and Order*, FCC 02-48, 17 FCC Rcd. 7435 (2002) in Docket 98-153, the Commission, proceeding “cautiously,” established what it referred to as a potentially “overprotective” regulatory scheme for then-nascent UWB technology, which technology nonetheless was found to offer “significant benefits” for public safety, businesses and consumers:

UWB technology holds great promise for a vast array of new applications that we believe will provide significant benefits for public safety, businesses and consumers. With appropriate technical standards, UWB devices can operate using spectrum occupied by existing radio services without causing interference, thereby permitting scarce spectrum resources to be used more efficiently. This First Report and Order (“Order”) includes standards designed to ensure that existing and planned radio services, particularly safety services, are adequately protected. We are proceeding cautiously in authorizing UWB technology, based in large measure on standards that the National Telecommunications and Information Administration (“NTIA”) found to be necessary to protect against interference to vital federal government operations. These UWB standards will apply to UWB devices operating in shared or in non-government frequency bands, including UWB devices operated by U.S. Government agencies in such bands. We are concerned, however, that the standards we are adopting may be overprotective and could unnecessarily constrain the development of UWB technology. Accordingly, within the next six to twelve months we intend to review the standards for UWB devices and issue a further rule making to explore

however, and the current regulatory environment for UWB products is, as the result, “overprotective” and unnecessarily restrictive. As stated in the Petition, most UWB products, in order to be eligible for a grant of equipment authorization, require waivers of multiple sections of the Subpart F, Part 15 rules in order to reach the marketplace. This is an expensive and time-consuming process which has hampered the rollout of the technology and in many instances precluded new UWB applications entirely. Exactly the negative result that the Commission anticipated in 2002 from adopting the Subpart F rules has come to pass: the technical standards that the Commission established seventeen years ago have “unnecessarily constrain(ed) the development of UWB technology.”⁶ GPSIA’s contention that the Bosch Petition “fails to provide sufficient, facts, data, or analysis to justify this radical (sic) revision of the rules”⁷ is not well-taken. Bosch merely asks that the Commission do now what it said in 2002 that it would do six months or a year thereafter. The review of the Subpart F, Part 15 rules is *long* overdue. The evidence of this is the plethora of waiver requests that have been filed (and for the most part, granted ultimately). Regulation by waiver for rollout of new technologies is inconsistent with the statutory mandate⁸ to support the provision of new technologies and services to the public.

2. Notwithstanding GPSIA’s (mis)characterization of the Bosch Petition, Bosch is supportive of the goals and intentions of GPSIA with respect to the protection of GPS signals from interference. Nor does Bosch dispute the point made by GPSIA that GPS has increasingly important, diverse, ubiquitous applications deserving of interference protection. However, nothing in the proposed, revised UWB rules removes any necessary interference protection for

more flexible technical standards and to address the operation of additional types of UWB operations and technology.

(*First Report and Order*, 17 FCC Rcd. at 7435)

⁶ *Id.*

⁷ GPSIA Opposition, at 1.

⁸ It is the policy of the United States to encourage the provision of new technologies and services to the public. 47 U.S.C. § 157 (Communications Act § 7).

GPS signal reception. Bosch takes exception to the unsupported allegation of GPSIA that “the potential of UWB devices to interfere with GPS is (and continues to be) well established.”⁹

GPSIA cites comments filed nineteen years ago by the GPS Industry Council (before any UWB use had been authorized, save for a few highly restrictive waivers for individual products) for the proposition that allowing UWB devices in spectrum utilized by incumbents had interference potential to GPS. It also cites the *First Report and Order* in Docket 98-153, released in 2002, at paragraph 34, for the proposition that “the Commission specifically recognized GPS operating at 1559-1610 MHz as well as the then planned, now deployed, L5 GPS in the 960-1215 MHz band would be susceptible to UWB device interference that would degrade the use of the GPS signal.”¹⁰ However, (a) the Commission’s statement cited by GPSIA was not applicable to UWB devices generally, but only to UWB operation below 2 GHz; and (b) it merely expressed concern about adverse effects, should interference to various services below 2 GHz actually occur; it was not a finding that there would likely be any such interference:

The Commission noted that it had a number of concerns about generally permitting the operation of UWB devices in the region of the spectrum below approximately 2 GHz. This is perhaps the most heavily occupied region of the spectrum and is used for public safety, aeronautical and maritime navigation and communications, AM, FM and TV broadcasting, private and commercial mobile communications, medical telemetry, amateur communications, and GPS operations. Further, 41 of the 64 restricted frequency bands are at or below 2 GHz, not counting the TV broadcast bands. Of particular concern is the impact of any potential interference to the GPS band at 1559-1610 MHz. The Commission also expressed concern about interference to any additional frequencies allocated to GPS, *e.g.*, the planned L5 frequency in the 960-1215 MHz band. GPS will be increasingly relied upon for air navigation and safety, and is a cornerstone for improving the efficiency of the air traffic system. GPS also may be used by commercial mobile radio E-911 services to enable police and fire departments to quickly locate individuals in times of emergency. Moreover, businesses and consumers are now employing GPS for various applications, such as for navigation by automobiles, boats and other vehicles, surveying, hiking, and geologic measurements. Therefore, any harmful interference to GPS could have a

⁹ GPSIA Opposition, at 5.

¹⁰ *Id.*, at 4, Fn. 5.

serious detrimental impact on public safety, businesses and consumers. In addition, propagation losses are not as great below 2 GHz, and services in this region of the spectrum tend to employ omnidirectional antennas that do not discriminate against undesired signals. These factors tend to increase the risks of interference below 2 GHz.

3. GPSIA concedes the fact, cited by Bosch at page 2 of the Petition, that as far as can be ascertained, upon diligent inquiry, *there have been no reported instances of interference from UWB devices to GPS to date*. Nor does GPSIA dispute Bosch's statement at page 8 of the Petition that there is no evidence of ambient noise increases from UWB devices. Instead, GPSIA claims that these circumstances establish that "the UWB rules are working, as intended, to prevent increases in the noise floor and interference to existing users."¹¹ Of course, one cannot manage spectrum using that metric, because to do so would preclude any spectrum overlays at all, and it would ensure the most inefficient uses of spectrum in favor of incumbents who have occupied spectrum historically. The idea is not to have Part 15, Subpart F rules which underregulate or overregulate, but rather to create a regulatory environment that is the least restrictive in terms of precluding new, desirable products, applications and technologies while at the same time providing necessary levels of protection to incumbents in the spectrum under consideration and appropriately limiting out-of-band emissions. GPSIA's position, however, does not support such an approach. They appear content to preclude UWB applications because the status quo, created 17 years ago (for what was supposed to be a temporary period subject to reevaluation) has not resulted in any instances of interference to date. But that absence most certainly does not by itself justify the retention of the current rules, or the current "regulation by rule waiver" conditions that preclude entire classes of RF products for which there is established demand, but which fail a cost/benefit analysis due to regulatory compliance burdens and

¹¹ *Id.*, at 7.

expenses. At footnote 15 of GPSIA's pleading, it is suggested that the UWB "regulation by waiver" process should be continued, and that additional requirements should be placed on those who seek UWB waivers "so that other spectrum users at risk of potential interference can readily assess the extent of that risk of the specifically proposed application." Bosch would suggest that the argument compounds the detrimental effects of the current overregulation of UWB.¹² If, as in the case of UWB devices and systems, there are large numbers of waiver requests¹³ and large numbers of waivers granted, that is a strong indication that the rules are disaccommodating and should be revised.¹⁴ Furthermore, conditions governing waiver grants have been well-established for years and the showings required are very stringent already.¹⁵ Adding additional regulatory

¹² The disadvantages of regulating by waiver include (1) delays in getting a product to market (typically 12-24 months); (2) high legal and engineering expenses for manufacturers and hence for consumers; (3) unpredictability as to outcome; and (4) an arbitrary, and somewhat inconsistent series of permitted and non-permitted devices. A product should not be permitted or prohibited based on whether or not the manufacturer can suffer the risk, delay and expense of a rule waiver proceeding each time it has a new or even a modified UWB device. An overhaul of the UWB rules that eliminates unnecessary restrictions and distinctions, and allows certification and marketing of any UWB device that presents no realistic threat of interference. The regulated manufacturing industry needs certainty as to applicable regulatory obligations.

¹³ GPSIA disputes the claim that there has been a large number of waivers sought and granted, claiming at page 7 of its Opposition that there have been less than a dozen waivers sought and granted for UWB devices since the inception of the UWB rules, though there have in the same time period been 442 equipment authorization grants for UWB devices. Bosch has well-established in its Petition why the Subpart F rules are disaccommodating and necessitate waivers in *virtually every case* in which certification is sought pursuant to the Subpart F, Part 15 rules. Many of these waivers relate to the definitional rules for UWB devices and the means of complying with the minimum bandwidth requirement of Section 15.503(d) of the rules, which severely limits the types of modulation schemes that might be employed in a UWB emission. However, GPSIA fails to distinguish in its tallying of the number of UWB devices that have been issued a grant of equipment authorization (certification) which have been approved pursuant to the Subpart F, Part 15 rules to which the Bosch Petition relates and the Section 15.250 rule which more broadly regulates wide bandwidth digital devices and which is limited in its application to the band 5925-7250 MHz. See, *Radiated Emission Limits and Additional Provisions*, Subpart C, Part 15.

¹⁴ Furthermore, the current rules are arbitrary. The definitional rules in Subpart F of Part 15 limit applications for UWB technology, and they limit the modulation schemes that can be deployed, without reference to interference potential. These regulatory limitations have a preclusive effect on devices of great utility in a variety of industries. Worse, the limitations actually encourage the development of devices and systems that use more bandwidth than is operationally necessary, or transmitters that inject noise, in order to increase the occupied bandwidth of a signal exclusively for the purpose of meeting the strict definitional regulation.

¹⁵ The Commission is authorized to grant a waiver under section 1.3 of the Commission's rules if the petitioner demonstrates good cause for such action. 47 CFR § 1.3; see also *ICO Global Communications (Holdings) Limited v. FCC*, 428 F.3d 264 (D.C. Cir. 2005); *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969). Good cause, in turn, may be found and a waiver granted "where particular facts would make strict compliance inconsistent with the public interest." *Northeast Cellular*, 897 F.2d at 1166; see also *ICO Global Communications*, 428 F.3d at 269 (quoting *Northeast Cellular*); *WAIT Radio*, 418 F.2d at 1157-59. To satisfy this public interest requirement, the waiver cannot undermine the purposes of the

burdens on manufacturers of RF products creates a further disincentive to develop UWB products than that which exists now.

4. There is no portion of the Bosch Petition that proposes to liberalize or to change in any manner the current UWB radiated emission limits in the GPS bands. This is clearly established by Exhibit 1 of the GPSIA Opposition, which is a redline of the Bosch Petition Appendix referenced to the existing rules which Bosch proposes to change. No portion of the proposed changes relates to the radiated emission limits in the current rules applicable to the GPS bands. There exists within Part 15, Subpart F now (and Bosch does not propose to change these rules whatsoever) with respect to each use-case for UWB devices, EIRP limits in dBm per 1 kilohertz in the GPS bands. Looking for example at Section 15.517 of the current rules, pertaining to indoor UWB applications (where, presumably, GPS receivers will be in closest proximity to UWB devices and in the largest numbers),¹⁶ Subsections (c) and (d) thereof provide the following limits for UWB radiated emissions and average limits:

(c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in § 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-53.3
1990-3100	-51.3
3100-10600	-41.3
Above 10600	-51.3

(d) In addition to the radiated emission limits specified in the table

rule, and there must be a stronger public interest benefit in granting the waiver than in applying the rule. See, e.g., *WAIT Radio*, 418 F.2d at 1157 (stating that even though the overall objectives of a general rule have been adjudged to be in the public interest, it is possible that application of the rule to a specific case may not serve the public interest if an applicant's proposal does not undermine the public interest policy served by the rule); *Northeast Cellular*, 897 F.2d at 1166 (stating that in granting a waiver, an agency must explain why deviation from the general rule better serves the public interest than would strict adherence to the rule).

¹⁶ Almost all UWB devices are designed to operate in the range 3100-10600 MHz.

in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

The EIRP in dBm per 1 kilohertz of -85.3 per this table equates to -55.3 dBm/MHz. Based on studies in CEPT and in the ECC, the UWB limit in the GPS frequency ranges (depending on the use case regulated) is below -65 dBm/MHz. So, while Bosch did in fact propose generally that the United States UWB rules should be harmonized internationally, there is no proposal in the Bosch Petition to relax the radiated emission limits in the GPS bands. Even if Bosch had made such a proposal, the European radiated emission limit for UWB is *more stringent* in the GPS bands than are the current United States regulations.

5. Furthermore, with respect to spurious emissions, GPS receivers used in many applications (for example, within a smartphone) can be expected to have very close geographic proximity to mobile CMRS transmitters and Wi-Fi and other broadband emitters. Spurious emissions limits for those types of devices are more relaxed than is the requested UWB limitation. At page 10 of its Opposition, GPSIA claims, in the process of criticizing¹⁷ ETSI EN 303 883, *Short Range Devices (SRD) Using Ultra Wideband (UWB); Measurement Techniques*,

¹⁷ GPSIA accuses Bosch of deliberately failing to note that the ETSI EN 303 883 study is not now final. However, the Bosch Petition was transparent and candid with respect to UWB studies in Europe, which are ongoing and which offer a good deal of guidance in this proceeding going forward. For example, Footnote 22 of Bosch's Petition reads in relevant part as follows:

...the European Telecommunications Standards Institute (ETSI) and the industry evaluated the different kinds of possible UWB signals individually. If the measurement setup and equipment is chosen appropriately, UWB emissions could be measured correctly, such that all types of emissions can be compared with existing regulatory requirements (dBm/MHz mean or dBm/50MHz peak). The related ETSI measurement is identified as EN: 303 883. *ETSI is currently updating EN 303 883. Now, a new EN 303 883-1 is planned, which will focus on transmitter measurements only.* A specific UWB test setup will be specified to fulfill a correct result depending on the UWB signal characteristics and the averaging requirement limit in dBm/MHz averaged over 1 millisecond. (emphasis added)

that the “de facto transmitter limit” of – 30 dBm/MHz for frequencies 1000 MHz to 40000 MHz is a “real world co-channel interference threat to sensitive services with signals at or below the noise floor, including GNSS and GPS signals.” What GPSIA fails to note is that the UWB limit for spurious emissions is below the spurious emission limit for unlicensed devices. All that is specified in the current UWB rules (See Subpart F) is a limit on the desired emission within the occupied bandwidth of a UWB signal. The main point is that if there are other digital parts in a GPS or UWB device (such as the display, micro-controller, etc.), these components are developed based on EMC considerations which are at a higher level than the recommended unwanted emission limits (including spurious) between 1 GHz and 40 GHz of -30 dBm/1 MHz. The -30 dBm/1 MHz limit for unwanted emissions is the generic level for unlicensed transmitters in Europe and similar to the EMC requirement (CISPR 22). For emissions from mobile service devices, the spurious emission level is more relaxed (-27 or -23 dBm/MHz). So it is difficult for GPSIA to assert, as it has, that the -30 dBm/1 MHz level for unwanted emissions is inappropriate, since that limit is lower than the spurious limit applicable to the RF components which radiate from GPS-proximate or co-located digital devices.¹⁸ It can in any case be safely

¹⁸ This effect was noted as long ago as 2002 in studies conducted by the Commission’s Office of Science and Technology, where indoor and outdoor tests of ambient noise in GPS bands were conducted relative to UWB signals. Among other things, the Commission found:

The measurement results show that the GPS L1 and L2 frequency bands are quiet with respect to existing ambient emissions at those outdoor locations where tests were conducted. However, the data also reveals that in at least some locations, particularly indoor locations similar to those assumed in the derivation of the UWB emission limits, the ambient noise environment, rather than the GPS receiver thermal noise density, may actually be the limitation to the reception of the low-amplitude GPS signals.

These measurement results show that although many of the devices tested radiate emissions into the GPS frequency bands, the associated amplitudes were at much lower levels than permitted by the applicable limits. However, it was also determined that the amplitudes associated with these emissions were frequently in excess of the limits established for UWB emissions.

See, Measured Emissions Data For Use In Evaluating The Ultra-Wideband (UWB) Emissions Limits In The Frequency Bands Used By The Global Positioning System (GPS), Project TRB 02-02 Report October 22, 2002.

stated that spurious emissions from a UWB transmitter within the GPS bands will be substantially below -30 dBm/MHz. For this reason, ETSI measures a UWB device in two steps: (1) with all components and all emissions of the device active; and (2) if there is an emission over the UWB limit, the UWB transmission is turned off and all unwanted emissions can be viewed (i.e. there are no wanted or spurious UWB emissions present) and has to be subject, in theory, to the EMC emission rules (-30dBm/MHz over 1GHz) governing digital devices. To simplify the limits in the ETSI EN's for UWB, ETSI considered the spurious emission limits from ERC REC 74-01 instead of the CISPR 22 limits. The reason for this specification is that the spurious emission limits are specified down to 9 kilohertz (instead of 30 MHz for EMC) and in some sub-GHz frequency ranges, the limits are more stringent compared to the EMC limits. This procedure and the limits in the ETSI EN 303 883 are currently under revision.¹⁹

6. At page 13 of its Opposition, GPSIA asserts that the Bosch Petition includes an attempt “to relax or eliminate minimum transmission bandwidth requirements.” That assertion is inaccurate. Bosch, which was a participant in the Docket 98-153 proceeding, supported the Commission’s proposed minimum bandwidth requirement from the outset and supports the requirement that each UWB emission have a fractional bandwidth equal to or greater than 0.20 or a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth. The point missed completely by GPSIA is that it is necessary to modify the means by which the minimum bandwidth requirement is measured. As was clearly discussed extensively in the Bosch Petition, the current requirement (routinely waived by the Commission in response to waiver requests) that the minimum bandwidth be achieved “at any point in time” is unnecessarily

¹⁹ This two-step test is necessary because otherwise, it would be not possible to obtain a grant of equipment authorization for an UWB device because, over the complete range up to 10 GHz there will be radiated peaks from the electronic components which will be over the UWB limits, though the source of the emission/peak is not from the UWB transmitting circuitry. The most critical range for this consideration is below 2 GHz.

restrictive. The requirement, unless flexibly applied (which has not been the case to date), precludes the use of essentially all modulation schemes, except a continuous-wave signal of at least 500 MHz bandwidth. Pulsed emissions, frequency-hopped emissions, and swept frequency (*e.g.*, FMCW) systems are all precluded by this requirement because they do not “at all times during its transmission” have a bandwidth of the requisite magnitude. Bosch is not proposing any change in the minimum bandwidth of a UWB signal, but only a reasonable means of determining compliance with the definition in a way that makes sense and does not preclude vast numbers of applications using other than a continuous wave emission. There is no increase in interference potential to GPS or any other service as the result of the changes proposed to Section 15.503(d) of the current rules.²⁰

7. The remainder of the rules changes proposed are principally for the purpose of facilitating additional use cases for UWB going forward. It is unclear why GPSIA views these changes to be a reduction of technical interference protections; there are no such reductions proposed. Bosch has proposed revised definitions limiting, for example, “imaging systems” and “surveillance systems” so as to include radiolocation and communications systems using fixed infrastructure, and certain outdoor mobile and fixed applications such as motion sensors and perimeter protection systems. Permitted UWB applications should include ranging, tracking, and object classification. Significant improvements in home automation and energy efficiency are possible without any increase in interference potential at all.

8. In summary, Bosch would respond to GPSIA by saying that there is nothing in the Bosch Petition that would increase RF levels from individual devices or in the aggregate, in the

²⁰ If the rule changes requested in the Bosch Petition were enacted, the revised rules would allow a UWB device to switch off the modulation, and the emission could be zero. Currently, the rules require that, without any modulation, the UWB devices still must transmit signals with at least 500 MHz. Some products sidestep that requirement by inserting noise into the transmitted signal so as to achieve the minimum required bandwidth.

GPS bands, beyond that which is permitted now under the rules adopted seventeen years ago. There is no justification for the blanket opposition to revisiting the UWB rules registered by GPSIA. To urge the status quo going forward would (1) lead to continued inefficient spectrum management when the opposite is called for urgently now; and (2) to deprive consumers and American industry of new products and technologies using UWB emissions that have not been able to develop normally due to overregulation.

Therefore, the foregoing considered, Robert Bosch LLC respectfully again requests that the Commission review and modify the UWB rules under Part 15, Subpart F as set forth in the Bosch Petition for Rule Making and in the Appendix thereto, by means of a Notice of Proposed Rule Making issued at an early date.

Respectfully submitted,

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