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

FILED/ACCEPTED
APR 27 2012
Federal Communications Commission
Office of the Secretary

In the Matter of	)	
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Amendment of Part 15 of the Commission's Rules to Permit the Operation of Vehicular Radar Systems in the 77-81 GHz Band	)	**RM -** ______________

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APR 27 2012
Federal Communications Commission
Office of the Secretary

To: The Commission
Via: Office of the Secretary

PETITION FOR RULE MAKING

Robert Bosch, GmbH (Bosch), for itself and on behalf of the "79 GHz Project,"[1] by and through counsel and pursuant to Section 1.401of the Commission's Rules (47 C.F.R. §1.401), hereby respectfully requests that the Commission issue at an early date a *Notice of Proposed Rule Making* proposing to modify Section 15.253 of the Commission's rules (47 C.F.R. §15.253) in accordance with the proposed Appendix attached hereto. This would permit the operation of unlicensed, short-range vehicular radar systems (SRR) in the band 77-81 GHz (in addition to the bands 46.7-46.9 GHz and 76.0-77.0 GHz, which are presently available for such operation pursuant to that Rule Section). As good cause for this Petition, Bosch and the 79 GHz Project state as follows:

I. Introduction

1. Bosch is a multinational corporation which manufactures many different types of high-quality products for numerous industries, including vehicular radar systems and

[1] The "79 GHz Project" is a presently ongoing, international automotive 79 GHz frequency harmonization initiative and worldwide operating vehicular radar frequency standardization platform. *See*, www.79ghz.eu. This project, among other things, tracks the progress of allocation or authorization of the 77-81 GHz band in various countries relative to automotive radar systems. At the outset of the project, 79 GHz radar equipment was authorized in 27 countries that are CEPT and EC members; and in Singapore and Australia.

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other automotive components and systems.[2] Bosch is active in establishment of international standards for automotive radar systems, anti-collision systems, and automatic braking systems.[3] Bosch manufactures Long-Range automotive Radar (LRR) systems for vehicles in the 76-77 GHz range and SRR automotive radar systems to operate at 77-81 GHz. SRR automotive systems are now permitted in Europe and in many countries other than the United States. Bosch has a distinct interest in the effective performance of these advanced safety systems in motor vehicles in the United States and in their reliable performance, on which motor vehicle operators and passengers increasingly rely for their safety.

2. Bosch is the 79 GHz Project partner tasked with advocacy for authorization of the use of 77-81 GHz (typically referred to in the automotive industry, and referred to herein, as the "79 GHz" band) in the United States and Canada.[4]

3. There is presently a worldwide plan to consolidate automotive radars in the 76-81 GHz band.[5] CEPT and the European Commission have concluded that, aside from 24

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[2] Bosch is a leading global supplier of technology and services, including automotive and industrial technology, consumer goods, and building technology. Robert Bosch GmbH has more than 300 subsidiaries and regional companies in over 60 countries. Including sales and service partners, Bosch is represented in roughly 150 countries. It has a worldwide development, manufacturing, and sales network. Each year, Bosch spends more than 3.5 billion euros ($5.7 billion U.S.) for research and development. In North America, Bosch manufactures and markets automotive original equipment and aftermarket products, industrial drives and control technology, power tools, security and packaging technology, thermotechnology, household appliances, solar energy and healthcare products. Bosch employs nearly 24,000 associates in more than 70 locations throughout the U.S., Canada and Mexico.

[3] Among Bosch's automotive products is its Long Range Radar (LRR3), the world's first application of a silicon-germanium (SiGe)-based 77 GHz radar sensor. This device is a major step in bringing semiconductor-based radar technologies to the automotive mass market. In addition to being the key component for adaptive cruise control (ACC), LRR3 enables advanced safety functions such as predictive collision warning (PCW), emergency braking assist (EBA) and automatic emergency braking (AEB). These and other SRR technologies vastly enhance the safety features of modern automotive electronics and are obviously in the public interest, as is demonstrated herein.

[4] Other project partners include Autocruise s.a.s. (a TRW company), ERTICO – ITS Europe, Continental (ADC Automotive Distance Control Systems GmbH), and Renault s.a.s. Associate Members include Autoliv, BMW, Centro Recerche Fiat, Daimler AG, Delphi, Infineon, Peugeot Citroen, ST Microelectronics, UMS, Valeo, and Volkswagen AG.

GHz automotive radars, the 79 GHz band should be the long-term, globally harmonized frequency band for all automotive radar applications. Long-range automotive radars now operate in the United States at 76-77 GHz pursuant to Section 15.253 of the Commission's Rules. However, that 1 GHz-wide band is used only for medium and long-range radars (i.e. vehicle and infrastructure radar systems). Sharing studies conducted by the automotive industry have concluded that frequency sharing between SRR systems and LRR automotive radars is not possible. It is firmly settled that the 79 GHz frequency range should be considered as the most suitable band for SRR worldwide.[6] Indeed, the Commission has repeatedly acknowledged this.[7]

4. Automotive collision-warning SRRs operating in the 79 GHz band are vehicle environmental sensing systems. These units require a typical operating range of up to 150 meters[8] and are used for a number of applications to enhance the active and passive safety for all kinds of road users. Applications that enhance passive safety include

[5] The 77-81 GHz band was designated by the European Conference of Postal and Telecommunications Administrations (CEPT) as early as July 2004 for automotive radar. The European Commission has adopted the decision 2004/545/EC on the harmonization of radio spectrum in the 79 GHz range for the use of automotive radar. The harmonized standard EN 302 264 has been adopted by ETSI for short-range radar (SRR) operating in the 77-81 GHz band. In March of 2010, the Ministry of Internal Affairs and Communications (MIC) in Japan has started a study group in the info-Communications Council for the introduction of high-resolution radar in the 77-81 GHz frequency band. In October of 2010, the State Radio Frequency Committee of Russia allocated the 77-81 GHz band for automotive radar.

[6] Sharing with the Radioastronomy Service has been studied in Europe and in the United States, as is extensively discussed hereinbelow. The European studies concluded (and the United States studies have confirmed – see *infra*) that regulatory measures can be developed enabling coexistence between SRRs in the frequency band 77-81 GHz and the Radioastronomy Service.

[7] For example, in Docket 03-102, resolved in 2004, the Commission adopted domestically the RAS and space research service allocations in the 77-81 GHz band. The Commission refused to withhold the domestic implementation of the RAS and space research allocations due to possible future use by vehicular radar systems, but it did "recognize that there [was] a great deal of ongoing international discussion about the current and future spectrum needs of SRR systems" in that band. The Commission at the time denied a request filed by Delphi Corporation to initiate a proceeding to establish rules to allow vehicular radar operations in the 77-81 GHz segment. *However, the Commission invited proposals in the future for such use*. The Commission said that "entities may file petitions for rule making requesting the Commission to take such action. Such petitions should include specific proposals for technical and other rules."

[8] According to ECC ERC/REC 70-03 Annex 5, *Road Transport and Telematics (RTTT)* the maximum peak power density shall be – 3 dBm/MHz EIRP associated with a peak limit of 55 dBm EIRP. The maximum mean power density outside of a vehicle resulting from the operation of one short range radar shall not exceed – 9 dBm/MHz EIRP.

obstacle avoidance, collision warning, lane departure warning, lane change aids, blind spot detection, parking aids and airbag arming. SRR applications which enhance active safety include "stop and follow," "stop and go," autonomous braking, firing of restraint systems and pedestrian protection. The combination of these functions is also referred to as a "safety belt" for cars.

5. By contrast, the frequency band 76-77 GHz, already designated for vehicular and infrastructure radar systems in the United States pursuant to Rule Section 15.233, and in Europe pursuant to ECC Decision ECC/DEC/(02)01 on Road Transport and Traffic Telematic (RTTT) systems, is used for such applications as Adaptive Cruise Control (ACC) systems, with a maximum bandwidth of 1 GHz. One or multiple narrow lobes control or scan the driving path in front of the car to determine the distance to the vehicle driving ahead for maintaining a constant minimum safety distance. RF radiated power (EIRP) of these systems is limited to 55 dBm peak and 50 dBm average power or 23.5 dBm average power for pulsed radars. Sharing studies conducted by the automotive industry have concluded that sharing is *not* achievable between high-resolution SRR and LRR systems, due to foreseeable saturating interference from LRRs into SRRs (but not vice-versa). Therefore, a common band between the two systems is not feasible. The SRRs would be jammed due to the lack of spatial separation. Therefore a separate frequency band for SRR systems in the frequency range 77-81 GHz was determined to be necessary.

6. Bosch notified the Commission's Office of Engineering and Technology beginning approximately two years ago at a series of meetings dealing with the 79 GHz band that it intended to submit in the near term a Petition for Rule Making proposing the

modification of Section 15.253 of the Commission's rules to permit the operation of automotive SRRs in the 77-81 GHz band (in addition to the present 76-77 GHz band now permitted by that rule Section). This is the petition referred to in those meetings. Bosch and other members of the 79 GHz Project have reached out to the Radioastronomy community and the Amateur Radio Service in order to determine and to insure compatibility between those radiocommunication services and the addition of unlicensed SRR systems at 79 GHz. This Petition assumes, and Bosch and the 79 GHz Project commit to the continuation of cooperative interference-avoidance efforts to insure spectrum compatibility with incumbent radiocommunication services as the 77-81 GHz band becomes available for unlicensed SRR systems. Bosch and the 79 GHz Project are committed to establishing private-sector interference avoidance protocols and plans in order to insure compatible sharing. The basis for this assurance is set forth below.

7. There is presently a shortage of available spectrum for vehicular radars in the United States. Making additional spectrum in the 79 GHz frequency range would have no significant impact on incumbent radio services with allocations at 77-81 GHz, including the Amateur Radio Service; any non-vehicular Radiolocation uses; or passive Radioastronomy applications. Bosch does not propose herein a domestic spectrum *allocation* for vehicular radar devices. Rather, the instant Petition proposes only the modification of Section 15.253 of the Commission's rules to permit the operation of vehicular radars to operate at 77-81 GHz on the same basis that vehicular radars are now operated in the United States at 76-77 GHz: on a non-allocated basis, premised on non-interference to licensed services, and on the acceptance of interference from allocated

services in the band.[9] Since in any case the 79 GHz band is allocated in the United States on a primary basis to Radiolocation and Radioastronomy, a modification to the U.S. domestic table of frequency allocations (47 C.F.R. § 2.106) in order to permit operation of vehicular radars (a radiolocation function) at 77-81 GHz is unnecessary.[10] Only the single Part 15 rule requires modification in order to permit this expanded use. This Petition does not propose any change to the primary Amateur Service allocation at 77.5-78 GHz or to the secondary Amateur Service allocation at 78-81 GHz. Bosch and the 79 GHz Project do, however, suggest that the Commission consider the addition (actually the reinstatement) of a separate, additional domestic allocation to the Amateur Service at 75.5-76 GHz. This would permit international harmonization of Amateur operation in that segment with ongoing Amateur uses by European radio Amateurs and an accommodation for those Amateur operators whose experimental operations could be subject to limitations on occasional instances from aggregate vehicular radars in the 77.5-81 GHz band in some areas. Such harmonization would insure a wider availability of

[9] The Commission's Office of Engineering and Technology staff has asked during meetings on this subject why the automotive industry would propose an unlicensed, Part 15 paradigm for SRR systems, which are safety systems and which presumably require interference protection in order to function reliably at all times. There are several reasons for this, though there would not be opposition from Bosch or the Project to a Part 95-type "license by rule" regulatory framework for 79 GHz SRRs. First, the Commission has already created, via Section 15.253 of the Rules, a Part 15 regulatory scheme for LRRs at 76-77 GHz, which has worked well for the past 10 or more years, without interference reported. Second, as among automotive manufacturers, there are standards that are voluntarily adhered to which permit maximum interference-free spectrum sharing and frequency re-use. This is necessary since automobiles of various manufacture share roadways in close proximity to each other. Third, the 79 GHz band permits an exceptionally high level of frequency re-use for these extremely short-range devices at the very low power levels involved, and the systems are configured with the main beam of the SRRs in a generally downward direction. Interaction with other active or passive services that are spectrum-sharing partners is highly unlikely. Finally, unlicensed operation of SRRs is a practical method of authorizing the devices, given their low power, the high degree of frequency re-use due to high free-space attenuation, and the fact that the devices operate in very large numbers of privately owned motor vehicles, and their deployment is mobile, itinerant and ubiquitous.

[10] However, the 77.5-78 GHz segment is allocated on a primary basis to the Amateur Service. This is discussed below at, *inter alia,* paragraphs 10 and 17.

equipment for United States radio Amateurs and it would facilitate international communications experimentation via Amateur Radio.

II. Automotive Radar Systems Save Lives, Prevent Automobile Collisions and Reduce Injuries and Damage from Collisions That Do Occur

8. The value of automotive radar systems to the public as safety-of-life devices is beyond question, and the statistics supporting that are highly compelling. The Commission stated in 2002, when first permitting short-range vehicular radars at 24 GHz that it expected "vehicular radar to become as essential to passenger safety as air bags for motor vehicles..."[11] This prediction has largely been validated since that time. The National Telecommunications and Information Administration (NTIA) expressed its commitment to "work with the Commission to ensure that an adequate frequency allocation in the 77-81 GHz band is available for the operation of vehicular radar systems."[12] Automotive radar systems have been proven to substantially reduce injuries and death due to automobile collisions.[13] The National Highway Traffic Safety Administration (NHTSA) determined that the number one cause of death in persons aged

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[11] *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, First Report and Order, ET Docket 98-153, released April 22, 2002, at ¶ 18.

[12] *See,* the Comments of NTIA in ET Docket No. 98-153, at 22-23 (filed January 15, 2004).

[13] Various studies on the safety benefit of automotive safety systems have been published. At the 21st International Technical Conference on the Enhanced Safety of Vehicles, Stuttgart, held in June of 2009 (www.esv2009.com), the following studies were presented:

(A) Daimler provided a study that showed that with its Brake Assist Plus (collision warning and partial braking) it is possible to prevent 53% of all rear-end collisions that otherwise cause injuries. To support this figure, a comparison of repair parts statistics of cars with and without radar-based functions was made. It could be clearly determined that at speed between 14 and 50 km/h could be reduced by 22%. It was also shown that the impact speed of collisions was reduced (e.g. impact speed between 14 and 45 km/h by 38%). In sum, crashes could be avoided or at least the impact speed can be reduced significantly.

(B) The Swedish Road Administration (SRA) published a study that reduction of collision impact speed by 10% would reduce the risk of fatalities by 30%.

(C) The German Insurers Accident Research (UDV) stated that autonomous partial braking could avoid 12% of all accidents. Systems with autonomous emergency (full) braking could avoid 40% of all kinds of collisions.

4 to 34[14] during 2005 were multiple vehicle traffic crashes.[15] According to a Honda study in 2005, the use of its collision mitigation braking systems reduces the number of rear-end collisions by 38% and the number of fatal rear-end collisions by 44%. Bosch completed a 2009 study which concluded that emergency braking assist technology will reduce personal-injury rear-end collisions by 39%; and that automatic emergency braking will reduce personal-injury rear-end collisions by 74%. The Insurance Institute of Highway Safety completed a 2010 study of the effects of forward collision warning radar systems on passenger car collisions. The study found that 20 percent (i.e. 1.2 *million*) of passenger car collisions can be avoided by the use of forward collision radars; 9% (i.e. 66,000) of accidents with injuries can be prevented by such use; and 3% (i.e. 879) of fatal accidents can be prevented by such use. Daimler made a presentation to the World Automotive Congress in September of 2008, reporting on a study of 66,000 real accidents, using the German In-Depth Accident Study database. The study was limited to analysis of rear-end collisions. The study concluded that 20 percent of all rear end crashes could have been avoided if the cars had been equipped with short-range radar-based intelligent brake assistance. Even in cases when the crash was unavoidable the reduction of crash energy was significant and the severity of the crash consequences would have been mitigated in 25 percent of the accidents.[16]

9. However, to date, the availability of these life-saving and injury-preventing technologies has been limited in the United States to equipment integrated into more

[14] The age groups in this study between ages 4 and 34 included young children (4-7), children (8-15), teens (16-20), young adults (21-24) and other adults (25-34).
[15] *See* National Highway Traffic Safety Administration, "Evaluation of an Automotive Rear-End Collision Avoidance System, DOT HS 810 569 (March 2006) *available at:* http://www.nhtsa.gov/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/2006/HS910569.pdf.
[16] See also Schittenhelm, Dr. Helmut., *Design of Effective Collision Mitigation Systems and Prediction of Their Statistical Efficiency to Avoid or Mitigate Real World Accidents* (Daimler AG), 14 September 2008.

high-end passenger vehicles due to the absence of an internationally harmonized standard for SRRs.[17] Worldwide regulatory authorization would be beneficial in terms of efficient use of spectrum as well as in the economies of scale that would encourage substantial rollout of SRR technology. It would allow deployment of SRRs in a *much* wider range of passenger vehicles cost-effectively, thus making the extensive safety features of SRRs available to the widest number of motorists and passengers in motor vehicles. Therefore, it is necessary to make available the 79 GHz band in the United States for SRRs at the earliest possible time.

10. A very important step in this worldwide harmonization process has just been accomplished. At WRC-2012, Resolution 654 (a copy of which is attached hereto as ***Exhibit A***), which proposes the allocation of the band 77.5-78 GHz to the radiolocation service to support automotive short-range high-resolution radar operations, was unanimously adopted. This Resolution, at WRC-15, is expected to lead to an international allocation in all three ITU regions which would allow the operation worldwide of automotive SRRs at 79 GHz. Because of the very short-range nature of SRRs in the 77-81 GHz band; the low probability of interference to incumbent radiocommunication services; the exceptionally high frequency re-use capabilities of this frequency range (for reasons including high free-space and foliage/obstacle attenuation); and the well-established desirability of expanded use of SRR technology in motor vehicles in the United States, it is unnecessary and undesirable to await the outcome of WRC-15 in order to permit this critically important safety use via Part 15 rule changes in the United States.

[17] However, *see* ITU-R Preliminary Draft Revised Recommendation ITU-R M.1452-1 (Question ITU-R 205-4/5) Regarding Millimeter-Wave Automotive Radars and Radiocommunication Systems for Intelligent Transport System Applications. This recommendation provides system requirements, technical and operational characteristics of millimeter-wave ITS applications, including automotive radars at 76-77 GHz and 77-81 GHz. (See especially Annex 2 thereto).

As discussed above, an allocation is not necessary domestically in order to permit now the benefits of these technologies.

III. Allocation of the 79 GHz Band

11. The band 76-81 GHz was subject to substantial reallocation in the United States domestically as the result of, and following, actions taken at the 2000 World Radiocommunication Conference (WRC-2000) in Istanbul. The Commission, in ET Docket 03-102 conformed the domestic table of frequency allocations (47 C.F.R. § 2.106) in the band 76-81 GHz and above 95 GHz to the international table as amended at WRC-2000. That U.S. proceeding was initiated in 2003, and was resolved in a *Report and Order*, 19 FCC Rcd. 3212 (2004) released in February of 2004. Because the domestic allocation table reflects actions taken at WRC-2000; because the Commission's domestic allocation decisions pursuant thereto are of relatively recent vintage; and because the Commission initiated that proceeding at the request of NTIA [which recommended changes to the frequency bands above 71 GHz based on coordination with NTIA's Interdepartment Radio Advisory Committee (IRAC)], it is neither necessary nor timely to impose changes in the domestic table in this frequency range at the present time. However, the Commission did, looking ahead in 2004, specifically reserve the opportunity in this band for vehicular radars in the United States.

12. WRC-2000 realigned the 76-81 GHz band (and frequency bands above 95 GHz) on a primary basis variously for the amateur, amateur-satellite, Earth exploration satellite (EESS), fixed, fixed-satellite (FSS), inter-satellite (ISS), mobile, mobile-satellite (MSS), radio astronomy (RAS), radiolocation, radionavigation, radionavigation-satellite (RNSS), and space research (SRS) services. Additionally, WRC-2000 realigned these

bands on a secondary basis for amateur, amateur-satellite, RAS, radiolocation, and SRS. The primary intent of the WRC-2000 realignment of allocations in the 76-81 GHz band and bands above 95 GHz was to place scientific services, such as the EESS and RAS in spectrum better suited to their communication needs. Regarding the 76-77 GHz band, the Commission in Docket 03-102 adopted a primary RAS allocation and secondary SRS allocation to share the band with unlicensed vehicle radar systems in the United States. The Commission effectively deleted the amateur radio allocation in this segment to avoid potential interference to all new users of the band, with the recognition that there were other allocations above 77 GHz for the Amateur Service.

13. In a separate proceeding initiated prior to Docket 03-102, the Commission realigned the allocations in certain other bands above 71 GHz in accordance with the international reallocations of these bands. In a *Report and Order* in WT Docket No. 02-146, decided in October of 2003, the Commission reallocated the 71-76 GHz and 81-86 GHz bands (among others) in accordance with the *Final Acts of WRC 1992* and most of the international reallocations in the *Final Acts of WRC-2000*. These bands are now allocated on a primary basis variously for the fixed, mobile, fixed-satellite, and mobile-satellite, broadcasting, broadcast satellite, radiolocation, and radio astronomy services. In addition, portions of these bands are allocated on a secondary basis for space research and radio astronomy. The Commission in that Docket also adopted service rules to allow a broad range of licensed fixed and mobile services and unlicensed devices to operate in the 71-76 GHz and 81-86 GHz bands.

14. Prior to 2004, the 76-77.5 GHz and the 78-81 GHz bands were allocated to the radiolocation service on a primary basis, and to the amateur service on a secondary basis,

except that the amateur allocation was (and now still is) primary in the 77.5-78 GHz portion. The 77-81 GHz band was allocated to the amateur-satellite service on a secondary basis, except that in the 77.5-78 GHz portion, the amateur-satellite service had (and now still has) primary status. The 76-77 GHz band was (and currently is) also used by vehicular radar systems on an unlicensed basis under Section 15.253 of the Commission's Rules.

15. In Docket 03-102, the Commission had proposed to implement a new allocation to the RAS on a primary basis in the 76-77.5 GHz and 78-81 GHz band segments and on a secondary basis in the 77.5-78 GHz band segment. Additionally, it proposed new secondary allocations for the SRS (downlink) throughout the 76-81 GHz band and for the amateur-satellite service in the 76-77.5 GHz segment. Automotive interests argued that 77-81 GHz should not be allocated to the SRS until further compatibility studies were conducted, because the 77-81 GHz band was identified by the European Conference of Postal and Telecommunications Administrations (CEPT) as a "possible future home" for SRR operations that will be forced to relocate from the 24 GHz range before 2014.[18] The automotive industry was concerned about sharing of the 77-81 GHz band between SRRs and other services that the Commission was proposing in Docket 03-102 and specifically asked that the Commission authorize the use of 77-81 GHz for SRR operations. Delphi requested at that time that the Commission initiate a proceeding to consider granting vehicular radars access to the 77-81 GHz band per the Part 15 unlicensed devices rules. The Commission, however, found it necessary at the time only to implement the allocation changes from WRC-2000 in order to provide EESS and RAS operations with the flexibility to operate in spectrum suited to their needs, and

[18] The migration from 24 GHz to 79 GHz for SRRs is now anticipated to be completed by around 2022.

to make domestic allocations consistent with the International Table of Allocations. *The Commission concluded that, as a practical matter, sharing conflicts are "highly unlikely" in any portion of these bands*. However, it also found that the vehicular radar advocates raised valid spectrum concerns. Most of the RAS and EESS (passive) allocations below 174.8 GHz are co-primary with other active radio services. Licensed services have to share with the passive services and protect them in many cases. RAS millimeter wave receivers are, however, few in number and are usually located on high mountains in order to escape atmospheric absorption of incoming signals from space. Such receivers are in rural areas, not the urban areas where the Commission anticipated that most use of these bands by Commission-regulated users would occur. They are also typically protected (or could be protected) from nearby roadways by natural and man-made barriers.

16. At 76-77 GHz, the Commission held that vehicular radar operations *could* share with RAS and SRS. Section 15.253 of the Rules limits radiated emissions from vehicular radar systems operating in the 76-77 GHz band, depending on the mode of operation, at a distance of 3 meters from the exterior surface of the radiating structure, which reduces the likelihood that they will cause interference. Also, the Commission noted, RAS observatories are few, and are sited and designed to be protected from sources of interference. Therefore, and with that understanding, the Commission allocated the 76-77 GHz band to the RAS on a primary basis. Similarly, the Commission said that SRS users could site earth stations (or use shielding) so as to protect their operations from vehicular radar operations. Finally, the Commission found that SRS downlinks would not likely interfere with vehicular radar operations or endanger the user

of vehicular radar devices. Therefore, it allocated the 76-77 GHz band to the SRS on a secondary basis. Since that time, *Bosch and the 79 GHz Project are unaware of a single instance of interference in the 76-77 GHz band.* As is more fully discussed below, it is anticipated that there will be no more interaction between SRRs and SRS or RAS passive systems at 79 GHz than there has been at 76-77 GHz.

17. The Commission did, however, note potential interference conflicts at 76-77 GHz between the amateur-satellite service and vehicular radar systems. Amateur-satellite service stations are operated by individuals who could deploy their earth stations anywhere, and amateurs are permitted great flexibility in the type of antennas and the effective radiated power they use to transmit. So, the Commission reasoned, an amateur earth station could either receive interference to its operations or cause interference to a passing vehicular radar device on an unpredictable basis. Therefore, the Commission did not implement its proposed secondary amateur-satellite allocation for the 76-77 GHz band. It did retain the existing secondary amateur service allocation but continued a 1988 "suspension" of amateur operation until technical sharing criteria could be developed to address potential sharing problems in this band. Not allowing amateur operations in the 76-77 GHz band was not a significant burden, FCC concluded, because amateurs were then and now are permitted to operate in the adjacent 77-81 GHz band. Subsequently, the amateur service was excluded from the 76-77 GHz band, and as well from the 75.5-76 GHz band, but was given a primary allocation at 77.5–78 GHz.

18. Regarding the 77-81 GHz segment, the Commission ultimately in Docket 03-102 adopted domestically the RAS and SRS allocations set forth in the table below. The Commission found that it would not be proper to withhold the domestic implementation

of the RAS and SRS allocations due to some "possible future use" by vehicular radar systems, although it "recognize(d) that there [was] a great deal of ongoing international discussion about the current and future spectrum needs of SRR systems." The Commission denied Delphi's request to initiate a proceeding to establish rules to allow vehicular radar operations in the 77-81 GHz segment. However, the Commission said that "entities may file petitions for rule making requesting the Commission to take such action. Such petitions should include specific proposals for technical and other rules." So, the door was left very much open for the instant Petition.

19. The current status of allocations in the band 77-81 GHz and in the bands above and below it is as follows:

71-84 GHz (EHF)					1
International Table			United States Table		FCC Rule Part(s)
Region 1	Region 2	Region 3	Federal Government	Non-Federal Government	
71-74 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth)			71-74 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth) US389		Fixed Microwave (101)
74-76 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING-SATELLITE Space research (space-to-Earth) 5.559A 5.561			74-76 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE Space research (space-to-Earth) US387 US389	74-76 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING- SATELLITE Space research (space-to-Earth) US387 US389	
76-77.5 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149			76-77 RADIO ASTRONOMY RADIOLOCATION Space research (space-to-Earth) US342	76-77 RADIO ASTRONOMY RADIOLOCATION Amateur Space research (space-to-Earth) US342	RF Devices (15) Amateur (97)

	77-77.5 RADIO ASTRONOMY RADIOLOCATION Space research (space-to-Earth) US342	77-77.5 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) US342	RF Devices (15) Amateur (97)
77.5-78 AMATEUR AMATEUR-SATELLITE Radio astronomy Space research (space-to-Earth) 5.149	77.5-78 Radio astronomy Space research (space-to-Earth) US342	77.5-78 AMATEUR AMATEUR-SATELLITE Radio astronomy Space research (space-to-Earth) US342	Amateur (97)
78-79 RADIOLOCATION Amateur Amateur-satellite Radio astronomy Space research (space-to-Earth) 5.149 5.560	78-79 RADIO ASTRONOMY RADIOLOCATION Space research (space-to-Earth) 5.560 US342	78-79 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.560 US342	
79-81 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	79-81 RADIO ASTRONOMY RADIOLOCATION Space research (space-to-Earth) US342	79-81 RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) US342	
81-84 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) 5.149 5.561A	81-84 FIXED FIXED-SATELLITE (Earth-to-space) US297 MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) US342 US388 US389		Fixed Microwave (101)

IV. Sharing Status of the 79 GHz Band and Proposed Uses

20. Since Docket 03-102, decided in 2004, there have been no domestic rulemaking proceedings initiated seeking to permit vehicular radars (SRRs) in the 77-81 GHz band. There are, however, current proceedings before the Commission dealing with other radiolocation applications within 77-81 GHz and one pertaining to Section 15.253 of the Commission's rules. None would necessarily preclude nor inhibit SRR operation at 77-81 GHz. Nor would SRR operation at 79 GHz inhibit or create any necessary

incompatibility with incumbent services or any proposed radiolocation application.

21. In 2010, at the request of certain petitioners, the Commission commenced a docket proceeding[19] proposing technical rules for the operation of unlicensed level probing radars (LPR) in several frequency bands. LPR devices are low-power radars that measure the level (relative height) of various substances in man-made or natural containments. In open-air environments, LPR devices can be used to measure levels of industrial materials such as coal piles or water basin levels. An LPR device also may be installed inside an enclosure, *e.g.*, a tank made of materials such as steel or fiberglass and commonly referred to as a tank level probing radar (TLPR). In the *Notice of Proposed Rule Making and Order* (*Notice and Order*) in the Docket 10-24 proceeding, the Commission proposed rules applicable to TLPR devices for operation in the 77-81 GHz band inside steel and concrete tanks. Subsequently, and very recently, with the intention to expand the uses of LPR devices, the Commission has now proposed to permit outdoor use of LPRs in the 79 GHz band as well as on additional frequencies under existing Part 15 rules for unlicensed devices.[20] To address the apparent need for a comprehensive and consistent approach to LPR devices, the Commission proposed rules that would apply to the operation of LPR devices installed in both open-air environments and TLPRs inside storage tanks in, among other frequency bands, 75-85 GHz.

22. LPR devices are typically installed at fixed industrial sites, such as quarries, paper mills, ore refineries or at facilities adjacent to bodies of water, such as dams, storm water lift stations, and sewage treatment plants, all of which are generally well away from

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[19] See, *Amendment of Part 15 of the Commission's Rules To Establish Regulations for Tank Level Probing Radars in the Frequency Band 77-81 GHz, Notice of Proposed Rulemaking and Order* (*Notice and Order*), ET Docket Nos. 10-23, 06-216 and 07-96, 25 FCC Rcd. 601 (2010).
[20] *See*, the *Further Notice of Proposed Rule Making*, ET Docket 10-23, FCC 12-34, released March 27, 2012.

public roadways. The Commission proposed requiring LPR devices to utilize narrow beamwidth transmit antennas focused in a downward orientation. This operational restriction and the relatively low power levels proposed will minimize the likelihood of interference to SRRs, even in those few instances in which roadways are in close proximity to a fixed LPR system. There is a high level of free space path loss (FSPL) at this frequency range. FSPL is calculated according to the formula:

FSPL = 20 log F(GHz) + 20 log D(m) + 32.5, with frequency F in GHz and distance D in meters. The wavelength of an LPR device operating at 75 GHz is 4 millimeters, and the free space path loss at this frequency is approximately 79.5 dB at a distance of 3 meters (*i.e.*, 750 wavelengths away) from the transmitter. Given this free space attenuation, it is anticipated that there will not be any interaction between LPRs or TLPRs and SRRs at 79 GHz.

23. The Commission has also a currently open Docket proceeding [21] proposing to permit the use of foreign object detection (FOD) radar equipment in the 78-81 GHz band at airports in the United States on a licensed (Part 90) basis. In that proceeding, the Commission sought comment on the potential for interference from 78-81 GHz band radiolocation systems to other services in the 78-81 GHz band. The *Notice of Proposed Rule Making and Order* in that proceeding asserted that these FOD radars will improve airport safety and minimize possible instances of collision of aircraft on airport runways with objects on the runway. Bosch submitted comments in that proceeding interposing no objection to the Notice proposal *per se*, but urging the Commission to take no action in that proceeding which would hinder or preclude the rollout of SRRs in the 77-81 GHz

[21] See, *Amendment of the Commission's Rules to Permit Radiolocation Operations in the 78-81 GHz Band, and Request by the Trex Enterprises Corporation for Waiver of Section 90.103(b) of the Commission's Rules*, WT Docket No. 11-202, *Notice of Proposed Rule Making and Order*, 77 FR 1661 (Jan 11, 2012).

band. Bosch urged that *unlicensed* operation of FOD radars at airports should not be permitted for several reasons, and that the Commission should not resolve the FOD Docket proceeding without the benefit of technical showings, cooperatively prepared by the stakeholders in this proceeding, as to the electromagnetic compatibility between mobile FOD radar systems at airports, automotive SRR radars at 77-81 GHz, Radioastronomy (RAS), and the Amateur Service. While it is anticipated that FOD radars can be operated without any necessary interaction with SRRs, the Docket 11-202 *Notice of Proposed Rule Making and Order* noted that there are currently no specific power limits, bandwidth limitations, or frequency stability requirements for radiolocation operations in the 78-81 GHz band. At Paragraph 7 of the *Notice of Proposed Rule Making and Order*, the Commission expressed concern that limiting use of the 78-81 GHz band to use by FOD radars solely on a licensed basis could inhibit or preclude future opportunities for additional systems with safety-related applications to use the band. Specifically, the Commission notes the operation of SRRs in Europe [citing ECC/DEC/(04)03] and cited the firm commitment of NTIA to "work with the Commission to ensure that an adequate frequency allocation in the 77-81 GHz band is available for the operation of vehicular radar systems."[22] The Commission noted that SRR is likely to be authorized on an unlicensed basis, as is the case with other automotive radars operating at 76-77 GHz.

24. SRRs in the 79 GHz band radiate in multiple directions from a motor vehicle and require a certain (albeit low) degree of interference protection in order to function adequately. If FOD radars at airports utilize directional antennas, aimed in a generally downward direction toward an airport runway, that configuration, despite the mounting

[22] *Op. Cit.*, Comments of NTIA in ET Docket No. 98-153, at 22-23 (filed January 15, 2004).

of the radar on a motorized vehicle moving the FOD radar back and forth along airport runways will likely minimize interference on public roadways adjacent to airports. The operating and installation configuration of the radar, coupled with the limited propagation characteristics of the 77-81 GHz band, could provide sufficient protection for SRR operation in the 78-81 GHz band. Bosch suggested therefore that it is possible that FOD radars, depending on the operating parameters contained in the Part 90 rules, could avoid interaction with SRR-equipped motor vehicles on roadways near airports (and without adverse interaction with the few millimeter-wave radioastronomy observatories in the United States). Such compatibility, however, is determined by siting of FOD radars in each case.

25. Bosch urged that FOD radars be operated only on a licensed basis. This is necessary because the Part 15 rules do not typically address siting issues. Nor do they include restrictions on installation configurations. Instead, (with but very few exceptions) they simply limit field strength or the characteristics of the device itself, not where and how the device is to be used *in situ*. Regulation of siting of an RF device (and the enforcement of that regulation) is more appropriately addressed through a licensing process. The interference potential of FOD radars may depend on the location of the radar on a mounted vehicle on the airport property near a runway. An appropriate licensing condition for the FOD radar might be that the radar must be mounted and utilized so that when in use it does not, within the main beamwidth of the antenna (azimuth or elevation), illuminate a public roadway near the airport.

26. FOD radars must be licensed for another reason. There is no effective way to address interference after-the-fact or to incorporate eligibility or use restrictions on

operation of unlicensed FOD radars. The Commission lacks the resources to effectively enforce Part 15 rules in most cases, so the interference must be addressed *ex ante*.[23] Without licensing, the ability of the Commission to address interference problems on a case-by-case basis is lacking. FOD radars at specific airports are indeed safety systems, and licensing FOD provides necessary interference protection for the specific locations of their operation.

27. The Federal Aviation Administration (FAA) supported the authorization of FOD radars, but *only* on a licensed basis. It stated that "[a] practical measure would be demonstrated assurance that FOD radars and other systems (licensed or non-licensed) can operate compatibly in the same spectrum." Specifically with respect to the compatibility between FOD radars and automotive radars in the 78-81 GHz band, FAA stated: [24]

> A question was raised about FOD radars if they share the spectrum with vehicular collision avoidance radars, which now operate on a non-licensed, non-interference basis (NIB). Specifically, what would be the FAA's position if vehicular radars were elevated to primary status? Automotive radars on an NIB potentially present operational challenges and regulatory problems if interference to either system occurs. Neither safety service (assuming that vehicular radars are considered safety systems) shall accept interference; hence, primary status becomes a challenge. Regulatory status alone does not assure compatibility. Compatibility will have to be designed into both systems.

Bosch agrees with FAA's assessment. On the one hand, it would be anomalous in Commission jurisprudence to suggest that a licensed mobile radio service operating in

[23] Unspecified, unlicensed FOD or other fixed radar siting would completely preclude automotive radars at 77-81 GHz. This is because it would be impossible to coordinate any automotive radar operation with radiolocation facilities without limiting geographic deployment and other parameters. Automotive manufacturers and automotive radar manufacturers work closely together as a matter of necessity to coordinate standards for operation of SRRs so that motor vehicles of different manufacture can utilize SRR technology without interference, even in close traffic conditions. Such coordination could not be duplicated with respect to FOD radar operations if unspecified radiolocation systems were permitted to operate generally in the 77-81 GHz band.

[24] FAA Spectrum Engineering Services Letter to NTIA Office of Spectrum Management dated October 13, 2011 (emphasis in original).

accordance with a primary allocation in the Table of Allocations should be subject to rules in Part 90 to limit in the licensing process the interference potential to Part 15 unlicensed vehicular radars. However, the ongoing worldwide harmonization of automotive radar use of the 76-81 GHz band is well-known, and the Commission has specifically asked in the *Notice of Proposed Rule Making and Order* in the FOD radar proceeding what the preclusive effect would be of authorizing Part 90 operation by FOD radars. If the rules governing FOD radars are not carefully designed and installed, then as FAA noted in its comments in that Docket, there could be a very significant preclusive effect on automotive SRRs, and therefore a very significant adverse effect on vehicular safety.

28. Bosch is of the view that there can be sufficient compatibility among RAS, automotive SRRs, Amateur Radio and FOD radars in this band, but FOD radars should not be authorized without compatibility studies and the ascertainment and specification of operational and technical parameters based on those compatibility studies.

V. Compatibility with the Radio Astronomy Service (RAS)

29. There are now, and there have been ongoing cooperative efforts initiated by Bosch and other 79 GHz Project members to ascertain the interference potential as between automotive SRRs and millimeter-wave Radioastronomy facilities. Bosch representatives have met numerous times with National Science Foundation (NSF) staff, with the Committee on Radio Frequencies (CORF), and with other radioastronomy representatives to evaluate the interference potential. During 2011, tests were done at the Kitt Peak Radioastronomy Observatory in Tucson, Arizona, using samples that were provided by two industry members (Bosch and Continental) of SRR devices operating in

Other comments filed in that docket proceeding note that there is over a decade of experience with SRR technology in Europe, where radioastronomy observatories are located much closer to urban centers than they are in the United States, and there have been no substantiated claims of harmful interference arising from vehicular radar in the 76-77 GHz band.

31. There are numerous reasons for this level of compatibility. Some, such as the high degree of free space attenuation, and the generally downward-looking antenna orientation of SRRs have been mentioned hereinabove. However, there are other reasons why the probability of interference to RAS observatories is very low. First of all, there are relatively few (i.e. fewer than ten) millimeter-wave radioastronomy observatories in the United States. Second, those few millimeter-wave observatories that do exist domestically are, as the Commission has noted several times, "usually located on high mountains in rural areas where access to RAS telescopes is controlled at distances of at least one kilometer."[27] The Radioastronomy community has disputed the Commission's finding in this respect, however, claiming that high fences would be required in order to attenuate the aggregate noise of numerous vehicles located at distances even several kilometers from a radio telescope. Bosch suggests that a realistic separation distance necessary to predictably minimize the probability of interference to millimeter-wave radio telescopes is actually very low. The attached Kitt Peak study results are "worst-case" results inasmuch as the test did not take into account substantial attenuation of the radar signal by trees, other vehicles, guard rails, buildings, diffraction losses, and ground

[27] See, *Amendment of Part 2 of the Commission's Rules to Realign the 76-81 GHz band and the Frequency Range above 95 GHz Consistent with International Allocation Changes,* Report and Order, 19 FCC Rcd 3212 (2004); and *Notice of Proposed Rule Making* in ET Docket Nos. 11–90 and 10–28, FCC 11–79, released May 25, 2011 (the *NPRM*), 76 Fed. Reg. 35176-35181.

scatter. It was also the case that during the tests, the main beam of the SRR antenna was aimed at the RAS receive antenna. The study, at Table 1, Page 10, concludes that separation distances of between 15 and 39 kilometers are called for in order to provide complete protection under the worst case for the Kitt Peak observatory. But the Kitt Peak antenna is sited such that it has a line-of-sight path to the City of Tucson, Arizona, which is not typical of RAS sites. As well, at Page 15 of the Study it is stated that "[m]itigation factors such as any terrain shielding, orientation of the transmitter antenna with respect to the observatory, or attenuation of the transmitter if mounted behind the vehicle bumper have not been taken into account, and would tend to reduce the avoidance radius."

32. In a Spectrum Planning Discussion Paper (SPP 2006-11) dated December, 2006 released by the Australian Communications and Media Authority entitled *Planning of the 71-76 GHz and 81-86 GHz Bands for Millimetre Wave High Capacity Fixed Link Technology,* there was an extensive discussion of the effects of foliage and vegetation loss as well as penetration loss in the millimeter-wave spectrum near 70 GHz. This document shows that the foliage losses near 70 GHz are "significant." Where foliage depth is 10 meters, for example (which is roughly equivalent to a large tree or two in tandem) the foliage loss is approximately 50 dB. Similarly, when millimeter-waves are propagated through various materials, they are more or less strongly attenuated.

33. Given the high degree of attenuation through free-space path loss, atmospheric absorption loss, and foliage and penetration attenuation applicable at 79 GHz, it is suggested that the actual interference contour around any of the few radioastronomy observatories due to automotive SRRs is predictably very low. Given this, and given the fact that the observatories can, through the use of constructed