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

In the Matter of	)	
	)	
Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band	)	**ET Docket No. 15-26**
	)	
Amendment of Part 15 of the Commission's Rules to Permit the Operation of Vehicular Radar Services in the 77-78 GHz Band	)	**RM-11666**
	)	
Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band	)	**ET Docket No. 11-90**
	)	
Amendment of Section 15.253 of the Commission's Rules to Permit Fixed Use of Radar in the 76-77 GHz Band	)	**ET Docket No. 10-28**
	)	
Amendment of the Commission's Rules to Permit Radiolocation Operations in the 78-81 GHz Band	)	

To: The Commission

COMMENTS OF ROBERT BOSCH, LLC

Robert Bosch, LLC (Bosch), by counsel and pursuant to Section 1.415 of the Commission's Rules (47 C.F.R. §1.415), hereby respectfully submits its comments in response to the *Notice of Proposed Rule Making and Reconsideration Order*, FCC 15-16, 80 Fed. Reg. 12120, released February 5, 2015 (the Notice).[1] The Notice proposes to substantially modify the Commission's Part 15 and 95 rules and the domestic Table of Allocations with respect to the 76-81 GHz band in order to accommodate the development of, and to authorize automotive and other radar applications in that band in the United States. The Commission also seeks to develop

[1] Because the Notice in this proceeding was published in the Federal Register on March 6, 2015, these comments are timely filed.

a regulatory framework that will allow various services including automotive radars to operate on an interference-protected basis in the band. The Notice also considers service rules that provide for the deployment of various radar applications in this band domestically. The Commission initiated this proceeding in response to Bosch's May 15, 2012 Petition for Rulemaking, RM-11666, though the Notice proposal differs materially from the proposals contained in Bosch's Petition. For its comments in response to the Notice proposals and in the interests of automotive and automotive equipment manufacturers in worldwide harmonization of automotive radar and in the development of important next-generation automotive safety equipment in the band 76-81 GHz, Bosch states as follows:

I. Introduction and Background.

1. In this proceeding, the Commission proposes specifically: (1) to expand radar operations in the 76-81 GHz band; (2) to modify the domestic Table of Frequency Allocations to provide a new domestic, co-primary [2] allocation for the radiolocation service in the 77.5-78 GHz band in the United States; (3) to authorize the proposed, expanded radar operations on a blanket, or "licensed-by-rule" basis as a personal radio service under Part 95 (rather than on a Part 15 unlicensed basis as is the case now with respect to 76-77 GHz automotive radars); and (4) to evaluate the compatibility of incumbent operations, including that of the amateur radio service and radioastronomy, with radar applications (especially automotive radar applications) in the 77-81 GHz band. This combination of Commission proposals is undertaken in large part on the Commission's own initiative, inasmuch as it differs widely from the regulatory proposals in the Bosch petition.

[2] The other co-primary user would be the amateur service and the amateur satellite service. There already exists a radiolocation allocation in the remainder of the 76-81 GHz band.

2. The largest substantive difference between the Notice and Bosch's Petition for Rule Making is that the Commission has proposed to permit radiolocation generally in the 76-81 GHz band, including, generically, fixed radar installations. Bosch had proposed limiting the radiolocation uses at 77-81 GHz to automotive radar applications and the Bosch Petition did not revisit the issues in Dockets 11-90 and 10-28 or the regulatory status of 76-77 GHz. The Notice proposal in the instant proceeding is based in large part on the Commission's *assumption* that there is not any significant incompatibility between automotive radars and generic fixed radar systems in this band. Bosch takes strong issue with the assumption. It is understood that the Commission's laudable goal is to create a regulatory framework for 76-81 GHz that will "encourage efficient, innovative uses of the spectrum and to allow various services to operate on an interference-protected basis."[3] However, surprisingly, the Commission is willing to make the assumption (without any studies to support that assumption) that generic fixed radar applications will be compatible with automotive radar applications (and also with incumbent radioastronomy, amateur radio and amateur satellite service facilities) at 76-81 GHz.[4] Bosch strongly opposes the authorization in this proceeding of generic, fixed radar applications at either 76-77 GHz or 77-81 GHz because there is presently no definitive study that evaluates technical compatibility between fixed radar installations and automotive radars. It is unreasonable to make assumptions in this

[3] *See* the Notice, at 1.

[4] The Commission states that other than the Bosch Petition, this proceeding is based on two Petitions for Reconsideration in ET Docket Nos. 11-90 and 10-28; See, Navtech, Petition for Partial Reconsideration, filed Sept. 5, 2012 dealing with Fixed Radar operations at 76-77 GHz only; and Honeywell, Petition for Partial Reconsideration, filed Oct. 10, 2012, which dealt with use of mobile radars in the band 76-77 GHz only mounted on aircraft wings and which are proposed to be used only while such aircraft are located on the ground on airport runways and taxiways to avoid wingtip collisions. Neither of those Petitions for Reconsideration addressed the 77-81 GHz band whatsoever, nor did any other aspect of those two earlier docket proceedings. Even if any current consideration of generic fixed radar operation was timely (which, given the state of automotive radar implemention, it is not), that evaluation should be limited to the 76-77 GHz band segment, where such operation has been urged by NavTech and Honeywell in their petitions for reconsideration in Docket 11-90. Any consideration of fixed radars in any portion of the 76-81 GHz band should, however, await the completion of conclusive, refereed studies that credibly establish compatibility with incumbent services *and* with automotive radar operations. This subject is further discussed hereinbelow.

case in particular,[5] based on no underlying compatibility analysis. There should be studies performed that can competently ascertain the level of compatibility between automotive radar systems and fixed radar systems as a predicate to any broad authorization for fixed radar systems. Those studies, which would also facilitate a determination of the proper operating parameters of fixed radar installations and the necessary level of regulation of them, do not now exist.

3. By sharp contrast, the Commission assumes that there is a *dearth* of available information about the extent of compatibility between and among automotive radars and incumbent services in the 76-81 GHz band. Based on that incorrect assumption, the Notice asks whether or not the existing amateur and amateur-satellite service allocations should be removed from the band. There is not in the record thus far relative to RM-11666 any factual predicate for the conclusion that there is any incompatibility between amateur radio operation and automotive radars,[6] or that either application is incompatible with ongoing radioastronomy activities in the band 76-81 GHz. The understanding of Bosch to date is that there is sufficient compatibility between incumbent uses and automotive radar operations in order that the authorization of SRR automotive radar systems at 77-81 GHz can be safely implemented immediately, either on a Part 15 basis or by means of a Part 2 domestic allocation and the implementation of Part 95 service rules for automotive radars. This compatibility has in fact been definitively established by a

[5] It is urgent to make no compatibility assumptions where the basic function of an automotive radar system is the protection of human life and property and where the assumption is that automotive radars at 76-81 GHz will become ubiquitous in the United States.

[6] Quite to the contrary, Bosch and other members of the 79 GHz Project have reached out to the radioastronomy and amateur radio communities in the United States in order to evaluate and to ensure compatibility between those incumbent services and short range automotive radar systems (SRRs) at 77-81 GHz. Bosch on behalf of the 79 GHz Project participants has committed to the continuation of cooperative interference-avoidance efforts to insure spectrum compatibility with incumbent active radiocommunication services as the 77-81 GHz band becomes available for unlicensed SRR systems, and with radioastronomy. Bosch is committed to establishing private-sector interference avoidance protocols in order to insure compatible sharing with incumbent radio services.

credible, current ITU study[7] discussed hereinbelow. Simply stated, there is no submission from any entity that establishes (1) any need to permit *generalized*, fixed radar installations at 77-81 GHz; or (2) that automotive radar is in any sense incompatible with radioastronomy or amateur radio at 77-81 GHz.

4. Other than the above issues and other, less significant issues addressed below, Bosch is generally gratified by the Commission's responsiveness to RM-11166. Bosch notified the Commission's Office of Engineering and Technology beginning in approximately 2010 at a series of meetings dealing with the band 77-81 GHz that it intended to submit 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 76-77 GHz which is now permitted by that rule Section for use by automotive long range radars (LRRs)]. The Office of Engineering and Technology staff was most accommodating on numerous occasions and afforded sufficient opportunities for Bosch to explain the ongoing worldwide standardization of automotive radars at 76-81 GHz and its technical plan for domestic rollout of SRR automotive radars at 77-81 GHz.[8]

5. Bosch did not propose a domestic spectrum *allocation* or service rules for vehicular radar devices and systems, but rather only the modification of Section 15.253 of the

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[7] See, ITU Report M.2322.

[8] Automotive radar applications are evolving from providing additional comfort functions, such as Adaptive Cruise Control (ACC) and Collision Avoidance (CA) radar, to functions that significantly add to passive and active vehicle safety. This requires systems that can detect objects in close proximity to the vehicle, such as pedestrians or bicycles. Such applications require radar sensors that have a target separation capability of less than 10 centimeters. Radar sensors that provide this resolution require an operating bandwidth of 4 GHz.

LRR type sensors detect the relevant road traffic in order to adapt the speed of the vehicle to that of other vehicles ahead. To satisfy the demands for increased car safety, and depending on the application, one or more LRR type systems may be combined with additional SRR radar sensors in one vehicle. Based on the sensor information, the data processing system in the vehicle will trigger the appropriate radar. SRR sensors cover the close proximity of a vehicle and will add additional active and passive safety functions, e.g. autonomous emergency braking, active blind spot assistance and lane change assistance. *See*, Recommendation ITU-R M-2057-0, *Systems Characteristics of Automotive Radars Operating in the Frequency Band 76-81 GHz for Intelligent Transport Systems Applications* (02-2014)

Commission's rules to permit the operation of vehicular radars to operate at 78-81 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] This model has worked well for automotive radars in the 76-77 GHz band to-date. Only the single, Part 15 rule required modification was necessary in order to permit this expanded use of 77-81 GHz for automotive radars in the United States. However, as noted in the Petition, it is not unreasonable to create a co-primary, domestic radiolocation allocation at 77.5-78 GHz and to premise the regulatory structure for automotive radars on a "license-by-rule" service such as Part 95.[10] However, it is not reasonable to include all radar systems in the same rule Subpart of Part 95 unless and until it can be concluded by compatibility studies that fixed radar systems will not preclude or interfere with automotive radar systems. Prior to such a study, the Commission should limit fixed radiolocation applications to those individual applications that are determined to be compatible, such as FOD radars at airports that do not illuminate public rights-of-way, and tank level probing radars.

[9] The Commission's staff asked why the automotive industry would propose an unlicensed, Part 15 paradigm for SRR systems, which are, *de facto* if not *de jure*, safety systems, and which therefore might be presumed to require interference protection in order to function reliably at all times. However, the Commission had already created, via Section 15.253 of the Rules, a Part 15 regulatory scheme for LRR automotive radars at 76-77 GHz, which has on information and belief worked well for the past 15years without reported interference. Second, in this frequency range, there is an exceptionally high level of frequency re-use for the extremely short-ranges of both LRR and SRR automotive radars at the power levels involved. Third, the systems are configured such that the main beam of the SRRs is in a downward direction. Interaction between those automotive radars and active or passive services that are spectrum-sharing partners, *other* than those in immediate geographic proximity to the automobiles (such as fixed roadside radars or fixed radars that might illuminate a public roadway) is therefore highly unlikely. Finally, unlicensed operation of SRRs is a practical method of authorizing automotive radars, 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] While Part 95 of the Commission's Rules has heretofore encompassed principally personal radiocommunication services such as the Citizen's Radio Service, MURS, FRS, GMRS and the like, it also encompasses personal locator beacons, so automotive radars would not be the first radiolocation service regulated by Part 95 rules.

II. The Commission Should Authorize Short Range Automotive Radar Systems at 77-81 GHz and Limit Radiolocation Operations at 76-77 GHz to Long Range Automotive Radar Systems.

6. There are two quite different applications of automotive radar systems in this frequency range. As Bosch explained in its Petition for Rule Making, there is presently a worldwide plan to consolidate automotive radars in the 76-81 GHz band.[11] CEPT has concluded that the 77-81 GHz band should be the only globally harmonized frequency band for SRR automotive radars. 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 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 at 77-81 GHz (this segment is typically referred to in Europe and Asia as the "79 GHz band") and LRR automotive radars at 76-77 GHz is not possible. It is firmly settled internationally that the 79 GHz frequency range should be considered as the most suitable band for SRR worldwide.[12] Indeed, the Commission has repeatedly acknowledged this over more than a decade.[13] Given this, the allocation decisions and regulatory treatment of incumbent LRR

[11] 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.

[12] Indeed, the United States' proposal for WRC-15 Agenda Item 1.18 [which is intended to consider a primary allocation to the radiolocation service *for automotive applications* in the 77.5-78.0 GHz frequency band in accordance with Resolution 654 (WRC 12)] is to create a co-primary allocation to the radiolocation service (with the amateur service) at 77.5-78.0 GHz, thus to create a contiguous radiolocation allocation at 76-81 GHz.

[13] For example, in Docket 03-102, resolved in 2004, the Commission adopted domestically the radioastronomy (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, although the Commission "recognize(d) 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

automotive radar systems at 76-77 GHz may not be at all applicable to SRR automotive radar systems operating at 77-81 GHz.[14]

7. Indeed, the LRR automotive radar applications at 76-77 GHz are fundamentally different from the SRR automotive radar applications at 77-81 GHz.[15] 79 GHz SRR vehicular radar sensors can and should use up to 4 gigahertz occupied bandwidths in order to permit good range separation and object discrimination. Depending on the vehicle speed, and the functionality of the radar, the bandwidth requirement for a single sensor would be lower,

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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."

[14] 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 30 meters, and are used for a number of applications to enhance active and passive safety for all kinds of road users. Applications that enhance passive safety include 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. By contrast, the frequency band 76-77 GHz, already designated for vehicular and infrastructure radar systems in the United States and in Europe, 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 (e.i.r.p.) 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 Ultra Wideband SRR and LRR systems. Because of foreseeable saturating interference from LRRs into SRRs (but not vice-versa) a common band between the two 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.

[15] See, e.g. Recommendation ITU-R M-2057-0, *Systems Characteristics of Automotive Radars Operating in the Frequency Band 76-81 GHz for Intelligent Transport Systems Applications* (02-2014), which describes the relative characteristics of 76-77 GHz LRRs (which it terms "Category A" systems) and 77-81 GHz SRRs (which it terms "Category B" systems) as follows:

> Regarding functional and safety requirements, the automotive radar systems operating in the 76-81 GHz range can be separated in two categories:
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> – **Category 1**: Adaptive Cruise Control (ACC) and Collision Avoidance (CA) radar, for measurement ranges up to 250 meters. For these applications, a maximum continuous bandwidth of 1 GHz is required. Such radars are considered to add additional comfort functions for the driver, giving support for more stress-free driving.
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> – **Category 2**: Sensors for high resolution applications such as Blind Spot Detection (BSD), Lane-Change Assist (LCA) and Rear-Traffic-Crossing-Alert (RTCA), detection of pedestrians and bicycles in close proximity to a vehicle… For these high resolution applications, a necessary bandwidth of 4 GHz is required. Such radars directly add to the passive and active safety of a vehicle and are therefore an essential benefit towards improved traffic safety. The increased requirements for active and passive vehicle safety are already reflected in the requirements for vehicle testing. Radar E operates with a higher field of view to enable high-resolution applications such as pedestrian detection, parking-aid, emergency braking at low speed (< 30 km/h).

typically on the order of 1.5 gigahertz. Higher bandwidths would be utilized in certain circumstances, for example in parking lots or garages and in urbanized driving environments. With the full 4 gigahertz of bandwidth available at 79 GHz, interference-free operation of multiple vehicular radar sensors in safety-critical urban environments is possible with full functionality of the systems. Up to 3 sensors can operate on an interference-free basis in the same immediate area. By contrast, the LRR radars at 76-77 GHz operate at or less than 1 gigahertz occupied bandwidth and are in general forward-looking anti-collision radar systems. It is necessary to separate these two types of automotive radar by frequency band. It is also suggested that the bands be considered *separately* for regulatory treatment under the circumstances. This is not to suggest that the Commission should afford either LRR automotive radars or SRR radars safety service classifications pursuant to ITU Radio Regulation No. 1.59. As the Notice indicates at paragraph 50, the proposed radiolocation allocation may enhance safety for some applications but they are not intended to be used for safety services and thus are not entitled to any higher priority or greater protection than with respect to any other primary allocated service in the bands at issue.

8. The Commission acknowledges the necessary regulatory differences between LRRs and SRRs in this frequency range. At Paragraph 30 of the Notice, the Commission states that:

> We find merit in Bosch's request, and propose to grant SRR applications access to additional spectrum apart and distinct from the spectrum currently used for LRR. In particular, we propose to provide up to 4 gigahertz of bandwidth for SRRs so that these radars can gather information about objects with a sufficient resolution. Moreover, the extensive catalogue of enhanced features supported by SRR and the expectation that their deployment will become more widespread suggests that the public interest would be served by providing SRR with expanded access to the 77-81 GHz band. Given that the LRR applications use a narrower bandwidth than that used by SRR applications, the SRR applications will have a lower transmit power density level than that for LRR applications and therefore will have low likelihood for causing any potential interference.

These conclusions are accurate in all respects. The Commission's conclusion that operation of vehicular radars in this frequency range is "a good fit" in that the high level of attenuation of LRR and SRR automotive radar signals in this frequency range and the use of narrow beamwidth automotive radar antennas permits extensive frequency re-use, is well-taken.[16] Overall, the Commission properly proposes to accommodate automotive radar systems in the 76-81 GHz band, noting that "(a)s a practical matter, these applications offer new and tangible ways to enhance the safety of the Nation's drivers, and to meet important automotive safety objectives." In order to realize this important goal, however, it is necessary for the Commission to proceed prudently with the addition in this band of any new applications that might prevent SRRs and LRRs from meeting these important safety objectives.

III. The Commission Should Not Permit Fixed Radar Systems in the 76-77 GHz or 77-81 GHz Bands Except on a Case-By-Case Basis, Where Compatibility with Automotive Radar and Incumbent Services is Affirmatively Demonstrated.

9. As is noted above, there is currently no finalized study that evaluates fixed and vehicular transport traffic applications and the compatibility between the two. There is an ongoing study in Europe (CEPT PT SE24 WI 51) which stands to provide some technical details for fixed radar systems that might assist in evaluating such compatibility. The proponents of fixed radar applications and the automotive industry are contributing to this study. The results of this study are expected by the end of 2015. However, there is at the present time no technical evidence of compatibility between fixed radar installations generally and either LRR or SRR

[16] Paragraph 31 of the Notice includes the following statement which is entirely accurate:

"At these millimeter wave frequencies, radio propagation losses increase more rapidly with distance than at lower frequencies and antennas that can narrowly focus transmitted energy are practical and of modest size (footnote omitted). While the limited range of such transmissions might appear to be a major disadvantage for many applications, it does allow the reuse of frequencies within very short distances and, thereby enables a higher concentration of transmitters to be located in a geographic area than is possible at lower frequencies (footnote omitted). This characteristic makes the band especially desirable as vehicular radars become more common throughout the transportation ecosystem. Moreover, these frequencies are adjacent to the 76-77 GHz band, which has already proven to be well suited for LRR applications."

automotive radar systems. The Commission did, however, in Dockets 11-90 and 10-28 [17] visit on its own motion the issue of fixed radar compatibility with LRR automotive radar at 76-77 GHz. As noted at paragraph 17 of the Notice, the Commission held ultimately in Dockets 11-90 and 10-28 that it "continue(d) to believe that vehicular radars should be able to share the band with fixed radars operating at the same levels and noted that there were no conclusive test results indicating that there would be incompatibility issues between the two types of radars." [18] With respect, it is not prudent spectrum allocations policy to premise a sharing evaluation on the *absence* of evidence of *incompatibility*. Instead, it is necessary to establish affirmatively that there *is compatibility* between the two uses under consideration. That information is lacking at the present time. There is no basis therefore to conclude that generic fixed applications should be newly permitted in any portion of the band 76-81 GHz. A competent study in advance of authorizing potentially conflicting uses would allow a determination of the proper regulations that might govern the addition of fixed radar installations at a later date, once the implementation of SRRs in the United States progresses. In this manner, the Commission can be assured that the potential of automotive radar systems, and especially SRRs, to "enhance the safety of the Nation's drivers, and to meet important automotive safety objectives" will be realized.[19] Furthermore, the Commission's assumption that there are no studies indicating incompatibility

[17] See, Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band, *Report and Order*, 27 FCC Rcd 7880, 7885, para. 14 (2012)

[18] It is noteworthy that there was strong opposition in dockets 11-90 and 10-28 to allowing fixed radar applications in the 76-77 GHz band. The automotive industry noted that preliminary results from a European study indicated that: (1) Fixed 76-77 GHz installations result in significant interference to automotive radar sensors; (2) Simulation results show that the interference power of an interferer with +45 dBm EIRP is up to 75 dB above the noise floor of the 76-77 GHz automotive radar sensor will disrupt its operation and such interference cannot be mitigated in the radar sensor; and (3) In contrast, interference between and among different automotive radar sensors is avoidable. The automotive industry is developing countermeasures. However, an unlimited number of fixed radars in the same band would make it extremely difficult to develop countermeasures for all possible interference scenarios.

[19] Because the potential for harmful interference to vehicular radars at 76-81GHz translates directly into a danger to persons and property, and because the public does and should be able to depend on the automotive radars' functionality at all times that the vehicle is in motion, the need for conclusive compatibility analyses relative to dissimilar uses in the same frequency band in the same geographic area and the same environments is critical.

between automotive radars and fixed generic radars at 76-77 GHz is in fact incorrect. ETSI Technical Report [TR 102 704 V1.2.1 (2012-2013)][20] is limited to ground-based vehicles only and *does not recommend fixed outdoor radar operation at 76-77 GHz*. Section 6.2.1.2 of the 2012 version of the Technical Report, entitled "*Sharing and compatibility issues still to be considered"* states in relevant part that:

> Particular attention needs to be given to restrict the application in the 76 GHz to 77 GHz to surveillance ground based vehicular radar applications and not allow applications for installations to fixed sites or certain mobile installations in order to ensure compatibility…The most critical potential interference aspect for general surveillance radar applications is that this kind of application may overlap in the direction of automotive SRRs on public roads. In such scenarios, the surveillance radars potentially blind automotive radars operating in the same frequency and area.

10. Indeed, the Commission's actions to date with respect to the 76-77 GHz band have heretofore been consistent with the prudent, case-by-case approach for fixed radars suggested by Bosch. As the Commission notes at paragraph 35 of the Notice, the Commission has previously found that foreign object detection (FOD) radars could be made compatible with LRRs at 76-77 GHz *by limiting the FOD radars to airports only and to condition their use on the absence of illumination of any public roadway*.[21] Because of these limitations the Commission ensured that there would be no interaction with LRR automotive radars at 76-77 GHz. Similarly, in authorizing tank level probing radars, the Commission carefully analyzed the characteristics of that specific fixed application to ensure that it would not interact with automotive LRR radars due to the differences in operating environments of each:

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[20] See, *Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Short Range Devices (SRD); Radar sensors for non-automotive; ground based vehicular applications in the 76 to 77 GHz frequency range* (2012), available at: http://www.etsi.org/deliver/etsi_tr/102700_102799/102704/01.02.01_60/tr_102704v010201p.pdf

[21] Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band, *Report and Order*, 27 FCC Rcd 7880, at 7888-7889, para. 26 (2012).

> As for spectrum sharing between vehicular radars and LPR, we believe that LPR devices will be able to co-exist successfully with vehicular radars because the LPR is installed in a downward-looking position at fixed locations and the main-beam emission limits have been carefully calculated to avoid harmful interference to other radio services. We further find that the extreme propagation losses of radio signals at these frequencies would mitigate any potential harmful interference beyond a very short distance from the LPR device, as noted above. [22]

The Commission also relied on extensive ETSI studies from Europe which established standards for level probing radars, which do not exist relative to unspecified fixed radars in the band 76-81 GHz or any portion thereof. Therefore, until such time as there are definitive, reliable compatibility studies that conclusively establish that automotive LRR and/or SRR radar systems are compatible with generic, fixed radar systems, the Commission should not proceed with any generic authorization for fixed radar systems.

11. At paragraph 55 of the Notice, the Commission asks for comment on the extent to which it should allow fixed radar systems limited to bandwidths of up to 1 gigahertz and whether to limit such operation to the 76-77 GHz band. Under no circumstances should the Commission authorize generic, fixed radars in the 77-81 GHz range, and there is no predicate for permitting them in the 76-77 GHz range either. The Commission's statement at paragraph 51 of the Notice relative to its assumption of compatibility[23] has not been verified and, as discussed above, assumptions cannot be made on a generic basis relative to compatibility with safety-based

[22] 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, FCC 14-2, *Report and Order and Order*, 29 FCC Rcd 761, 775, para. 29, released January 15, 2014.

[23] The Notice states at paragraph 51 that: "(F)ixed radars operating at the same maximum power levels as vehicular-mounted radars would be even less likely to interfere with the RAS and Radiolocation services than vehicle-mounted radars because the locations where they are used would not change. We stated that fixed radars should be able to co-exist with vehicular radars because they both operate with the same power level and use antennas with narrow beam-widths, thus reducing the chances that the signal from one radar would be within the main lobe of the receive antenna of the other. In a worst-case scenario, where two radars are aiming directly at each other, fixed radar should have no more impact on vehicular radar then that by another radar located on a stationary vehicle. We continue to believe this is the case."

systems.[24] The fact is that technical parameters of fixed radars are different from those of vehicular radars. With the latter, there are scanning radars and moving vehicles. For fixed applications either the antenna is moved or rotated or else it will act as a simple movement detector. There is nothing about the 76-81 GHz band that makes the band uniquely suitable for movement detectors. In fact, the cost of such is prohibitively high. Overall, there must be some valid premise for the Commission's assumption of compatibility between fixed and automotive radars, and it is not appropriate at all for the Commission to place the burden on the proponents of automotive radar to prove a negative, which is precisely what the Notice does.

12. The Notice does not ask for comment as to alternative millimeter-wave bands for fixed radar applications. [25] However, there are numerous alternatives. Fixed radars utilizing a minimum of 1 GHz bandwidth should be considered for various alternative frequency bands including the bands near 60 GHz and 122 GHz. The Commission should, at the same time that it is exploring the technical compatibility between fixed and automotive radars based on competent

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[24] Neither does Navtech, the only proponent of generic, fixed radar systems at 76-77 GHz, offer any compatibility analysis of its own. It merely criticizes the MOSARIM study conclusions referenced in the Notice at paragraph 53 thereof . Navtech's Petition for Reconsideration in Docket 11-90 offers nothing by way of support for fixed radar installations at 76-81 GHz. Navtech manufactures a scanning radar system for incident alerting, traffic control, obstacle alerting and other fixed industrial, security and surveillance applications such as perimeter protection. It claims suitability for ITS applications *along roadways and in tunnels used for automotive traffic*, among other varied applications in varied environments. A portion of its Petition for Reconsideration is dedicated to touting the allegedly beneficial applications of its fixed radar systems for roadway incident detection, including a 360-degree scanning radar antenna system mounted in roadside configuration. Navtech claims that its systems are designed for use in the millimeter-wave bands, and claims that the 76-77 GHz band is "beneficial" as opposed to other millimeter-wave bands for its application because of "lower weight, improved measurement results (e.g. range resolution) and reduced size for new equipment." It does not indicate whether it could or could not use other millimeter wave bands in the United States that would not involve interaction with automotive radar systems. It is therefore impossible to evaluate the necessity for Navtech to utilize the 76-77 GHz band in the United States, *vice* other millimeter wave bands for the use of its technology, and Navtech offers *nothing at all* by way of compatibility showings.

[25] Fixed radars that might be added to the 76-81 GHz band, according to Footnote 32 of the Notice, include: "antennas mounted on outdoor or indoor fixed structures, *e.g*., antennas mounted on the building or on a telephone pole. Some of the examples of fixed infrastructure applications are detection of locations of stopped vehicles or pedestrians, detection for industrial machinery including port cranes, mining trucks and locomotives, and provide security monitoring for government and public infrastructures." These applications include traffic safety functions where the fixed radars would be close to or at the same elevations as automotive radars and in close geographic proximity. Obviously, there are compatibility issues and these must be evaluated thoroughly and completely before making any allocation decisions.

technical sharing studies, also explore alternative millimeter-wave allocations for fixed radar systems so as to eliminate any potential conflict.

IV. There is Sufficient Evidence of Compatibility between Automotive Radar Applications and Incumbent Services at 76-81 GHz that No Additional Regulations are Necessary.

13. In stark contrast to the absence of definitive studies relative to the compatibility between automotive radars and generic fixed radar systems, there does exist a definitive study establishing the compatibility between automotive radars and incumbent radioastronomy and amateur radio operations in the 77-81 GHz band. It is and has been Bosch's position that there should be no change in the radioastronomy allocations in the 76-81 GHz band, and there need be no change in the Amateur Radio domestic primary allocation at 77.5-78 GHz, or in the secondary Amateur allocation at 77-77.5 GHz or 78-81 GHz in order to accommodate new SRR automotive radar systems at 77-81 GHz. Nor are any additional Part 97 rules necessary to accommodate compatible sharing of that band between radio amateurs and automotive radar systems. Indeed, that is also the position of the United States in anticipation of consideration of WRC-15 Agenda Item 1.18 later this year.[26] The Notice, at paragraph 33, states that the Commission believes that new proposed radar operations will be compatible with incumbent operations in the 76-81 GHz band. This is provably true with respect to the compatibility between automotive radars and incumbent radioastronomy and amateur radio operation. It is not provably true, to date, with respect to fixed radio systems and incumbent services.

14. The Commission has held numerous times that automotive radar can be considered compatible with the radioastronomy service (RAS) at 76-77 GHz. In Docket 03-102, the Commission had proposed to implement a new allocation to the RAS on a primary basis in the

[26] The United States proposal for WRC-15 Agenda Item 1.18 is for a co-primary allocation to the radiolocation service and the amateur service at 77.5-78.0 GHz and to continue the secondary allocation for the Amateur Service at 76-77.5 GHz and 78-81 GHz.

76-77.5 GHz and 78-81 GHz band segments and on a secondary basis in the 77.5-78 GHz band segment. 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. *The Commission concluded that, as a practical matter, sharing conflicts are "highly unlikely" in any portion of these bands*. The Commission noted that most of the RAS and Earth exploration satellite service (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 from nearby roadways by natural and man-made barriers.

15. At 76-77 GHz, the Commission held that vehicular radar operations *could* share with RAS. 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. Since that time, *Bosch is unaware of a single instance of interference to RAS in the 76-77 GHz band*. the Commission, in Docket 11-90, speaking of changes proposed in the Part 15 rules governing automotive radar operation at 76-77 GHz, was correct in its assessment that "there is very little

likelihood that vehicular radar systems operating at either the current or proposed limits would cause harmful interference to radio astronomy equipment."[27]

16. It is anticipated that there will be no more interaction between SRRs and RAS passive systems at 79 GHz than there has been at 76-77 GHz. In Bosch's 2012 Petition, Bosch described ongoing cooperative efforts initiated by various entities to ascertain the interference potential as between automotive SRRs and millimeter-wave RAS facilities. Bosch representatives met numerous times with National Science Foundation (NSF) staff, with the Committee on Radio Frequencies (CORF), and with other radioastronomy representatives to discuss and evaluate the interference potential. During 2011, tests were done at the Kitt Peak Radioastronomy Observatory in Tucson, Arizona, using a Bosch-provided example of an SRR device in the 79 GHz band, tests under NSF auspices evaluated the potential for interaction between automotive radar systems and radioastronomy observatories in the frequency band 77-81 GHz. The results of those studies are public and are considered authoritative.[28]

17. However, there is empirical evidence of the absence of any significant interference potential between SSRs and RAS facilities. The RAS has been sharing the 76-77 GHz band with automotive radars since 1996,[29] by <u>all</u> accounts compatibly. According to the BMW Group in comments filed in 2011 in Docket 11-90, dealing with proposed changes to the Commission's Part 15 rules dealing with the 76-77 GHz band, BMW had been offering Advanced Cruise Control (ACC) systems using 76-77 GHz radars in the United States and elsewhere for more than 10 years. The main sensor in these systems is used for collision mitigation and avoidance

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[27] *Notice of Proposed Rule Making* in ET Docket Nos. 11–90 and 10–28, FCC 11–79, released May 25, 2011, 76 Fed. Reg. 35176-35181, at paragraph 14.
[28] A complete copy of the test results and conclusions was attached to Bosch's Petition as ***Exhibit A***.
[29] See, *Amendment of Parts 2, 15 and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications,* First Report and Order and Second Notice of Proposed Rule Making, at Paragraph 17; ET Docket No 94-124, 11 FCC Rcd 4481 (1996).

systems. BMW reports no interference complaints. Toyota Motor Corporation's Reply Comments dated August 1, 2011 in that same proceeding note at page 4 that Toyota "has no information of any documented instances of such interference in areas where these vehicular radar systems have been used for over a decade in proximity to radio astronomy sites." Similarly, Delphi noted in Docket 11-90 that 76-77 GHz automotive radar systems have been implemented in both the U.S. and Europe starting in 1999 without any reports of harmful interference to radio astronomy. Other comments filed in that docket proceeding note that there was, as of several years ago, over a decade of experience with SSR technology in Europe, where radio astronomy observatories are located much closer to urban centers than they are in the United States, and there had been no substantiated claims of harmful interference arising from vehicular radar in the 76-77 GHz band.

18. There are numerous reasons for this level of compatibility. Some, such as the high degree of free space attenuation, and the 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."[30] A realistic separation distance necessary to protect millimeter-wave radio telescopes is actually very low. The Kitt Peak study results appended to Bosch's petition for Rule Making are "worst-case" results inasmuch as the test did

[30] 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 76 Fed. Reg. 35176-35181.

not take into account substantial attenuation of the radar signal by trees, other vehicles, guard rails, buildings, diffraction losses, and ground scatter.[31] It was also the case that during the tests, the main beam of the SRR antenna was aimed at the RAS receive antenna. That study concludes that separation distances of between 15 and 39 kilometers are called for in order to provide complete protection for the Kitt Peak observatory. However, 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. 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."

19. 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 showed 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

[31] As described in the joint report created from those studies, it is noted at Page 2, second paragraph as follows: "...the beam of the feed was redirected from the sub reflector by mounting a plane mirror in front of it"… "using this arrangement the 12 meter dish mount was used to point the beam of the telescope feed at the radar to achieve a "line of sight" path from the radar to the telescope receiver. " The modification of the telescope antenna by introducing the additional mirror is also shown in the report. It should be noted that the operating condition of the telescope in this experiment does not reflect real world operation. Recommendation ITU-R SA.1513-1 states in Section 2 and Section 3, Figure 1, that: "radio astronomy observations are generally made with pointing angles above 5 degrees elevation." Overall, the number of RAS observatories operating in the 77-81 GHz band is very low. The existing observatories are remotely located to reduce the interference potential into their receivers. The results of the experiment regarding the required protection radius of RAS sites to avoid interference from a stationary vehicular radar in dry air in the line-of-sight condition is considered definitive and strongly indicates compatibility.

attenuated. Given the high degree of attenuation through free-space path loss, atmospheric absorption loss, and the high degree of 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 shielding and the inherently remote siting of their antennas, reduce to a manageable level any interference potential from SRRs without any regulatory constraints. ITU-R Rep M.2322 also supports the view of the Commission that sharing is possible between radioastronomy and automotive radars.

20. Also prior to the filing of the Bosch Petition, there were held extensive discussions and there were prepared technical evaluations by ARRL, the national association for Amateur Radio and Bosch that resulted in agreement that making available spectrum at 77-81 GHz for automotive radars would have no significant impact on incumbent radio services with allocations in that band, including the Amateur Radio Service. Neither did Bosch's Petition propose any change to the primary Amateur Service allocation at 77.5-78 GHz or to the secondary Amateur Service allocations at 77-77.5 GHz or 78-81 GHz. Bosch did, however, propose the *addition* (actually the reinstatement) of a *separate* allocation to the Amateur Service at 75.5-76 GHz, so as to permit international harmonization of that segment with ongoing uses by European radio amateurs who have access to that band, and an accommodation for those United States amateur operators whose experimental operations might be subject to an increased noise floor from aggregate vehicular radars in certain geographic areas in the 77-81 GHz band in some areas.

21. Given those discussions and because of a finalized international study (ITU-R Report M.2322 is discussed below), it is unnecessary to make any change in the domestic table of allocations in the band 76-81 GHz other than to add a co-primary allocation at 77.5-78 GHz for

the radiolocation service, should the Commission decide to proceed with the Part 95 regulatory model for LRRs and SRRs at 76-81 GHz. The definitive ITU study and Bosch's independent technical analysis establishes that there is compatibility in this frequency range between automotive radar, radioastronomy and amateur radio. That ITU report should be considered determinative of the compatibility issue as between automotive radar on the one hand and incumbent radio services on the other.

22. However, should any decision be made to change the table of allocations or to otherwise displace the Amateur Radio Service domestically from any portion of the 76-81 GHz band and to provide equivalent replacement spectrum for Amateur Radio purposes, Bosch's proposal for an *additional* allocation for the Amateur Service at 75.5-76 GHz as alternative spectrum for amateur radio experimentation should be considered.[32] This band was formerly allocated to the Amateur Service on a primary basis but that primary allocation was relocated to 77.5-78 GHz due to actions taken at WRC-03. The amateur allocation at 75.5-76 GHz was removed after 2006 in the United States. (See, RR 5.559A). As a separate matter, RR 5.561A states that the band 81-81.5 GHz is also allocated to the amateur and amateur-satellite services. That band could be considered as an additional component of replacement spectrum in the vicinity of 75.5-81.5 GHz if necessary. However, a continued allocation for amateur radio in the entirety of 77-81 GHz is reasonable and a 500 MHz co-primary allocation in that range for the amateur and amateur-satellite service is both necessary for radio amateurs and, based on a definitive study, compatible with automotive radars.

23. The very high level of frequency re-use in this band in particular contributes to the compatibility between Amateur Radio and automotive radar. The characteristics of automotive

[32] This would harmonize the European and United States Amateur Radio operation in this frequency range and encourage additional Earth-moon-Earth operation and future Amateur Satellite Service operation in the band.

radar systems also contribute to this compatibility. In normal operation, motor vehicles are moving along the lanes of a road. Vehicular radar sensors are mounted, at the highest, 1.5 meters above the ground. The antenna patterns of vehicular radar sensors utilize very low elevation angles. This, and the profoundly high attenuation from terrain shielding create a substantial interference buffer. By contrast, Amateur Radio operation in this band is largely oriented toward propagation experimentation from hilltops and mountaintops using temporary fixed, portable equipment.[33] Operation is centered near 78.192 GHz, though there has been some Earth-moon-Earth communications experimentation recently (starting in 2013) in the vicinity of 77.1 GHz. [34] Amateur Radio operation in this band is not extensive at present, though there is a large and increasing investment in equipment for this band by those who conduct experiments in the band. There is not currently any Amateur Satellite Service operation in this band and none is imminent.

24. ITU Report M.2322, "*Systems Characteristics and Compatibility of Automotive Radars Operating in the Frequency Band 77.5 78 GHz for Sharing Studies*" was developed in preparation for consideration of WRC-15 Agenda Item 1.18 in support of the consideration of a co-primary allocation for the radiolocation service at 77.5-78 GHz. The Report studied the compatibility between vehicular radars on the one hand and radiolocation and the amateur radio service and amateur satellite service in this frequency range. The conclusion drawn was that automotive radar systems are compatible with incumbent radioastronomy and with amateur radio operation. At Section 6.1.3 of that study, the following conclusions are summarized relative to amateur radio service compatibility with automotive radar systems:

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[33] Citing an ECC Report (56), ITU Report M.2322 at Section 6.1.3. describes typical Amateur Radio operation in these frequency ranges as follows: "antennas are in general mounted on masts as high as practical, high buildings, hills or mountaintops in order to obtain the least obstruction towards the horizon in order to make long distance contacts possible".

[34] A substantial amount of Amateur Radio experimentation in this band has occurred from hilltops in the National Radio Quiet Zone in Green Bank, West Virginia on a coordinated basis, with no reports of interference to any radioastronomy operations from the National Radio Astronomy Observatory.

A. The operation of the amateur service in the mountain top scenario is not expected to be significantly constrained by the radiolocation service.

B. With a careful choice of the building atop which an amateur receiver might be installed, it is still possible to operate amateur stations.

C. The allocation of the band 77.5-78 GHz to the radiolocation service is not expected to impose severe constraints on the radio amateur service.

D. Minimum coupling loss (MCL) calculations demonstrate that the distances over which interference could be expected are small and are all less than 200 meters for the scenarios considered. The MCL calculations consider the spatial average scenarios. The worst case scenario would be where the transmitter and receiver are directly facing each other. This would result in large protection distances. However, the probability of this is very low due to the highly directional antennas used by radio amateurs and the narrow beamwidths of those antennas. No mitigation was used in those calculations. Direct line-of-sight was used between the interferer and the victim without considering any terrain parameters (buildings, trees, hills etc.) which will considerably attenuate the signal.

These conclusions are based in part on a tabulation (at Table 3 of Report M.2322) of the technical parameters of Amateur stations operating in this band and those operating parameters which might be used in future operations. Transmitter power used by radio Amateurs is quite low as a practical matter due to the complexity of achieving higher power in this frequency range.

25. It does not appear that there is any need to change any allocation or service rule relative to other services in order to accommodate SRRs or additional LRRs at 76-81 GHz due to geographic and normal vertical separation between automotive radars and hilltop or mountaintop amateur radio operation in this band. However, should the Commission conclude otherwise, Bosch continues to recommend that a potential displacement allocation for the Amateur Service might be in the 75.5-76 GHz band. Restoring an Amateur allocation in that specific segment would facilitate international harmonization of Amateur Service operation in this frequency range. This is potentially problematic due to the large number of co-primary services with allocations in this band and the need, pursuant to U.S. Footnote 389 to protect 28 military sites with fixed satellite installations in the frequency range 71-76 GHz. Nevertheless, a secondary

Amateur allocation in this band would be necessary should there be any displacement from the band 77-81 GHz for any reason.

26. More importantly, however, and pursuant to the existing footnote (RR 5.561A), the band 81-81.5 GHz is also allocated to the amateur and amateur-satellite services. That band should be considered a component of a replacement spectrum allocation domestically in the vicinity of 75.5-81.5 GHz if there is any reduction in the amateur or amateur satellite allocation in the 76-81 GHz band. The 81-81.5 GHz band also has a number of co-primary service allocations and it is also subject to the U.S. Footnote 389 requirement to protect satellite uplink facilities at 28 military sites, but that can be addressed through normal coordination processes similar to those which apply to other Amateur allocations. Thus, while there is no necessity to displace amateur radio or the amateur-satellite service from the 77-81 GHz band, should the Commission decide to do so for any reason, the 75.5-76 GHz band and the 81-81.5 GHz band are both useful components of an equivalent replacement spectrum allocation for the amateur and amateur-satellite services.

V. Part 95 Regulation of Automotive Radar is Reasonable, as is Grandfathering of Already-Deployed 22-29 GHz Automotive Radars; No Change in Operating Parameters Should be Permitted for FOD Radars; Aircraft Wingtip Radars Require Compatibility Studies; and No New Fixed Radars Should be Permitted at the Present Time.

27. The Commission should proceed with the proposed allocation for SRR automotive radars in the 77-81 GHz band, either pursuant to the Part 15 regulatory paradigm proposed by Bosch or (pursuant to a co-primary allocation at 77.5-78 GHz) as a Part 95 licensed- by-rule service. Bosch has been of the view that the Part 15 regulatory paradigm for automotive radars at 76-77 GHz has worked efficiently since that band has been available for LRRs, but it is acknowledged that as a practical matter, fundamental incompatibility can be more effectively

avoided or remedied through the allocation process and that would indicate that the Part 95 regulatory structure proposed for automotive radars in the Notice is more appropriate.

28. It is entirely reasonable to grandfather existing, 22-29 GHz vehicular radars that are already installed and in use for the life of the vehicle. There is an anticipated sunset date of 2022 for radars in that frequency range in Europe, which is sufficiently far in the future that prohibiting certification of new vehicular radars that operate in bands other than 76-81 GHz is not burdensome.

29. At Paragraph 46 of the Notice and thereafter, the Commission proposes to consolidate the FOD detection radars in the 76-81 GHz band pursuant to Part 95 rules. The impetus for the expansion of the frequency range for FOD radars is unclear. The Commission simply states that this would provide additional spectrum in the band. Bosch urged in the proceeding dealing with FOD radars that these be licensed by the Commission and operation of these devices under Part 95 rather than Part 90 is immaterial. There is no stated demand for additional spectrum for FOD radars, however, and therefore no basis for extending these radars into the 77-81 GHz range. That said, as long as the FOD radars are obligated to be utilized only at airports and provided that they must continue to avoid any installation that illuminates a public roadway (which was a critical and necessary condition for authorizing these devices in the first place), there should not be created any incompatibility.

30. With respect to aircraft-mounted, wingtip radars for use when aircraft are taxiing on the ground, the concern is that the mounting of those radars is considerably higher off the ground than is the case with other vehicular radars. The proponent of this application, Honeywell, suggests but does not establish that its aircraft-mounted radar application at 76-77 GHz is compatible with automotive radar systems in the same band. The record in the Docket 11-90

proceeding does not support such a finding. Honeywell, like Navtech submitted nothing which establishes the level of compatibility with deployed automotive radar systems in the 76-77 GHz band. Neither does Honeywell indicate the extent of susceptibility of its radars to interference from properly operating automotive radar systems. Nor does it show that the 76-77 GHz band is necessary or even preferable as opposed to other bands which could be used for the same application. It is these kinds of issues about which the Commission simply cannot make assumptions. Navtech, Honeywell and any other party that advocates fixed radar applications in this band should be made to provide the same justifications and analyses that the 79 GHz Project has done, by way of establishing compatibility between and among incumbent uses and the proposed new use of the band.

VI. Conclusions.

31. The Commission should proceed with the proposed allocation for SRR automotive radars in the 77-81 GHz band without delay, either pursuant to the Part 95, licensed-by-rule regulatory paradigm (pursuant to a co-primary allocation at 77.5-78 GHz) or alternatively as a Part 15 rule change as proposed by Bosch in RM-11166. The Commission's Notice proposal to expand radar operations in the 76-81 GHz band should not include any authorization for generic fixed services in any portion of the 76-81 GHz band, pending completion of a definitive study establishing affirmatively that there is compatibility of those fixed radar applications with incumbent operations, including that of Amateur Radio and radioastronomy, and especially with SRR and LRR automotive radar applications in the 76-81 GHz band. Until that time, the only fixed radar applications that should be considered must be on a case-by-case basis premised on a showing of compatibility. Because there is now a dearth of studies relative to the effects of mixing fixed and automotive radars and because the only indications at this point are that fixed

radars are in fact *not* compatible with automotive radars in this range, creating an allocation and adopting service rules premised on nothing other than an assumption and the (incorrect) assertion that there are no studies indicating *incompatibility* is in any case poor spectrum management policy. In Europe, within CEPT, the interference potential between fixed infrastructure systems and automotive radars in the band is currently under study. Results are expected by end of 2015.

32. By contrast, competent, determinative studies show that there is compatibility between SRR automotive radars at 77-81 GHz and (both) radioastronomy and amateur radio. The allocations for those services in the band should remain intact. ITU-R Report M.2322 establishes that there is compatibility in this frequency range between automotive radar, radioastronomy and amateur radio. Should the Commission for any reason conclude otherwise, the Commission should establish (and should consider in any case) a co-primary allocation for the Amateur Service at 75.5-76 GHz as displacement spectrum for amateur radio experimentation. Another option for the radio amateurs exists pursuant to international footnote (RR5.561A) which states that the band 81-81.5 GHz is also allocated to the amateur and amateur-satellite service. However, the existing allocation for amateur radio can be maintained in the entirety of 76-81 GHz which, based on studies, is compatible with automotive radars.

33. With respect to sharing with radioastronomy, the studies in ITU-R Rep M.2322 support the assumptions of the Commission that sharing is possible between the two services. A thorough course of experiments was initiated by Bosch and others at the University of Arizona telescope, an environment that clearly represents a worst-case condition, that in normal operation anywhere could not and will not occur. Overall, the number of RAS observatories operating in the 77-81 GHz band is very low. The existing observatories are remotely located to reduce the interference potential into their receivers. The results of the experiment regarding the required

protection radius of RAS sites to avoid interference from a stationary vehicular radar in dry air in the line-of-sight condition is considered definitive and strongly indicates compatibility.

Therefore, the foregoing considered, Robert Bosch LLC respectfully requests that the Commission resolve this proceeding in accordance with the recommendations contained in these comments, and not otherwise.

Respectfully submitted,

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