Comments on FCC 15-16 by Thomas Williams, Amateur Radio Station WA1MBA

SECTION I

Individual investment, activity, and contributions to the Amateur Radio Service 4mm Band

This comment is written by Thomas D. Williams, Ph.D., Advanced Class Amateur Radio License WA1MBA. I have been working professionally in the field of EHF remote sensing for security applications, communications and radar for the majority of my career. I have held the FCC First Class Radiotelephone License and have been awarded five patents, several in the field of passive millimeter wave security sensing. I participated in the first successful Amateur radio use of the 120 GHz and 145 GHz bands, and have been promoting the use of the 77 GHz (4mm) band for over a decade.

In this first section of these comments I refer to the investment, activity and contributions to the Amateur service on the 4mm band. Although other Amateurs who operate on this band share may have similar time and cost to construct and in many cases, the time to support operations, this section describes the magnitude of this activity in my case. In the second section I comment on the FCC 15-16 docket.

Photo of initial radio system on date of first Radio Amateur 4mm band communication by author (face hidden). Unlike other 4mm radios, this one uses a lens as the aperture.

1) Building, testing repairing

I have spent over 200 hours building, testing, repairing and upgrading my 4mm radio system. This effort spans the time from 2003 to the present. A photo is shown above.

Starting in July 2005 with a home made mixer, local oscillator made from a home-made and designed locked crystal oscillator, along with surplus parts, the radio was capable of our first (local) communication on this band. Frequency stability and accuracy are paramount in establishing narrow band communication. Unlike much wider bandwidth applications in the millimeter wave spectrum, the concentration of signals into narrow bandwidths maximizes the received signal and therefore allowable distance between stations. Of course, others had communicated on this band before (see the published accomplishments of Brian Justin, WA1ZMS for instance).

2) Money spent

I have spent over $7,000 on components and specialized test equipment, both new and used in order to build, test, repair and put my 4mm radio on the air. With this test equipment (and a few components), I have assisted other local amateurs with their 4mm radios.

3) Time spent supporting actual on-the-air activities for 4mm, including all the driving, set up etc.

I began operating on the 4mm band on July 2005
I have continued ever since, at least four times a year. In one year we operated over a dozen times.

My total time supporting on-air activity is over 100 hours. My total time promoting on-air activity exceeds 100 additional hours.

4) Time spent actually on the air on 4mm

My logs show air time of over 20 hours. Although much time is taken to establish fairly short conversations, one conversation lasted some 20 minutes.

5) Comments on contributions to the art, technical specifications of equipment

Each person's equipment varies in its power level, sensitivity and other factors. My case is similar to most.

Power: 3 dBm
EIRP: 50 dBm (20 dBW)
Aperture: Diameter 250 mm
Receiver Noise Figure: 5.1 dB
System Noise Figure: ~7 dB
Communication bandwidth: 500 Hz to 5 KHz
Instantaneous system bandwidth: 10 MHz
Frequency of operation: 78,192.100 MHz
Frequency Stability after 30 minutes warm-up: 100 Hz in 10 minutes

Frequency Accuracy after 30 minutes warm-up: 1 KHz

Next planned System Improvement:
Increase power level to 20 dBm at the feed (EIRP 67 dBm [37 dBW]) - working amplifier in hand, expect to implement Summer of 2015.

Distance records in the Eastern US:
All communications were first established via CW (Morse code) in a 500 Hz bandwidth, and then, depending on conditions, moved to SSB (voice) in a 2.5 to 5.0 KHz bandwidth. At each record distance, at some point in the years, both CW and SSB were used successfully.

Date	Distance
2005	21 km
2006	43 km
2014	88 km
2014	125 km
2014	205 km

Of course, none of these improvements in our communications distance would be possible without the cooperative work of several Amateur Radio License holders and their radios. In addition to the author, these activities and much of the other activity reported herein includes Amateur Radio Stations W1RIL Kenneth Schofield, W1FKF Donald Twombly, KA1OJ Mark Foster, N1JEZ Mike Seguin, and others in the Northeast who are readying stations including KT1J Henry Ingwersen of Vermont, and several other stations in New York.

Component Development:
Over the course of 2006 through 2013 I designed, tested, and constructed low noise/low power amplifiers for the Amateur Radio need on the 4mm band. These units were sold at parts cost (no money was paid for my labor, and no profit was made). 26 units were sent to amateurs in the US and 21 more internationally including Canada, several countries in Europe, Australia and Japan.

My personal labor for this project alone is estimated at 500 hours.
In the photo below you can see some of the amplifiers during construction and testing.

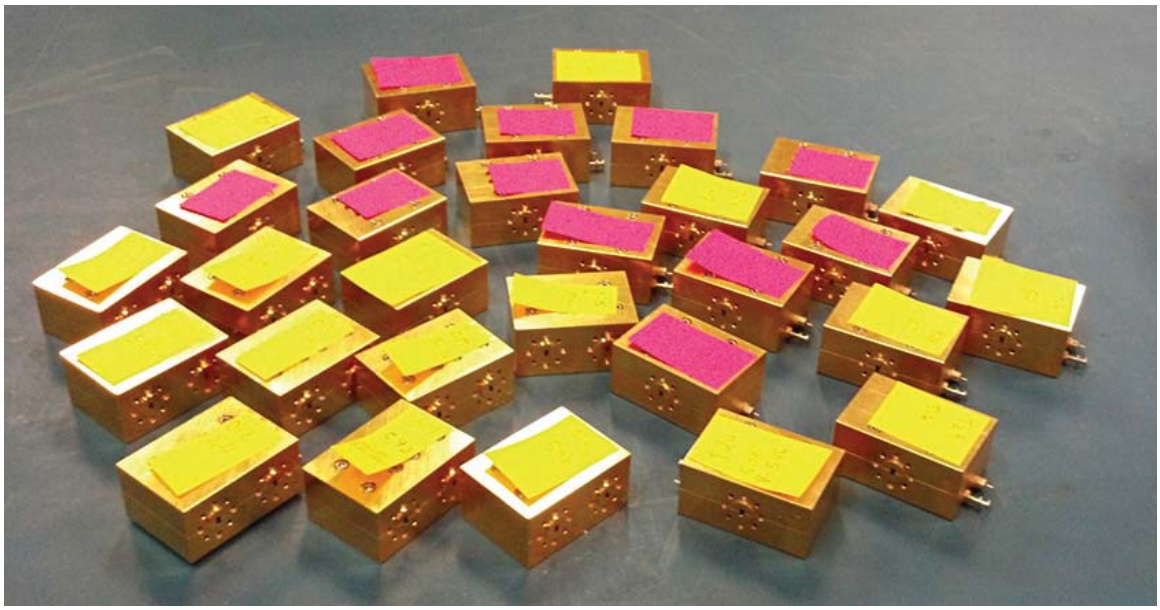
Photo of some of the 4mm band amplifiers during construction and testing.

Other Comments:
There are other sources of components and systems which Amateur Service licensees have at their disposal, including surplus equipment from development of E-Band communications systems and overseas companies selling to US amateur radio operators. From various reports it is clear that there are at least a dozen active amateurs presently on this band in the US with a number of others readying equipment to participate in the growing activity on the 4mm band. Some of the already active amateurs have built a second radio to introduce other amateurs to the band, conduct experiments and increase activity.

In Summary of Section I

Section I, in order to illuminate the magnitude of activity and effort describes my personal building testing, and repairing of my 4mm radio system estimated at over 200 hours. An estimate of the money spent so far is some $7,000. Time spent in preparing for on-air-activities on the 4 mm band exceeds 100 hours and time promoting activity exceeds another 100 hours. My time spent actually on-air on the 4mm band is over 20 hours even though conversations are relatively short, and my contributions to the art, include development and delivery of some 20 amplifiers to the US community, development and keeping equipment at excellent performance levels, and participating in local distance improvements which now exceed 200 kilometers. My projected annual activity level is expected to increase as I improve my radio performance.

SECTION II

FCC 15-16 by paragraph

1.…seek comment on compatibility of incumbent operations, including that of amateur radio, with radar applications…

Comment: There is no analysis of compatibility between the two services (SRR and Amateur Radio Service). The applicant should provide evidence of incompatibility by performing an actual analysis with functioning systems from both services.

21. Amateur. The Commission previously considered compatibility issues for amateur operations with vehicular radar and FOD.. In light of concerns about interference between amateur operations and vehicular radar, the commission imposed and maintained a suspension of amateur satellite allocation in 76-77 GHz.

Comment: Amateurs have not used the 76 to 77 allocation for a number of years either with satellites or terrestrially.

26, 27 and 28 These paragraphs draw a conclusion that the LRR and SRR systems are not compatible because of one-way interference and therefore wish to have separate bands for operation. Bosch seeks comment on their observations.

Comment: The question of bandwidth and interference might remain open until actual systems are deployed. With the desire to move SRR functions to the 4mm band, the question of interference between systems should be raised. The possibility of time-sharing the two functions of LRR and SRR on the same 4 GHz band has not been addressed.

Possibly the petitioner (Bosch) maintains that a continuous swath of 5 GHz which contains both LRR and SRR is somehow more attractive for a combination vehicular radar service yet to be developed. In a different paragraph (29), the Commission mentions potential for reduction of cost by having the bands close in frequency. That issue is addressed in comments on that paragraph (29).

The fact that Trex urges the Commission to ensure that rules do not unreasonably restrict additional valuable uses of the band should be taken into account. I count Amateur Radio Service as a valuable use of the band.

29. The Commission identifies this spectrum as a good fit. The reasons given are propagation losses allowing reuse, and the adjacency to the existing LRR band reduces cost by allowing adaptation.

Comment: If loss with distance were a primary issue, then the 60GHz band would be ideal for automotive radar applications. The primary scattering and attenuation at that band is ever-present atmospheric Oxygen, while the primary contributor to

attenuation at 4mm is water vapor, which varies considerably with time, season and geography.

Possibly the petitioner (Robert Bosch GmbH) maintains that a continuous swath of 5 GHz which contains both LRR and SRR is somehow more attractive for a combination vehicular radar service yet to be developed. If so, it would be helpful to understand why. It is possible that time sharing the two functions would reduce the need for 1 GHz of the bandwidth of the two services.

If SRR could use complex modulation, more sophisticated antennas and RF modules, and more processing that will do the same job with less bandwidth, then bandwidth could be preserved for other services. No analysis of the tradeoff between such increases in complexity and bandwidth is given. Most of the published materials about modulation schemes for SRR simply list a range of typical RADAR modulation methods, including frequency sweeping, pulse, chirp and coding. It is likely that no specific modulation method has been identified or agreed upon.

Time and again, complex systems have been manufactured in volume at competitive costs. Furthermore, initial adopter cost is usually covered by those who pay for luxury vehicles (as has certainly been the case so far for LRR and SRR). Lower cost automobiles naturally would be outfitted as the technology is proven and improved,. And as time goes on, lower costs can be achieved by further advances in technology, advances in underlying devices, and manufacturing in volume. Therefore, both present and future cost is either probably of minimal consequence to this proposed rule change.

31. This paragraph states the Commission's belief that the proposed radar operations will be compatible with incumbent operations on the band, and so the same technical principles that already allow successful shared operation on 76-77GHz would apply to the entire 76-81 GHz band.

Comment:. Regarding Amateur Radio Service operations, assuming the Commission includes all (existing) incumbent operations in this statement, the statement is difficult to understand. Amateur Radio Service is an incumbent operation with Primary Allocation on 77.5 to 78GHz, but is forbidden from operation on 76 to 77GHz for Satellite and in all practical terms from any operation on that portion of the band. Perhaps this paragraph needs clarification. This commenter expects that the Commission will allow Amateur Radio Service primary allocation to continue on 77.5 to 78 GHz. Other paragraphs address this issue more directly.

32. Asserts that 2015 WRCC will adopt an allocation to support vehicular radars in the 76-81 GHz range.

Comments: I believe that the applications to the WRCC do not address compatibility issues sufficiently to determine interference.

32. Vehicular Radar and Radio Astronomy and Observations.
Points are made that vehicular radar already poses a threat to the protected bandwidth as tested by the University of Arizona, out to 30 km.

Comment: There is no analysis of the amount of expected increase in the noise floor created on the band segment being requested if there are a large number of vehicles each operating a number of SRR components. To ascertain this, broad bandwidth modulation schemes should be implemented and re-tested, and a simulation developed which includes a rage of realistic densities of vehicles including that where every vehicle is operating when roads are filled.

34. Amateur Radio Operation
[paraphrased] This states that the ARRL does not believe there is any significant incompatibility considering the geographic nature of Amateur Radio use. The petition goes on to note that the FCC has moved Amateurs away from the radar portion of the band 76-77GHz. They cite the FCC ruling having referenced Amateur Satellite use. The petitioner goes on to seek an expansion of the record on the compatibility between amateur and vehicular radar services. The question is asked whether there are any mitigation strategies for compatibility between the two services and whether there are interference or compatibly studies on the subject, and wish to adopt rules that address amateur use [paraphrased]

Comment: This commenter does not know of any analysis of interference to RSS from Amateur Service. It would be advantageous to perform such an analysis to provide more complete information for some aspects of this rule change. In one paper study regarding potential interference to Amateur Service from RSS (see reference excerpts at the end of this section) it is stated that interference to Amateur Service is unlikely in realistic situations. This paper study now some 11 years old, assumes advances in SRR noise figure but not Amateur Radio (which is often at the state-of-the-art). There are other assumptions, such as the amount of increased noise level acceptable at the Amateur station which may be incorrect, but for the most part, the remaining assumptions hold for today's Amateur station.

Various modulation schemes are being discussed for SRR, some of which are coded to reduce interference between multiple radars - those on the same vehicle and those on other nearby vehicles. Radar signal coding and frequency sweeping reduces or eliminates interference from other radars (with other codes or sweeping states) and also from non-radar signals. Furthermore, with one exception, the bandwidth occupied by the SRR is very wide (otherwise the petitioner would not have required 4 GHz of bandwidth). Such SRR modulation schemes and bandwidths are often immune to signals from Amateur Radio Service radios which invariably use signals which occupy less than 4 kHz, about a million times smaller than the SRR.

Furthermore, there is no consideration given to analysis of the amount of expected increase in the noise floor created on the band segment being requested under assumptions of various densities of use (densities of vehicles).

These observations and others lead to the need for a study of compatibility and interference between the existing and proposed services.

I suggest specific action be taken as follows in order to resolve the potential for interference and thereby assure compatibility between the incumbent (Amateur Radio) and proposed (SRR) services. Also, the Amateur Radio Service may be served better by some additional considerations. (This action comment also addresses in part, paragraphs 39, 61, 62, 63, and 64)

1) **Adopt the rule change, and continue operations of the incumbent services specifically so that Amateur Radio Service continues to have Primary Allocation at 77.5-78 GHz for 4 years, renewable or vacated depending on the outcome of a study as described below (item 4). The SRR band of 77 to 81 GHz is assigned Co-Primary allocation in the 77.5-78GHz portion of the band. If that study is not performed, compatibility is assumed, and the incumbent services will continue. If the 77.5-78 GHz Amateur Radio Service Primary Allocation is vacated, develop and execute a plan for mitigation of costs to move frequency (as in item 5 below).**
2) **Additionally, create a new Amateur Radio Service (Co-)Primary allocation at 80.990 to 81.000 GHz (10 MHz wide). This serves two purposes. One is to provide a frequency where the atmospheric loss is lowest and therefore distance possibilities are the best, thereby furthering the communications art through experimentation and competition. The other is to provide a frequency, still within the operational bandwidth of SRR but very likely to have the least possible interference in both directions due to being on the edge of the band (where SRR is likely to have both reduced sensitivity and emissions to accommodate frequency accuracy limitations).**
3) **In anticipation of potential incompatibility finding, and for eventual international harmonization (whether or not the services are found incompatible), immediately establish a Primary Allocation for Amateur Radio Service at 75.5 to 76 GHz, without any restriction beyond part 97 rules. A negative result of using this frequency range is that it exhibits greater atmospheric loss. A positive result from possible harmonization with international frequency allocations is to increase the amount of available equipment and the possibility of earth-moon-earth communications across the globe.**
4) **The original applicant (Robert Bosch GmbH) or its assignee or some agency chosen by the Commission should produce a plan for testing and analysis and submit it to the Commission which will include a number of physical and operational SRR examples (laboratory systems with identical performance to expected systems would be adequate) with a range of**

modulation schemes and a number of Amateur Service radios (or fabricated systems with performance identical to typical Amateur stations) in normal operational mode. Interference should be analyzed in both directions and under a variety of realistic conditions. This testing plan should be executed and a report be made to the Commission within 4 years of adoption.

5) **If the Amateur Radio Service losses Primary Allocation privileges at 77.5 to 78GHz, a compensation plan should be developed and executed. Changing frequencies is costly because 1) frequency accuracy and stability (and therefore the reference oscillator) must be maintained to a few parts per billion and 2), and because inexpensive wide bandwidth synthesizers are inherently noisy, the typical Amateur LO chain is complex, often using multiple carefully locked oscillators, and 3), filtering is required to reduce or eliminate the LO and unwanted image from both receive and transmit chains. Typical cost for such changes may require expenditure of about $2,000 per station.**

38. The Commission asks whether the same emission limits as defined for unlicensed vehicular radars be applied to all emissions in the entire band.

The Commission describes LRR and SRR operations, but does not describe licensed operation, such as the Amateur Service in this paragraph. It is unclear whether or not the Commission is considering restricting licensed Amateur Service to the same power restrictions as SRR and LRR in this paragraph. Such restrictions are mentioned directly in other paragraphs (see 63).

39: Asks whether radiolocation (LRR and SRR for instance) be upgraded to Primary allocation on 77.5 to 78 GHz.

Comment: Amateur Service has been granted and continues to enjoy a Primary Allocation on only a small portion of the band (77.5 to 78 GHz). Until analysis shows that the Amateur Service (at reasonably high power) and RSS can not both operate without interference, Amateur Service should continue to be allocated primary in this band segment, even if it shares that Primary Allocation. See comment on paragraph 34 above.

60: Amateur Radio Use. Seek comment on how to structure future 4mm band use. This paragraphs states history. The Commission states that the action taken in 1998 was in the situation where there was little immediate impact on amateur operators and stated its plans to revisit the issue later. The Commission extended the suspension in 2004 and suggested it would be useful to consider the development of technical sharing criteria. Furthermore, the Commission states that the petitioner (Bosch) does not seek to alter the current arrangement of suspension of Amateur Service in the 76 to 77 GHz region.

Comment: The paragraph fails to state that the licensed Amateur Radio Service has been granted Primary Allocation for the 77.5 to 78 GHz portion of the band and is secondary over the remainder. Over the last 11 years much has changed in the Amateur Radio Service, including development of affordable circuits, station improvements to state-of-the-art, access to and use of surplus equipment, and dramatic increases in activity, bolstered by the Primary Allocation.

61: The Commission proposes to adopt a comprehensive approach for amateur radio use on these frequencies. Suggest extending 76 to 77 GHz ban to the entire 76-81 GHz band. The intention is to make the band from 76 to 81 one band only for radar. The Commission asks a few questions in this paragraph [I add letters to identify them]. (a) Given the continuing lack of technical sharing criteria or any other evidence of compatibility, should the Commission extend the 76–77 GHz amateur suspension to the entire 76–81 GHz band? (b) If so, should the Commission modify the current amateur suspension of use of the 76–77 GHz band by removing all amateur allocations from the 76–81 GHz band? (c) Alternately, would it be possible to lift our suspension of the amateur service and conduct both amateur and vehicular radar operations in the entire 76–81 GHz band? (d) The Commission goes on to conclude that there is no apparent technical reason to treat the 76-77 GHz and the 77-81 GHz bands differently – that it seeks comment on whether there are other approaches that would achieve compatibility between the amateur and radiolocation services within the76-81 GHz band that the Commission has not discussed.

Comment: It is now 2015, and there are many more Radio Amateurs operating in the 4mm band than in 2004. This operation has gained traction in part because the Radio Amateur Service was assigned Primary Allocation in the 77.5 to 78GHz portion of the band.

(a and b) There is no evidence of incompatibility, as noted in the cited references (see comments on paragraph 34). The Commission suspended Amateur Service operation in the 76-77GHz portion of the band at a time of little Amateur Service use. With such a large band available, it was appropriate to assign a Primary Allocation (at 77.5-78 GHz) in order to foster Amateur Service activity. Now that there is significant Amateur Radio activity in this band, the idea that the suspension should be extended to the entire band seems counterintuitive and punitive to the Amateur Radio Service. Other means should be reviewed and addressed to permit the continued use of the 4mm band by Amateurs Radio licensees.

(c and d) There is no reason to assume that the 76-77 and 77-81 GHz portions of the band be treated identically. Perhaps for the purpose of LRR and SRR these portions can be treated identically, but not for licensed use wherein only a small portion of the band is needed, such as for the Amateur Radio Service. The logic which originally separated a RADAR band excluding Amateur Radio Service and a Primary Amateur band effectively excluding interference from radiolocation was appropriate in 1998 and 2004 for the situation at that time. The establishment of the Amateur Radio Service Primary Allocation was effective and remains effective to

the purposes of advancing the Amateur Radio Service, the art of communication and signal propagation experimentation at this band.

It is quite possible that both services could coexist. Only one paper study evaluating compatibility in one direction, and no in-situ study has been conducted which would determine the potential for incompatibility between the services.

See Comment on Paragraph 34 for a suggested approach to compatible functioning of the two services.

62: Bosch states that it is unconvinced after meetings with Amateur groups that there is any significant incompatibility between Amateur Radio and SRR operations at 79 GHz. It cites Amateur Radio operation from mountaintops, being experimental, and therefore will provide separation. Bosch also notes that European regulators previously determined that the use of SRR within the band may be incompatible with Radio Amateur Service, but then stated that amateur users could be accommodated in the 75.5–76 GHz band (which is not currently available in the U.S.). The Commission seeks comment on these points.

Additionally, to help better inform its decision, the Commission seeks to develop a record on the types of amateur use, and the extent of such use, that is currently undertaken in the amateur 4 mm band..

Comment: Section 1 of these comments outlines the activity of one Radio Amateur (the commenter) and speaks to some of the operation in the US. Section 1 of these comments is to be considered a direct comment in answer to the Commission seeking a record as stated in this paragraph 62.

It could be true, as Bosch states, that there is any significant incompatibility between the Amateur Radio and SRR operations. Some of the Bosch citations are valid.

To offer a brief summary of the types of extant Amateur Radio Service Operation in the US, I offer below a few summary statements in addition to Section I of this document:

> **The majority of Amateur use in the US is in a narrow bandwidth of usually less than 4 kHz and often less than 2 kHz. Most stations operate with system noise figures below 7 dB, and power levels about 0 to 5 dBm with EIRP about 43 dBm. Some operate with higher power and larger apertures resulting in higher EIRP.**
>
> **Most activity is during the warmer months in the north, and year-round in the south of the country when access to hill and mountain tops is available. Often groups of amateur operators will establish dates for experiments for various purposes, such as equipment check-out or establishing increases in**

distance between stations. Often, dates are chosen when the weather forecasts predict low levels of atmospheric water vapor (low dew points).

In addition to individual or group selected times, there are notably 4 weekends in the year when the American Radio Relay League offers a competition (called a "contest"). In these contests microwave operation is either a primary feature or provides for extra competitive points due to the difficulties in operation and achieving extended distance. Among the reasons for sponsoring these competitions is increasing the amount of operation and extending the achievement of the Amateur Radio Service.

Regarding accommodation in another portion of the band, please refer to the Comment on paragraph 34.

63. This paragraph asks for rule modifications to realize successful shared use of the entire band, for example, limiting Amateur Service power, or other further limitations in addition to the normal part 97 rules?

Comment: There may be increases in power levels (affordable to Amateurs) in the future which would allow over-the-horizon experiments and effective Earth-Moon-Earth and other experimental Amateur Radio Service use. Such power should not be limited other than as presently permitted (1500 Watts PEP, unlimited antenna aperture). Early Earth-Moon-Earth experiments have been conducted in Russia and the US. The potential use of high power should be investigated (probably by simulation) in a compatibility study. Please see the Comment on Paragraph 34.

64: Under the suggestion that vehicular would gain sole primary allocation of 76 to 81, then could Amateur radio allocation be constrained to ITU Region 1 allocating the 75.5 to 76 GHz band.

Comment: Here is the present frequency allocation table for this portion of the band in the US (74-76GHz)

International Table	Federal Table	Non-Federal Table	FCC Rule Part(s)
74-76, **FIXED, FIXED-SATELLITE(spce-toEarth), MOBILE, BOOADCASTING, BROADCASTIN-SATELLITE, Space research (space-to-Earth,)**	**74-76** **FIXED, FIXED-SATELLITE (space-to-Earth), MOBILE, Space research (space-t0-Earth),**	**74-76** **FIXED, FIXED-SATELLITE (space to Earth), MOBILE, BROADCASTING, BROADCASTING-SATELLITE, Space research (space-to-Earth),**	**Fixed Microwave (101)**

5.561	**US389**	**US389**	

The entire 75.5 to 76 GHz suggested band segment is within the frequency limits of E-Band data communications in the US, as well as other potential satellite, mobile and broadcasting uses. The suggested change would require further changes to these other services to restore Amateur Service to Primary.

There would be costs incurred by Amateur Service licensees to moving to a different frequency. Neither the petitioner nor the Commission has suggested mitigation of such costs.

Please see the Comment on Paragraph 34 for a suggested method of implementing rule changes with respect to Amateur Radio Service to accommodate SRR in the 4mm band.

Reference Excerpts

[1]
EXCERPTS:
2.1 Receiver properties
Currently the receiver noise figure (no pre-amplifiers yet being available) can be estimated to be in the order of 12-15 dB. It is argued, with respect to costs and availability for radio amateurs, that this noise figure will be valid for the next decade.
The receiver bandwidth is 2.5 kHz. Although sometimes receivers with narrower bandwidth are used, this will be neglected as it does not influence the results.
It can be expected, however, that in the time frame foreseen for the possible application of 79 GHz SRR, pre-amplifiers will become available, thus lowering the receiver noise figure to about 4 dB.
Therefore two different noise figures of 12 dB and 4 dB were taken into account in this analysis.
Signals with rather small (S+N)/N ratios are common. A value of 3-5 dB is judged acceptable for many amateur contacts.

AND

8 Conclusion
The interference to amateur stations operating around 79 GHz from SRR has been studied based on worst-case-assumptions of antenna gain and antenna patterns; which are applicable at ferquencies around 79 GHz. Consideration was given only to the free space attenuation. Attenuation by absorption and the scatter losses were not taken into account.
Without consideration of mitigation factors, the calculated separation distances obtained in the worst case scenarios - in the order of 2 km in the main lobe to main lobe case - for 79 GHz SRR systems tend to show incompatibility of SRR with the Amateur and the Amateur Satellite Services.
However, although amateur stations could in some situations operate in the vicinity of roads, the probability of interference as a result of SRR radiating through its antenna

main lobe into the AS station antenna main lobe would be considered very low. The occurrence of the main beam to side lobe interference scenario would still be expected to be low.

and

[2]
EXCERPT:[in 2012 basically restating the 2004 paper study]
"although Amateur stations could in some situations operate in the vicinity of roads, the probability of interference as a result of SRR radiating through its antenna main lobe into the Amateur station antenna main lobe would be considered very low".

End of Reference Excerpts

REFERNCES

[1] ECC Report 56, within CEPT, Compatibility of Automotive Collision Warning Short Range Radar Operating at 79 GHz with Radio Communication Services, Stockholm, October, 2004, Executive Summary and Annex D Appendix 1

[2] European Commission: Contract no: 287929, International automotive 8-79 GHz frequency harmonization initiative and worldwide operating vehicular radar frequency standardization platform, Work Group WP2, Deliverable D2.1, Version 2.1, 12/12/2012, Page 17, Annex 2, A1. Sharing with Incumbent Users (Compiled by Robert Bosch GmbH)

End of Comments Section II

End of Comments by Thomas Williams, Amateur Radio License WA1MBA