NATIONAL RADIO ASTRONOMY OBSERVATORY
520 EDGEMONT ROAD CHARLOTTESVILLE, VA 22903-2475
TELEPHONE 434-296-0211 FAX 434-296-0278

25 May 2015

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 RM-11555
	)	
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	)	WT Docket No. 11-202

Response to Reply Comments of Robert Bosch LLC

by

National Radio Astronomy Observatory

I. Introduction

1. Here, the National Radio Astronomy Observatory ("NRAO" or "the Observatory") responds to the Reply Comments of Robert Bosch LLC (Bosch) as posted on 4/20/2015.

II. The Kitt Peak Test

2. At ¶12 in its reply comment, Bosch asserts that car radar emissions were detected in the Kitt Peak test due uniquely to the circumstance that the optical path was diverted toward the radar and that such circumstance, or any interference, could not occur under actual conditions. However, the test report that Bosch co-authored reads otherwise, ie

"A zone of avoidance of about 30 to 40 km around a mm-wave observatory would be needed, in order to keep interference from a single vehicle below the threshold defined in RA.769-2. … " with some caveats regarding mitigating circumstances over which Bosch and NRAO have argued in this forum. Bosch should not repudiate the conclusions of a test that it helped to design and whose results it endorsed.

3. In any case, the use of gain in the Kitt Peak test was for the convenience of the testers (including Bosch, which participated in the test design) and the telescope operator**.** The gain employed in the test was taken into account when the conclusions were drawn, as, indeed, all interference calculations from terrestrial transmitters to radio astronomy operations employ 0 dBi gain, as stated in ITU-R Recommendation RA. 769.

4. NRAO asserted that the SRR devices used in the Kitt Peak test had much smaller eirp than would be found on operational radars. At ¶15 Bosch discusses the power levels and eirp of SRR. Bosch asserts that it is coincidental that the 9 – 11 dBm eirp of the devices used in the Kitt Peak test are just those that are now cited in ITU-R Recommendation M.2057 as the input power levels to an operating car radar, before the outgoing gain of 23 – 35 dB or more. Somewhat conflating the radiated power and eirp, Bosch says that the higher eirp now cited in M. 2057 are due to advances in technology since the Kitt Peak test, and asserts that eirp in actual use are well below the maximum proposed by the FCC or in M. 2057, although without quantification.

5. The allowed power levels outside the vehicle in Europe cited by Bosch, -9 dBm/MHz, correspond to 7 mW over 4 GHz. NRAO hopes it is clear that this and the higher input power level -3dBm/MHz cited by Bosch refer to power, not eirp. In any case, 10 mW appears to be a fair estimate of the external radiated power.

6. At ¶21 concerning eirp levels, Bosch asserts that "NRAO's assumptions are not relevant when considering real world vehicular radar sensors," without quantifying what this actually means. The eirp requirements for SRR (actually, the output power requirements for 23 dBi outgoing gain) are discussed in Tables 1 and 2 of Annex C of ITU-R Report M. 2322. The stated goal of using SRR at ranges up to 100 m requires an operating eirp of 25 dBm to detect a car (Table 1) and more than 30 dBm to detect a person, in clear weather (Table 2 stops at 90m, requiring an extrapolation). This seems to imply that the need for eirp well in excess of 10 dBm should always have been understood on physical grounds. A 35 or more dB difference between the (10 mW) input power and outgoing eirp is present in the most recent version of the older car radar ITU-R Recommendation M.1452 that was being developed while the Kitt Peak tests were in progress.

7. A further criticism of the Kitt Peak test by Bosch was that it used stationary vehicles, which is not true: results were comparable for tests on stationary and moving vehicles. Moreover, at ¶23 Bosch says "In summary with respect to NRAO's conclusions at paragraph 25 of its comments, a stationary vehicle is not a situation that will be found and because of its rarity it is not a problem that calls for a regulatory solution." NRAO recalls that Toyota successfully petitioned the Commission several years ago to remove the then-current regulatory restriction that car radars had to be muted when the

vehicle was at rest. As for Bosch's assertion that cars never have their electrical systems on while at rest, it simply defies credulity.

III. Sidelobes

8. At several points, Bosch states that emissions cannot be received by a radio telescope unless the telescope is pointed at the emitter, for instance at ¶15 in repudiating the Kitt Peak test result and at ¶19 where Bosch notes that telescopes do not point below 5° elevation, ie toward cars on roads at lower elevation. All radio astronomy interference calculations for terrestrial transmitters are done using 0 dBi gain, that of an isotropic sidelobe, and are designed to be independent of the orientation of the telescope.

9. Moreover, radiation enters the sidelobes of an antenna merely by falling on or near the physical antenna structure, as those from car radars indeed will.

10. It is a tired canard that radio antennas must point at a source of radiation to receive interference from it and this is true of all radio science, not just radio astronomy.

IV. Fixed radars

11. At ¶16 and footnote 16, Bosch asserts that fixed radar installations will be a much larger interference problem for radio astronomy, particularly regarding height, and that both NRAO and CORF were remiss in not discussing this. However, for its part, NRAO simply wished not to beat a dead horse. The Commission has already denied regulatory relief in the form of exclusion zones and height restrictions around radio astronomy sites in the Tank Level Probing Radar proceeding ET Docket 10-23 even after the radar vendors had pre-agreed with NRAO to effect this solution, which is in force in Europe.

12. Bosch might have been aware of this situation, given that it cited the relevant FCC Order 14-2 (see it at ¶59) in its footnote 12. Perhaps the Commission will wish to re-visit its earlier decision now that Bosch has pointed out the severity of this problem.

V. A misreading of the NRAO comments

13. At paragraph 19 of its comments, Bosch misinterpreted NRAO's remarks regarding the relative levels of wanted and unwanted emissions. NRAO was referring to the power levels for in-band and unwanted emissions proposed by the Commission. With this understanding, NRAO stands by its statements.

VI. Has compatibility already been demonstrated for LRR at 76 – 77 GHz?

14. Bosch is fond of saying that radio astronomy and LRR have already been operating compatibly, in the current case, since 1996 (Bosch comments at ¶27). After having noted many times the miniscule market penetration for such radars, NRAO challenges Bosch to support its supposition that cars with such radars have ever operated within direct line of sight of any radiotelescope. Bosch was unable to supply an operational radar-equipped vehicle for the Kitt Peak test (Bosch footnote 12).

VII. Off again, on again

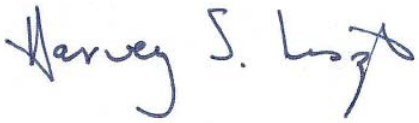
15. In referring to the request by NRAO and CORF for an off-switch (Bosch comments at ¶20), Bosch neglects the separate requests for a GPS-controlled exclusion zone and a manual, operator-controlled switch like those in place in all vehicles for automobile headlights.

16. Bosch neglects to note that GPS-controlled car radar - telescope avoidance systems have operated in Europe for many years to protect radio astronomy operations at 24 GHz. It is not a problem of any sort that "radar and GPS are promoted and sold by vehicle OEMs independently": Both are integrated into cars that are designed by an automobile manufacturer.

17. In this respect, NRAO suggests that Bosch is hardly in a position to speak authoritatively about the automobiles into which its devices may be incorporated, which seems more appropriate to the car manufacturers.

18. NRAO respectfully suggests that solutions to the car radar interference problem cannot be left to Bosch and the other radar device OEMs, but must engage the car manufacturers whose vehicles will have to be designed to follow the Commission's rules.

Respectfully submitted,
National Radio Astronomy Observatory



_____
Harvey S. Liszt
Astronomer and Spectrum Manager

Direct correspondence to:
Dr. Harvey S. Liszt (hliszt@nrao.edu)
Spectrum Manager
National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903-2475