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

In the Matter of	)	
Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band	)	WT Docket No. 07-293
Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band	)	IB Docket No. 95-91 GEN Docket No. 90-357 RM No. 8610

To: The Commission

COMMENTS OF AEROSPACE
and FLIGHT TEST RADIO COORDINATING COUNCIL

Aerospace and Flight Test Radio Coordinating Council ("AFTRCC"), by its counsel, hereby submits its Comments on the Notice of Proposed Rulemaking in the above-captioned proceeding. As discussed in detail below, certain of the proposals made by the WCS Coalition, if adopted, would cause serious interference to flight test telemetry.

Introduction

AFTRCC is the recognized Non-Federal Government coordinator for the shared, Government/Non-Government spectrum allocated for flight testing. AFTRCC works closely with Government Area Frequency Coordinators, who are responsible for Federal Government use of the spectrum, in an effort to ensure that interference-free flight test operations are protected, and hence flight safety maximized.

AFTRCC is also an association for the nation's principal aerospace manufacturers. In this capacity AFTRCC serves as advocate for the aerospace industry on matters affecting

spectrum policy. This fundamental mission was at the heart of AFTRCC's formation 54 years ago. Among its many accomplishments is AFTRCC's role in helping lead efforts which resulted in the allocation of the telemetry band at issue here, namely 2360-2395 MHz.[1]

Prior to 1997, the entirety of the band 2310-2390 MHz was authorized domestically for aeronautical mobile telemetry. In that year, the agency awarded licenses for the Satellite Digital Audio Radio Service ("SDARS") in the sub-band 2320-2345 MHz, and for the Wireless Communications Service ("WCS") in the sub-bands 2305-2320 and 2345-2360 MHz. Thus, WCS is immediately adjacent to the flight test band which begins at 2360 MHz.

The Commission's Notice invites comment on a "broad[ ]" set of issues affecting not just rules for SDARS terrestrial repeaters, and revisions to the rules for WCS operators, but also the implications of proposed changes on the "risk of interference with adjacent channel licensees, whether they are WCS, SDARS or licensees outside of the 2305-2360 MHz range....." Id. at paras. 3 and 22. Among these are Coalition proposals to relax out-of-band emission ("OOBE") levels for WCS mobile stations to 55 + 10 dB log (P) instead of the current 110+10 log (P) dB into SDARS spectrum. Id. at paras. 21-22. This proposal would increase dramatically the risk of interference to flight test telemetry. Hence, the current OOBE limits for WCS interference into the flight test band need to be significantly tightened.[2]

Background on Flight Testing

Aeronautical telemetry is used to gather data from aircraft and missiles undergoing flight testing. These data measure critical parameters such as stresses on control surfaces, engine temperatures, and fluid pressures, among many other measurement points. The telemetry stream

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[1] AFTRCC's memebrship includes the Companies shown on the attachment, among others.

[2] Those limits are currently 43+ 10 log (P) for 2360-2370 MHz and 70+ 10 log (P) for 2370-2390 MHz. Rule 27.53 (a).

provides a real-time link between engineers in the control room and the aircraft. While manufacturers avoid conducting flight tests over populated areas, telemetry receive antennas are frequently co-located with aircraft manufacturing plants. Employing thousands of people, these plants are found in or near metropolitan areas like St. Louis, Seattle, Wichita, and Ft. Worth.

Test data is transmitted from the aircraft typically using a 10 watt transmitter to extremely sensitive, 8-foot or larger, high-gain, dish antennas. These antennas are designed to detect weak and fluctuating signals from distances as far as 200 miles away as the aircraft undergoes what are often extreme maneuvers. Besides greatly enhancing the efficiency of flight test programs, this enables the engineers to detect dangerous conditions aboard the aircraft, and warn the pilot.

The receive antennas track the aircraft using the telemetry signal transmitted from the aircraft itself: If interference occurs, the tracking antenna can lose lock on the aircraft. It must then re-acquire the aircraft, a process made difficult by the fact that it is a high gain antenna seeking to locate and "capture" an aircraft using a pencil-thin beam. While this process is going on, test data are lost. This may require a re-flight at a cost of hundreds of thousands of dollars. Beyond this, if lock is lost during critical maneuvers, the risk to the pilot and persons on the ground increases significantly.

In short, AFTRCC Members are concerned about the risk of interference to telemetry -- the kind of risk inherent in certain of the Coalition's proposals.

Mobile Deployment

As AFTRCC understands it, the Coalition contemplates mobile and portable WiMax deployment, as well as high power base stations and lower power fixed stations at subscriber premises. Applications include Internet access and voice over Internet protocol. In such a scenario, an indeterminate number of mobile/portable subscribers could seek to transmit in any

given area at any given time. These devices, together with fixed subscriber stations, could be located at street level, or in the upper stories of high-rise office or apartment buildings, with a clear view of telemetry ground stations.[3]

The Engineering Statement attached hereto observes that where an AMT ground station receive antenna is pointed toward a WCS mobile transmitter, for example, the 43 + 10 log (P) dB OOBE level satisfies AMT protection levels (cf. eqn. 1) only at distances *r* over 100 km, that is well beyond the line of sight.

Moreover, this is based on single-entry analysis. No allowance has been made for aggregate effects. Being a consumer service, the aggregate effects could be considerable and would exacerbate the interference.

Thus, the current OOBE limit of 43+ 10 log (P) for 2360-2370 MHz and even 70+ 10 log (P) for 2370-2390 MHz is insufficient. As the Commission considers the Coalition's proposals for a fundamental re-structuring of WCS regulations, a significant tightening of the Rule 27.53(a) is required. This is timely since, what has worked to this point while WCS has been struggling (for years) to define a purpose and a technology,[4] will not work at all if mobile applications are allowed to proliferate.

The Coalition has proposed a range of values between 55 + 10 log (P) dB to 67 + 10 log (P) dB for low power fixed and mobile transmitters, depending on the separation in frequency from the edge of the WCS band. The 55 + 10 log (P) dB limit, which is the least restrictive, produces a separation distance of 32 km from telemetry receivers in order to avoid interference

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[3] Telemetry antennas are frequently mounted on structures 20 to 100 feet above ground so as to achieve a better view of distant test aircraft.

[4] As the Notice indicates, the direction of WCS was "uncertain[ ]" for so long that WCS licensees were granted a three-year extension of their build-out requirements in December 2006. Id. at para. 12.

to telemetry. The 67 + 10 log (P) limit produces a separation of 8 km to avoid interference. But a focus on separation distances per se misses the point: There is no way a telemetry operator, particularly one located in or near an urban area, can enforce a separation distance as against ubiquitous mobile, portable, and low power subscriber premises equipment. Accordingly, AFTRCC urges that the current limit of 110 + 10 log(P) dB not only be retained for the SDARS band -- which has afforded de facto protection for the AMT band -- but formally extended to protection of the AMT band from mobile and low power fixed stations as well.

To be sure, this may limit WCS largely to the provision of fixed services. However, WCS licensees took their spectrum knowing the OOBE restrictions that had been imposed for the protection of SDARS. See *Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service*, 12 FCC Rcd 10785, 10787 (¶ 3) (1997) ("mobile operations in the WCS spectrum [may be] technologically infeasible)." The Commission warned prospective bidders that "wide area, full mobility systems and service such as those being provided or anticipated in the cellular and PCS bands are likely to be of questionable feasibility." *Amendment of the Commission's Rules to Establish Part 27,* 12 FCC Rcd 3977, 3979 (¶ 5) (1997); see also 47 C.F.R. § 27.52(a) (9). [5]

Nor is the change necessary for the provision of WiMax services. Other bands including the PCS and cellular bands, the EBS and BRS bands, 1.7/2.1 GHz band, and the forthcoming 700 MHz band, are all available for this purpose.

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[5] Recognizing this, the entire 30 MHz of WCS spectrum was auctioned for under $14 million. *See* Press Release, *WCS Auction Closes*, Public Notice, 12 FCC Rcd 21,653 (1997) (noting that Auction 14, the WCS auction, "raise[d] a net total of $13,638,940 for the U.S. Treasury"). Licenses for some major U.S. cities like St. Louis went for a $1.00 each.

The OOBE from WCS Base Stations Should Be the Same on Both Sides of the WCS Band.

The Coalition has also proposed an OOBE limit of 75+ 10 log (P) for base station emissions into the SDARS band, i.e. on the other side of 2345-2360 MHz. If WCS equipment is designed to achieve this roll-off on one side of the band, there is no reason why it should not achieve the same roll-off on the other side -- indeed, this would be expected as a matter of standard design principles.

However, in AFTRCC's view adoption of the 75+ 10 log (P) OOBE limit, while necessary, is not sufficient. It should be backed up by a coordination regime to protect AMT stations. In particular, AFTRCC proposes that any WCS base station to be located within line of sight of an AMT receiver be subject to prior coordination with the affected AMT operators or their representatives.

Underscoring the importance of tightening the OOBE limit for WCS base stations from 43 +10 log(P) dB to 75 + 10 log(P) dB is the Coalition's apparent proposal to measure WCS base station power on an average rather than peak basis, with a potential peak to average ratio of as much as 13 dB. See WCS ex parte presentation of November 16, 2007 at attachment, page 3 (definition of *P* for defining OOBE limits). When the peak power exceeds the interference threshold for AMT operation for even periods as short as tens of microseconds, significant numbers of data bits in the ~5 Mbps AMT telemetry stream will be corrupted, and the telemetry antenna may lose its track. Adoption of the tighter OOBE limit will help compensate for this factor as well.[6]

[6] The power limit should be applied to EIRP rather than transmitter output power and, if average power is to be the measure, peaks limited to 6-8 dB for no more than 0.1% of the time.

Conclusion

For the foregoing reasons, AFTRCC urges that the Commission revise Part 27 consistent with the points advanced herein.

Respectfully submitted,

AEROSPACE and FLIGHT TEST RADIO
COORDINATING COUNCIL

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February 14, 2008

ENGINEERING STATEMENT

Analysis of Out of Band Interference into Flight Test Ground Stations operating in the band 2360 – 2390 MHz from WCS Fixed and Mobile Transmitters Operating in the band 2345 – 2360 MHz.

Introduction

Aeronautical Mobile Telemetry (AMT) operations are conducted in the band 2360 – 2390 MHz. The band from 2345 – 2360 MHz (together with 2305 – 2320 MHz)has been allocated for fixed and mobile use by the Wireless Communication Service (WCS).

Existing rules for out of band emissions (OOBE) from WCS devices operating in the band 2345-2360 MHz stipulate that from 2360 – 2370 MHz, a 43 + 10 log (P) dB per MHz limit applies. For the frequencies 2370 – 2390 MHz, the limit changes to 70 + 10 log (P) dB. Rule 27.53(a).

Since the allocation of the bands 2305 – 2320 MHz and 2345 - 2360 MHz for WCS ten years ago, there has been little, if any, development in the band, due to technological and application uncertainties. This appears about to change, and it is appropriate, therefore, to revisit the rules for this spectrum, given the anticipated expansion of its use. In particular, the Commission should revisit OOBE limits for protection of AMT vis-à-vis WCS.

Of particular concern is the potential use of the WCS band for mobile, portable, and fixed user applications. This will be in conjunction with a network of high power fixed site transmitters located on towers and buildings.

Recommendation ITU-R M.1459 of the International Telecommunications Union specifies the following pfd limit in order to protect aeronautical mobile telemetry (AMT) ground stations at low AMT ground station elevation angles against interference:

$$-180 \text{ dBW/m}^2 \text{/4 kHz} \quad (1)$$

As demonstrated below, the current 43 + 10 log (P) dB rule will not provide this level of protection. Furthermore, there is no mechanism under which coordination between AMT and mobile users can be accomplished. Details follow.

Analysis

To measure the protection afforded by the 43 + 10 log (P) dB rule against Rec. M.1459 standards, it is appropriate to compute a separation distance *r* within which out of band interference from WCS into AMT will occur. If one assumes a mobile WCS transmitter with an antenna gain of 0 dBi operating within line of sight of an AMT ground station telemetry receive antenna, we have

$$pfd_r = \frac{P_{OOBwcs} G_{wcs}}{4\pi \cdot r^2} \cdot \frac{4 \cdot 10^3}{10^6} \qquad (2)$$

where the numerical factors at the right hand side of the equation scale the 1 MHz bandwidth of the xx + 10 log (P) limit to the 4 kHz bandwidth of the Rec. M.1459 limit given by equation (1).

For an AMT ground station receive antenna pointing at a WCS mobile transmitter, the 43 + 10 log (P) dB OOBE level satisfies AMT protection levels (cf. eqn. 1) only at distances *r* over 100 km, which is well beyond the line of sight. This means that whenever a mobile or portable WCS transmitter is within line of sight of the main beam of an AMT ground station, interference will occur.

Various adjustments to account for terrain blockage, ground attenuation, etc., can be introduced into equation (2). However, portable WCS transmitters could also be operated in the upper stories of buildings with a clear line of sight to AMT ground stations.[1] This will be particularly true in areas such as St. Louis, Wichita, and Seattle where AMT ground stations are located at or near urban airports.

Of course, a similar situation will occur with fixed site WCS transmitters. Furthermore, WCS appears to propose that for user stations at fixed sites (e.g. a customer's premises), the OOBE limit will apply to transmitter output power, rather than to the transmitter's EIRP. See WCS filing of July 9, 2007 at Exhibit A, proposed Rule 27.53(a) (2). This means that for a fixed site installation utilizing a high gain directional antenna, the OOBE into the AMT band will be increased by an amount equal to the directive gain of the WCS antenna.

Of further concern is the proposal by the WCS Coalition for the use of average, rather than peak fixed site transmitter power in the definition of *P* used in defining OOBE limits, with a potential peak to average ratio of as much as 13 dB. See WCS ex parte presentation of November 16, 2007 at attachment, page 3. When the peak power exceeds the interference threshold for AMT operation for even periods as short as tens of microseconds, significant numbers of data bits in the ~5 Mbps AMT telemetry stream will be corrupted.

For prolonged exceedances (ranging from fractions of a second to seconds) of average power, the AMT receiver can lose bit synchronization. When this occurs, successful short term reacquisition of the telemetry signal is difficult to achieve. This is because the parabolic dish at the AMT ground station, which is tracking the motion of the aircraft based on measurement of the received telemetry signal strength, must "re-find" the aircraft. Because of the narrow beam of the parabolic dish antenna, this is a difficult and time-consuming process. During this search, what would in many systems be a rapid and automatic signal reacquisition is, for flight test, a cold-start acquisition of the AMT

[1] For the discussion here, portable WCS devices are regarded as falling under the proposed OOBE emission rules for mobile stations. See Coalition filing of November 16, 2007 at attachment page 7.

signal. During this time, the flight test aircraft and crew are at risk, and the financial cost of re-flying "test points" can be very large.

Furthermore, one cannot assume that main beam conjunction of an AMT ground station tracking antenna with a WCS transmitter is a low probability event. AMT antennas do not rotate with a predictable period, as do some radar antennas. They follow the aircraft, and antenna azimuth angles can vary rapidly, or slowly, during different time segments of the same test flight. Thus, a WCS fixed site, or an aggregation of large numbers of WCS mobile transmitters, could be present in the main beam for extended periods of time.[2] And, for ubiquitous WCS deployment, the density of WCS transmitters in view of the AMT telemetry receive antenna may be large for most, and perhaps all, values of antenna azimuth angle.

It is possible, in principle, to establish a coordination procedure between AMT and WCS base stations that could address out-of-band emissions from WCS base stations into AMT. No such approach is practical in the case of mobile, portable, and low power fixed subscriber units. For them, detectable out-of-band emissions must be precluded altogether.

The current OOBE limit for emission from WCS mobile transmitters into the SDARS band is 110 + 10 log (P) dB -- a limit which has provided de facto protection for the AMT band as well.

In a recent filing, the WCS Coalition has proposed a range of values between 55 + 10 log (P) to 67 + 10 log (P) dB for low power "fixed" and mobile transmitters, depending on the separation in frequency from the edge of the WCS band. See Coalition ex parte filing of July 9, 2007, Exhibit A, at page 1.

From the perspective of AMT operations, these low power "fixed sites" must be regarded as being mobile, as there is apparently no means for knowing where these transmitters are, and with whom coordination or resolution of harmful interference can be accomplished.

However, 55 + 10 log (P) dB, which is the least restrictive of the OOBE limits proposed by the Coalition for mobile and low power fixed sites, produces a separation distance of 31.7 km from telemetry receivers within which interference to telemetry could occur. For 67 + 10 log (P) dB, the distance is 8.0 km. Either of these OOBE limits would permit the operation of numerous WCS subscriber stations within interference range of AMT receivers. Thus, for successful operation of AMT ground station receivers within line of sight of WCS mobile and low power "fixed site" mobile transmitters, it is necessary that the OOBE limit for these transmitters be maintained at 110 + 10 log(P) dB for the SDARS band, and applied to the AMT band as well. This

[2] AMT receive antennas are typically mounted on towers or buildings 20 – 100 feet above the ground, enabling the common practice of operating down to zero degrees of elevation in order to track aircraft as much as 200 miles away.

limit will preclude a proliferation of devices which, by definition, are incapable of coordination.

In other words, given the ubiquity of mobile and portable use the separation distance necessary to protect AMT needs to be, for practical purposes, zero. There is no way of enforcing a protection limit for AMT receive locations, particularly those in or near urban areas, that is any less stringent than that.

The Coalition has also proposed that the OOBE limit for WCS base stations be 75 + 10 log (P) dB. AFTRCC concurs that it is necessary to tighten the OOBE limits for these sites from the current 43 + 10 log (P) rule to the more restrictive value 75 + 10 log (P). In addition, there must be a specified limit on the maximum WCS fixed site antenna gain -- unless the 75 + 10 log (P) dB rule is to be applied to EIRP, rather than transmitter power. Finally, peak, rather than average power should be used, unless there is a considerable reduction (e.g., 7 – 8 dB) in the peak to average ratio from the proposed value of 13 dB, and the occurrence of peak excursions is strictly limited (e.g., to less than 0.1% of the time).

My qualifications to present this Statement are attached.

Daniel G. Jablonski

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February 11, 2008

Daniel G. Jablonski, Ph.D.

PROFESSIONAL EXPERIENCE

1991 - Present: Physicist and Electrical Engineer, the Johns Hopkins University Applied Physics Laboratory (JHU/APL), Laurel, MD

1986 - 1991: Research Staff Member, Supercomputing Research Center, Institute for Defense Analyses, Bowie, MD

1981 – 1986: Research Physicist, Naval Surface Warfare Center, White Oak, MD

FACULTY APPOINTMENTS

1999 - Present: Instructor, Engineering Programs for Professionals, Whiting School, Johns Hopkins University

1985 - Present: Adjunct Professor, Capitol College, Laurel, MD

EDUCATION

Ph.D., Physics, Cambridge University, 1982

M.S. Electrical engineering and Computer Science, Massachusetts Institute of Technology, 1977

B.S. Electrical Engineering, Massachusetts Institute of Technology, 1976

TECHNICAL INTERESTS

Communications, microwave engineering, spectrum management, and spacecraft mission design, navigation, and analyses.

RECENT PROFESSIONAL ACTIVITIES

Over ten years analytical, laboratory, and range experience with aeronautical mobile telemetry operations, including flight line and flight test experience with F/A-18 E/F, F/A-18 C/D, T-2, T-38, V-22, and other aircraft.

Member of the U.S. Delegation, 2003 and 2007 World Radio Conferences, Geneva, Switzerland

Principal Investigator, "Steerable Beam Antennas for Flight Test Telemetry," for the Department of Defense, 2006 – 2008

Project Manager, "X-Ray Navigation and Autonomous Position Verification (Xnav)", for the Defense Advanced Research Projects Agency, 2006

Principal Investigator, "X-ray Communications", for the Johns Hopkins University Applied Physics Laboratory, 2008

Project Manager, Deep Space Network Antenna Arraying Analysis, NASA, 2008.

RECENT PUBLICATIONS AND PATENTS

Author, numerous FCC filings, engineering statements, and Coordination Agreements.

Author, numerous ITU submssions.

Author, several reports and analyses on compatibility and adjacent band interference between GPS and other systems, including L-band AMT.

Co-author, ITU-R Technical Report M.2118, "Compatibility between proposed systems in the aeronautical mobile service and the existing fixed-satellite service in the 5 091 – 5 250 MHz band", November 2007.

"The Three-Axis Antenna," provisional patent application filed 2007.

Contributor, Encyclopedia of Material Science and Engineering.

Contributor, **Reference Data for Engineers**, 9th Ed.

Contributor, **The World Book**, 2009 Edition.

Inventor of numerous other patents, applications, and disclosures

Author, over 60 additional publications.

PROFESSIONAL ACTIVITIES
Senior Member, IEEE
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Member of the Editorial Board, *IEEE Transactions on Microwave Theory and Techniques*
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