April 10, 2002

Via Electronic Filing

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: MSS ATC Out-of-Band Emission Limits:
***Ex Parte* Filing in IB Docket No. 01-185; ET Docket 95-18**

Dear Mr. Caton:

Please find attached a written *ex parte* presentation delivered today to Trey Hanbury, J. Breck Blalock, and Paul Locke of the International Bureau.

In accordance with Section 1.1206(b) of the Commission's Rules, I am submitting an electronic copy of this letter, and the attached presentation, for inclusion in the public record.

Respectfully submitted,

/s/

Lawrence H. Williams
ICO Global Communications (Holdings) Ltd.

Enclosure

1730 Rhode Island Ave., NW
Suite 1000
Washington, DC 20036

202 721 0960 phone
202 296 8953 fax
web: www.ico.com

April 10, 2002

<u>Via Electronic Filing</u>

Mr. Trey Hanbury
Special Counsel
International Bureau
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: MSS ATC Out-of-Band Emission Limits:
***Ex Parte* Filing in IB Docket No. 01-185; ET Docket 95-18**

Dear Mr. Hanbury:

ICO Global Communications (Holdings) Ltd. ("ICO") is pleased to respond to your request for an *ex parte* filing to explain ICO's views on appropriate out-of-band ("OOB") emission limits for Ancillary Terrestrial Components ("ATCs") of MSS networks operating at 2 GHz.

As you know, in the ATC *Notice of Proposed Rulemaking*,[1] the Commission proposed to adopt emission limits for ATC operation modeled on the limits currently in place for broadband PCS.[2] Although the MSS industry generally supported the ATC concept, one commenter sought assurances that ATC operation in the MSS downlink spectrum would not cause interference to adjacent MSS operations.[3] Following a thorough review of the technical issues that were raised, ICO filed an *ex parte* letter agreeing that the PCS limits may not

[1] In re Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band, *Notice of Proposed Rulemaking*, 16 F.C.C. Rcd. 15532 (2001) ("*NPRM*").

[2] *Id.* at 15555-56; *see also* 47 C.F.R. § 24.238.

[3] *See* Comments of The Boeing Company, IB Docket No. 01-185. ET Docket No. 95-18 (filed Oct. 19, 2001) ("Boeing Comments"), at 5-7, 9-10.

1730 Rhode Island Ave., NW
Suite 1000
Washington, DC 20036

202 721 0960 phone
202 296 8953 fax
web: www.ico.com

adequately protect MSS operations in adjacent downlink spectrum.[4] Since that time, ICO has worked intensively with some of the other MSS licensees to develop workable limits and is confident that sufficient protection against harmful OOB interference from MSS ATCs can be achieved through efficient engineering and appropriate OOB emission limits. As requested, this letter explains ICO's analysis and outlines our proposed rule revisions for MSS ATC OOB emissions. The text for the proposed rule appears in Attachment A.

As an initial matter, ICO notes that the 2 GHz MSS band is not like other frequency bands where frequency assignments and channelizations are predetermined. In those more usual cases, OOB emissions are easily specified in terms of offsets from a center frequency. In contrast, the 2 GHz MSS spectrum environment makes it possible, if not likely, that channelizations and network architectures for both Satellite Components ("SCs") and ATCs of the MSS systems will vary considerably from operator to operator and spectrum block to spectrum block. There is therefore no single set of center frequencies that would apply to all MSS or ATC implementations. As a result, the OOB emissions should be specified in terms of levels received in the band assigned to any other active MSS system. That is, the MSS ATC OOB emission limits adopted by the Commission should be specified in terms of emission limits in other MSS frequency blocks that are actually used by other MSS licensees, rather than by specified offsets from the center of a particular MSS block.

ICO proposes that the Commission adopt the following general OOB emission limits for MSS ATCs:

	When Transmitting in MSS Uplink Spectrum[5]	**When Transmitting in MSS Downlink Spectrum**[6]
Limits for ATC Base Stations	-67.0 dBW / 4-kHz	-100.6 dBW / 4-kHz
Limits for MSS User-Terminals Operating in ATC Mode	-67.0 dBW / 4-kHz	-119.6 dBW / 4-kHz

These limits should be measured at the transmitter (whether base station or UT) in the receive band assigned to the adjacent MSS systems. The limits for MSS uplink spectrum are identical to the PCS emission limits in Section 24.238 of the Commission's Rules. The limits for the downlink spectrum are more stringent, in recognition of the fact that ATC operations in MSS downlink spectrum likely represent a greater interference threat to MSS SC operations.[7]

---

4 *See* Letter from Suzanne Hutchings to William Caton, dated Jan. 29, 2002 ("Hutchings *Ex Parte*").

5 All values refer to effective isotropic radiated power ("EIRP") at the antenna output.

6 *Id.*

7 Correspondingly stringent limits are not needed to protect MSS SC uplink operations and would therefore be overly restrictive. If the downlink ATC OOB emission limits were also adopted in the

Attachment B shows how the proposed limits for the downlink direction will prevent any harmful interference from ATC operations into other MSS systems when appropriate separation distances are taken into consideration.

MSS operators could comply with the proposed limits for ATC operations through a combination of measures of each operator's own choosing. One such measure would be to reserve frequencies closest to the edge of the operator's MSS channel block for SC operations only, effectively creating an internal ATC "guardband" between MSS channel blocks. ICO has previously noted[8] that it could use an additional internal guard band for the ATC carrier of 0.611 MHz from the edge of its selected spectrum assignment. This internal guard band, together with the .389 MHz that already exists between adjacent channel blocks, would provide approximately 14 dB of further attenuation for ATC base-station and UT operations.

Another measure would be to use improved hardware components in the base stations and/or MSS UTs in ATC mode. Also, out of band emissions could be improved by approximately 30 dB and 12 dB for ATC base stations and UTs respectively by using improved hardware components/design.[9] Examples of readily available, low-cost hardware improvements include additional IF and RF filtering, sufficiently linear amplifiers, and improved local oscillators and LO filters. These, of course, are only examples of how an MSS-ATC operator could achieve the desired OOB emission levels; the optimal combination of guardbands and hardware improvements would depend on each operator's specific implementation choices and target services.

ICO is confident that ATC transmitters can be designed to meet the emission limits, that the limits will not unduly constrain either the satellite or the terrestrial component of 2 GHz MSS networks, and that the limits will provide sufficient interference protection under any of the ATC architectures proposed by ICO. Moreover, the actual MSS ATC OOB emissions into adjacent MSS spectrum are likely to be even lower than the proposed rule will require. For example, ICO expects that MSS ATCs s will make use of additional attenuation methods such as voice activation and power control. Voice activation makes use of the natural pauses during human speech to reduce transmit power. Cellular networks employ voice activation to limit transmit powers of base stations and UTs, as well as to preserve UT talk times. Normally, voice activity on a channel is considered to be approximately 40 percent. Taking a 40 percent

---

uplink spectrum, the cost and design difficulty for ATC UTs and ATC base stations transmitting in the uplink spectrum would rise considerably, and unnecessarily.

8 *See* Hutchings *Ex Parte* at 1.

9 ICO has reviewed recent data on critical components that can affect OOB emission levels and believes that improved hardware, together with careful attention to the transmitter design, can achieve these OOB emission levels.

voice activity factor into account would yield about a 4 dB improvement in the OOB performance of both ATC base stations and UTs. Likewise, ICO proposes to use power control both to optimize capacity of its system and to reduce emission levels in non-ICO bands. Taking power control into account, with a large number of mobile users and a more or less uniform distribution of users over a given cell, the average power transmitted from the UTs to the base station can be conservatively estimated at –4.77 dB below the power required at the edge of the cell. As with voice activation, the average power level of both UT and base-station transmissions, as well as the attendant out of band emission levels will be reduced by this amount.

Considering the MSS ATC emissions in the uplink band, ICO supports the Commission's proposal to use emission rules based on section 24.238 (translated to –67 dBW/4-kHz). Boeing's earlier filing expresses no concern about the proposed limits for MSS ATC emissions in the MSS uplink[10]. An example calculation using Boeing's aeronautical mobile-satellite (route) service ("AMS(R)S") is shown in Attachment B and explains how the proposed emissions of –67 dBW/4-kHz in the MSS uplink will allow ICO to provide service to a large number of MSS users in ATC mode and also keep the aggregate emissions generated within another MSS satellite footprint to within half of the co-ordination interference threshold of 6% $\Delta T/T$ (assuming 3% is allocated to the SC and 3% is allocated to the ATC).

ICO can assure the Commission that ICO's proposed limits are sufficient to protect MSS operations against harmful OOB interference and should therefore accommodate all parties' concerns. Notwithstanding, as the Commission is aware, Boeing's system is unique among 2 GHz MSS licensees in that it is designed primarily to provide aeronautical service. Therefore, Boeing may have unique interference concerns regarding AMS(R)S operations, particularly while airplanes equipped with their receivers are on the ground.[11] For example, Boeing's concerns seem to extend beyond OOB emissions, and encompass the issue of receiver saturation as well.[12] As explained more fully in Attachment C, ICO has investigated the specific issue of saturation and concluded that, with an appropriate selection of "off-the-shelf" receiver components and a proper design effort, saturation levels in the order of –55 dBW to –50 dBW can reasonably be achieved for any MSS UT. Designing receivers to perform at this level will eliminate special saturation concerns relating to operation of Boeing's system

---

10 *See* Boeing Comments at 12-13.

11 The range in which such concerns are relevant is quite small; ICO presents budgets in Attachment B demonstrating that the proposed OOB emission limits raise no interference concerns whatsoever at 130 meters.

12 Reply Comments of the Boeing Company, IB Docket No. 01-185, ET Docket No. 95-18 (filed Nov. 13, 2001), at 7 (¶ 11). Boeing seems to be concerned that ATC UT or base station transmitters could saturate the front-end of Boeing's receivers in an adjacent band.

on the ground at airports, and will do so with negligible additional cost and effort.[13] To the extent that the aeronautical nature of Boeing's system requires special protection beyond these reasonable measures, the Commission should resolve those concerns in the context of Boeing's earth-station application, as specified in Boeing's space-station authorization.[14]

With the above minor changes to the Commission's proposed OOB limits, ICO is confident that MSS-ATC operations will not generate harmful OOB interference into other MSS systems, including Boeing's AMS(R)S operations. Indeed, these emission limits are stricter than the limits to which 2 GHz MSS licensees are entitled under the current rules. Please find attached proposed rule text that would give effect to the changes described in this filing. If you have any questions or require any additional information, please do not hesitate to contact me at (202) 721-0966.

Respectfully submitted,

/s/

Lawrence H. Williams
ICO Global Communications (Holdings) Ltd.

Enclosure

cc: J. Breck Blalock
Paul Locke

---

[13] ICO stands ready to submit information and data sheets for "off-the-shelf" components that would allow the receiver saturation to be set at a level where ATC interference is of no concern.

[14] *In re* Application of the Boeing Co., *Order & Authorization*, 16 F.C.C. Rcd. 13691, 13704-06 (¶¶ 36-41) (2001). The Commission declared that Boeing's aeronautical operations "shall not grant The Boeing Company any status superior to the status of other 2 GHz Mobile-Satellite Service systems." *Id.* at 13707 (¶ 44(e)).

Attachment A

Proposed Rule Changes

PART 25 – SATELLITE COMMUNICATIONS

1. The authority citation for part 25 continues to read as follows:

   AUTHORITY: 47 U.S.C. 701-744. Interprets or applies sec. 303, 47 U.S.C. 303. 47 U.S.C. sections 154, 301, 302, 303, 307, 309 and 332, unless otherwise noted.

2. Section 25.202 is amended by revising paragraph (f) to read as follows:

Section 25.202 Frequencies, frequency tolerance and emission limitations.

*****

(f) *Emission Limitations.* Except as otherwise provided in subparagraph (f)(5) and (f)(6), the mean power of emission shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

***

(5) For MSS ATC operations in the band 1990-2025 MHz, the EIRP of out of band emissions measured within the authorized uplink frequency band of any other MSS licensee shall not exceed the following limits when the band is in use by another MSS licensee's commercial MSS operations:
   (i) for ATC base stations emissions as specified in (a) shall not exceed –67.0 dBW/4 kHZ;
   (ii) for MSS user terminals, operating in ATC mode, emissions as specified in (a) shall not exceed –67.0 dBW/4 kHz,

(6) For ATC operations in the band 2165-2200 MHz the EIRP of out of band emissions measured within the authorized downlink frequency band of any other MSS licensee shall not exceed the following limits when the band is in use by another MSS licensee's commercial MSS operations:
   (i) for ATC base stations, emissions as specified in (a) shall not exceed –100.6 dBW/4 kHZ;
   (ii) for MSS user terminals operating in ATC mode, emissions as specified in (a) shall not exceed –119.6 dBW/4 kHz,

Attachment B

1. ICO ATC OOB Emission Limits (MSS Downlink)

Table 1 demonstrates how the proposed limits of -119.6 dBW/4 –kHz for MSS UTs in ATC mode and –100.6 dBW/4 –kHz for ATC base stations transmitting in the MSS downlink spectrum will prevent any harmful interference from ATC operations into other MSS systems when appropriate separation distances and other factors are taken into consideration. The calculations take into account the degradation to an adjacent-band MSS UT due to an increase in noise temperature from combined ATC and SC interference. In this calculation, the normal inter-system coordination interference threshold of ΔT/T = 6% is used. The table reveals that the combined degradation due to the ATC and SC of an integrated ATC-SC system would not exceed the ΔT/T = 6% threshold.

Table 1: ICO ATC downlink OOB interference to other MSS UTs[15]

Parameter	Unit	MSS UT in ATC mode	ATC Base Station
Calculation of ATC degradation to other MSS downlink			
OOB emissions at full power (as per ICO proposal)	***dBW/4-kHz***	***-119.60***	***-100.60***
Number of MSS UTs in ATC mode / ATC Base Stations	#	6.00	1.00
OOB Spectral density	dBW/Hz	-147.84	-136.62
Distance to Other MSS UT	***m***	***35.90***[16]	***130.62***[2]
Free Space loss	dB	70.33	81.55
Polarization isolation (Linear-Circular)	dB	1.40	1.40
Total Received Interferer Spectral density from MSS UTs in ATC Mode / ATC Base Stations	dBW/Hz	-219.57	-219.57
Operating frequency	MHz	2185.00	2185.00
Other MSS SC UT Receive Noise Temp	K	200.00	200.00
Other MSS SC UT Receive Noise Spectral density	dBW/Hz	-205.59	-205.59
N/I due to ATC interference	dB	13.98	13.98
ΔT/T increase due to ATC interference	**%**	**4.00**	**4.00**
Calculation of SC degradation to Other MSS downlink			
Maximum Out of Band emissions from the satellite[17]	dBW/4-kHz	-10.00	-10.00
Polarization discrimination, minimum (ICO RHCP to other MSS RHCP)[18]	dB	1.00	1.00

15 Technical parameters used in this table are from the Boeing system.

16 If voice activation of 4 dB and power control of 4.77 dB are used, the distances will be reduced to 15 meters for MSS UTs operating in ATC mode and 50 meters for ATC base station.

17 OOB emissions for the satellite are calculated according to 47 C.F.R. § 25.202(f).

18 *See* ITU Radio Regulations, App. S8, § 2.2.3.

Table 1: ICO ATC downlink OOB interference to other MSS UTs[15]			
Parameter	**Unit**	**MSS UT in ATC mode**	**ATC Base Station**
Out of Band emission density received at the other MSS UT from ICO satellite	dBW/Hz	-226.59	-226.59
Number of visible satellites	#	4.00	4.00
average elevation factor for multiple satellites	dB	-2.00	-2.00
Out of band emission density received at the other MSS UT from all the visible ICO satellites	dBW/Hz	-222.57	-222.57
N/I due to ICO SC interference	dB	16.98	16.98
ΔT/T increase due to ICO SC interference	%	**2.00**	**2.00**
Total Change in Noise Temperature	%	***6.00***	***6.00***

2. ICO ATC OOB Emission Limits (MSS Uplink)

ICO supports the Commission's proposal to use emission rules based on section 24.238 of the Commission's rules (application of those rules results in an OOB emission limit value of –67 dBW/4-kHz). In an earlier filing Boeing expressed no concern over the Commission's proposed limits for MSS ATC s operating in the 2 GHz MSS uplink[19]. Table 2 provides an example calculation using Boeing's proposed system and reveals that the Commission's proposed OOB emission limit of –67 dBW/4-kHz for ATC in the MSS uplink will allow ICO to provide service to a large number of MSS users in ATC mode while simultaneously keeping the aggregate emissions generated within another MSS satellite footprint to within half of the normal inter-system co-ordination interference threshold of ΔT/T = 6% (assuming 3% is allocated to Satellite Component and 3% is allocated to ATC).

Table 2: ICO ATC to Boeing MSS satellites				
Parameter		**Units**	**Value**	**Calculation**
Calculation of acceptable uplink interference (3% ΔT/T)				
Noise Temperature of Boeing MSS Satellites	a	K	450.00[20]	
Noise Density, No of Boeing MSS Satellites	b	dBW/Hz	-202.07	=10log(a)+ Boltzmann's const.
Interference Criteria for ATC interference	c	%	3.00	
I/N due to interfering ATC Base Stations/UTs	d	dB	-15.23	=10log(d)
Aggregate interf. threshold at Boeing Satellite receiver	e	dB	-217.30	=b+c
Satellite Receive antenna gain	f	dB	34.80	

[19] *See* Comments of The Boeing Company, IB Docket No. 01-185, ET Docket No. 95-18 (filed Oct. 19, 2001), at 12-13.

[20] *See id.* at App. A, Table 4.

Table 2: ICO ATC to Boeing MSS satellites				
Parameter		**Units**	**Value**	**Calculation**
Polarization discrimination between ATC Base Stations / UTs and Boeing Satellite	g	dB	3.00	
Frequency of Uplink	h	MHz	2000.00	
Altitude of Boeing Satellite	i	Km	20182.0	
Max. Propagation loss to Boeing satellite at 90 deg. Elevation	j	dB	184.56	=32.45+20 log(h*i)
Allowed aggregate interference in the Uplink within Boeing satellite footprint for 3% ΔT/T degradation.	**k**	**dBW/Hz**	**-64.54**	**=e-f+g+j**
	l	**dBW/4-kHz**	**-28.51**	**=k+10log (4000)**
Calculation of allowed Users in ATC mode in a Boeing satellite beam cluster				
Emissions from one MSS User in ATC mode (Proposed rule)	**m**	**dBW/4-kHz**	**-67**	
Power control for large number of MSS users in ATC mode[21]	n	dB	20	
Voice Activation for large number of MSS users in ATC mode	o	dB	4	
Number of simultaneously active, operating, outdoor MSS users that could be in ATC mode in a Boeing beam cluster	**p**	**#**	**1,778,279**	**=10^((l-m+n+o)/10)**
Total number of MSS <u>subscribers</u> in ATC mode within Boeing satellite beam cluster, operating at 20 mErlang		**#**	**88,913,950**	**= p * 50**

For base stations operating in the uplink, the average gains in the direction of the satellite are well below 0 dBi. Therefore, in the direction of the satellite, OOB emissions will be lower than -67 dBW/4-kHz. Consequently, a number of ATC base stations equal to or greater than the calculated number of MSS UTs operating in ATC mode could be accommodated in the uplink band within the Boeing satellite beam cluster footprint.

Note: The above numbers are the worst case, assuming that MSS ATC operation is close to the edge of the band shared with ATC within the MSS block. The OOB emissions will decrease from - 67 dBW/4-kHz for those ATC carriers located further away from the band edge. This will allow the number of MSS users in ATC mode to increase further.

[21] ICO is ready to provide documentation to support assumptions on power control upon request.

Attachment C

Saturation of SC UTs

Boeing has expressed concerns that extend beyond OOB emission limit values. Specifically, Boeing is concerned about saturation of its proposed receiver front end due to adjacent band ATC operations.[22] ICO has explored the current state-of-the-art for receivers that could be used in the proposed Boeing system and believes that with an appropriate selection of "off-the-shelf" receiver components and a prudent design, saturation levels on the order of –55 dBW to –50 dBW are achievable for any MSS UT.[23]

Table 1 reveals that a MSS UT receiver saturation level of –55 dBW[24] will accommodate operations of ATC base stations and/or ATC UT's at close distances from reasonably designed MSS UTs.

Table 1: Saturation of Boeing SC UTs			
Parameter	**Unit**	**Base Station**	**MSS UT in ATC mode**
Number of ICO MSS ATC emitters	#	1.00	6.00
ATC Transmit frequency	MHz	2185.00	2185.00
ATC emitter transmit EIRP	dBW	27.00	-10.00
Aggregate ATC transmit EIRP	dBW	27.00	-2.22
Polarization Isolation	dB	1.40	1.40
Additional factors (Voice activation, Power control, etc.)	dB	0.00	0.00
Boeing UE Saturation level (-50 dBW possible)	***dBW***	***-55.00***	***-55.00***
Required Path Loss	dBW	80.60	51.38
Required distance from ATC emitter to Boeing UT	***m***	***117.08***	***1.65***

---

22 Reply Comments of the Boeing Company, IB Docket No. 01-185, ET Docket No. 95-18 (filed Nov. 13, 2001), at 7 (¶ 11). Boeing seems to be concerned that ATC UT or Base Station transmitters could saturate the front-end of Boeing's receivers in an adjacent band.

23 ICO stands ready to submit information and data sheets for "off-the-shelf" components that would allow the receiver saturation to be set at a level where ATC interference is of no concern.

24 Boeing's filing of April 5, 2002, cites a receiver-saturation level of –80 dBW, derived from Radio Technical Commission for Aeronautics ("RTCA") requirements for aircraft earth-station receivers in the L-band. *See* Letter from David A. Nall to William F. Caton dated Apr. 5, 2002, Further Technical Analysis at 10. ICO, however, is aware of no RTCA specification of any kind for the 2 GHz band. Boeing is already considering revisions to its receiver design, *id.* at 10-11, and ICO is confident that Boeing can achieve better saturation levels on the order of -55 dBW to -50 dBW.

ICO believes that, in practice, ATC OOB emission levels into other MSS receivers will be significantly lower than those shown above. Factors such as power control, voice activation, antenna isolation and other mitigation techniques will further reduce OOB emission levels. For example, by including 4.77 dB power control and 4 dB voice activation, the distances at which ATC Base Stations and UTs can cause saturation to the Boeing UTs change to 45 meters and 1 meter, respectively.