Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Expanding Access to Mobile Wireless Services Onboard Aircraft	)	WT Docket No. 13-301
	)	

REPLY COMMENTS OF GOGO INC.

Gogo Inc. ("Gogo") submits these reply comments in response to the Notice of Proposed Rulemaking (the "*Notice*") issued on December 13, 2013 in the above-captioned proceeding.[1] As further explained below, the rules proposed in the *Notice* are insufficient as drafted to ensure that the proposed Airborne Access Systems ("AAS") – in particular, the Network Control Unit ("NCU") component of such systems – will not cause interference to Gogo's licensed 800 MHz Air-to-Ground ("ATG") service. Thus, Gogo calls for more express technical restrictions to protect its service. In addition, use of the 850 MHz cellular band on board aircraft poses a significant interference threat to Gogo's licensed ATG service due to the immediate spectral adjacency of this band to Gogo's ATG band. Therefore, Gogo requests that the FCC prohibit use of this cellular band on board aircraft while the aircraft is in flight.

I. Background

Gogo has been a pioneer in the airborne communications sector for more than 20 years and is a leading provider of in-flight connectivity solutions, with the world's largest number of online aircraft in service. Through its subsidiaries, Gogo provides a variety of airborne

[1] *Expanding Access to Mobile Wireless Services Onboard Aircraft*, Notice of Proposed Rulemaking, 28 FCC Rcd 17132 (2013) ("*Notice*").

communications services to both the general and commercial aviation markets, offering both satellite and terrestrial network-based solutions.

Gogo holds exclusive air-ground spectrum at 849-851 MHz and 894-896 MHz (the "800 MHz ATG Bands"), which is immediately adjacent to the cellular service bands at 824-849 MHz and 869-894 MHz.[2] Gogo uses its terrestrial-based network to provide mobile broadband service on more than 2,000 commercial aircraft and approximately 2,250 general aviation aircraft. Gogo has contracts to provide this service for most of the major U.S. airlines, including American Airlines, Delta Air Lines, US Airways, United Airlines, Air Tran Airways, Alaska Airlines, Frontier Airlines, and Virgin America.

II. Network Control Units Could Cause Interference to 800 MHz ATG Networks.

Although the *Notice* tentatively concludes that AAS can facilitate airborne mobile broadband access "without causing harmful interference to terrestrial networks,"[3] it does not appear that the Commission specifically considered the potential impact of such systems on terrestrial-based ATG networks. The Commission seeks comment on an option through which AAS in the U.S. would incorporate an NCU (as European systems do) to raise the noise floor across "all commercial mobile spectrum bands" and prevent onboard mobile devices from communicating with terrestrial networks.[4] As discussed below, without proper restrictions, such NCUs – essentially acting as flying signal jammers – could create harmful interference to other nearby aircraft (or the same aircraft) equipped with 800 MHz ATG service, or to ATG ground stations. This would especially be the case if the NCUs (or other devices) transmit directly

[2] Call signs WQFX728 and WQFX729.

[3] *Notice* at ¶ 32.

[4] *Id.* at ¶¶ 30, 37.

adjacent to the 800 MHz ATG Band, as Gogo understands the NCUs (or other devices) would need to do to prevent mobile devices onboard aircraft from attempting to connect with terrestrial cellular 850 MHz networks.[5] The option to use NCUs in the U.S. may also pose additional interference scenarios that have not been encountered in existing European AAS deployments.

Interference from AAS to ATG on the same aircraft. Without explicit limits on out-of-band emissions ("OOBE"), NCUs or other devices could harm the operation of other equipment already installed in the same aircraft. Because one of the goals of the *Notice* is to expand access to in-flight broadband services,[6] the Commission presumably anticipates that some aircraft might have both an 800 MHz ATG system and an AAS. In that scenario, the NCU would be in close proximity to the ATG antenna, and OOBE limits on the NCU or other devices would need to be adopted.

Due to the many unknown interference variables associated with the co-existence of ATG and future AAS systems on the same aircraft, the Commission should, at the appropriate time, release a public notice ("PN") or notice of inquiry ("NOI") on this issue. In the PN or NOI, the Commission should request that stakeholders submit evidence, including analysis and/or test results, which may be used to develop suitable standards for coexistence between ATG and AAS. After reviewing these submissions, the Commission can consider OOBE and power level requirements for NCUs (or other devices) that will fully protect existing ATG systems operating on the same aircraft as AAS.

Interference from AAS to ATG on nearby aircraft. Any effort to expand access to in-flight broadband services should also protect current 800 MHz ATG services on nearby aircraft

[5] *See* Comments of Aeromobile Communications Limited, WT Docket 13-301, at appx. table 2 (Feb. 14, 2014).

[6] *Notice* at ¶ 1.

from interference. In the absence of technical requirements that specify satisfactory OOBE limits, an NCU or other device following the maximum EIRP defined outside the aircraft of 7.65 dBm/10 MHz[7] will increase the noise floor of a nearby ATG aircraft five nautical miles away by 5.8 dB. This is 11.7 dB higher than the level that would comply with the industry practice to limit interference to within 1 dB above thermal noise. Aircraft regularly fly in the same direction five nautical miles apart; this is the minimum separation distance for enroute flight. In this case, the interference will be long-lived because two aircraft could fly the same route while maintaining five nautical miles separation for the entire trip. There will be cases where interference is more severe, but shorter-lived, when two aircraft crisscross at different altitudes due to closer separation distance. However, the minimum case results in a required EIRP outside the aircraft of no greater than -24 dBm/100 kHz.[8]

The table below explains the assumptions used to conclude that, unless the Commission adopts specific limits, interference would exceed the tolerable level.[9]

[7] *See* European Conference of Postal and Telecommunications Administrations, *CEPT Report 48*, at 4 (Mar. 8, 2013), *available at* http://www.erodocdb.dk/docs/doc98/official/pdf/CEPTRep048.pdf. This report defines NCU maximum effective isotropic radiated power EIRP levels in the European 800 MHz band to be +7.65 dBm/10 MHz as measured outside the aircraft when the aircraft is flying at 8000 meters above mean sea level. For the purpose of these calculations, we assume that the European 800 MHz band is a reasonable proxy for the U.S. 850 MHz cellular band. Gogo notes that these limits were developed to protect co-channel terrestrial networks from harmful interference, not specifically to protect adjacent channel ATG systems. Gogo also notes that this EIRP is possible in the ATG band even if the NCU or other device were to comply with Part 22 rules, because the EIRP outside the aircraft depends on the values of NCU antenna gain and fuselage loss.

[8] This is calculated by subtracting 11.7 dB from 7.65 dB to give a required EIRP of -4 dBm/10 MHz. Converting to typical units used in Part 22 gives -24 dBm/100 KHz.

[9] The tolerable level as defined in this analysis assumes AAS and ATG are used on separate aircraft. As described previously, the issue of interference between AAS and ATG systems coexisting on the same aircraft is potentially much more severe and the technical requirements described here may or may not be suitable to allow this coexistence.

Band Edge	**849**	MHz
Source (Transmitter)	Aircraft A NCU/Picocell	
Victim (Receiver)	ATG Aircraft B Receive	
Source Transmit EIRP Power outside aircraft	7.65	dBm/10 MHz
Path length between source and victim	**5.00**	Nautical miles
Path loss (free space)	110.4	dB
Interference level at Victim Aircraft Antenna	-102.7	dBm/10 MHz
ATG aircraft		
Maximum Antenna Gain	8.5	dBi
ATG receiver noise figure	**4.0**	dB
Thermal Noise	-100	dBm/10 MHz
Interference threshold for 1dB rise in thermal noise floor (tolerable)	-105.9	dBm/10 MHz
Interference level at aircraft receiver	-94.2	dBm/10 MHz
Interference level above thermal noise	5.8	dB
Amount exceeding tolerable interference	11.7	dB

***Interference from AAS to ATG Base Stations*.** It is equally important that NCU emissions protect ATG base stations on the ground. Unlike terrestrial networks that typically employ antenna down-tilt, ATG antennas are directed toward the sky, making them even more susceptible to interference from airborne systems. Similar calculations to the table above show that a single aircraft at 3000 meters altitude and five nautical miles from an ATG base station would require an EIRP outside the aircraft of -22.3 dBm/100 kHz. A single aircraft at 8000 meters and 20 nautical miles from an ATG base station would require an EIRP outside the aircraft of -18.0 dBm/100 kHz. However, in this case it is very likely that multiple aircraft will be within these distances of a single ATG base station. Conservatively assuming aggregate

interference from six aircraft gives an increase of 7.8 dB, resulting in an EIRP requirement of -30 dBm/100 kHz.[10]

III. Any New Rules Should Expressly Protect Licensed 800 MHz ATG Band Services.

The technical requirements in the proposed rules as currently drafted are ambiguous at best and do not provide adequate protection for services in the 800 MHz ATG Band. For example, proposed Section 87.207 does not contain any specific emission limits but merely requires "minimal emissions" that will not cause harmful interference to terrestrial mobile networks. Specific limits are needed. In addition, operators of airborne access systems may not interpret "terrestrial mobile networks" to include ATG networks. Similarly, while proposed Section 87.207(a)(i) does not authorize operators to use the 800 MHz ATG Band for *the provision of* Airborne Mobile Service,[11] it does not exclude NCUs from transmitting in the 800 MHz ATG Band.[12] Thus, to protect services in the 800 MHz ATG Band from harmful interference, the Commission should expressly prohibit in-band NCU transmissions at 849-851 MHz and 894-896 MHz. For example, the Commission should adopt requirements that ensure that an NCU's EIRP outside the aircraft does not exceed -30 dBm/100 kHz in 849-851 MHz and 894-896 MHz.

Under the proposed AAS operating regime, the *Notice* acknowledges that the commercial mobile spectrum used by a mobile device would only be used for the link between the mobile

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[10] As mentioned above, the tolerable level as defined in this analysis assumes AAS and ATG are used on separate aircraft.

[11] Specifically, proposed Section 87.207(a)(i) requires airborne access systems to "utilize only frequencies authorized in section 87.206 for the provision of Airborne Mobile Service." Proposed section 87.206 does not include the 800 MHz ATG Band among the bands authorized for in-cabin use. However, the adjacent cellular service bands are included.

[12] Unlike the onboard picocell, the function of the NCU is not to "provide service," but to prevent mobile devices from connecting to terrestrial base stations.

device and the onboard picocell.[13] To relay the communication to the ground, the *Notice* explains that another link would be needed, such as "a satellite band *or the 800 MHz Air-Ground band*."[14] Thus, protecting the 800 MHz ATG Band is not only necessary to ensure reliable service to Gogo's direct end-user customers, but also to avoid interruptions to other service providers who may contract with Gogo to use Gogo's 800 MHz ATG link to backhaul their traffic.

IV. Airborne Access Systems Should Be Prohibited From Operating in the 850 MHz Cellular Band.

Aside from the NCUs, AAS themselves should not be permitted to utilize the 850 MHz cellular band while in flight. First, such operations would threaten adjacent channel interference to ATG systems in ways similar to the NCU interference described above. Second, allowing 850 MHz cellular band operations in-flight would be a significant departure from existing European services, which use high-band spectrum in-flight. The device ecosystem has already coalesced around high bands, and introducing new bands would cause unjustified complexity and additional equipment needs. In addition, preventing AAS from using the 850 MHz cellular bands will not harm competition because virtually all end-user devices sold by all U.S. operators are capable of operating on at least one, and often several, of the higher frequency bands used in the U.S. There is, therefore, no reason to expose ATG services to unnecessary interference risk.

V. Conclusion

For the reasons described above, Gogo urges the Commission to modify its proposed rules to provide express interference protection for the 800 MHz ATG Bands. Specifically, the

[13] *Notice* at ¶¶ 30, 42.

[14] *Id.* at ¶ 30 (emphasis added).

Commission should adopt requirements that ensure that the EIRP from an NCU or other device as measured outside the aircraft does not exceed -30 dBm/100 kHz in the 849-851 MHz and 894-896 MHz bands. It should also prohibit in-cabin airborne use of the 850 MHz cellular band.

Respectfully submitted,

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