Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to	)	WT Docket No. 04−435
Facilitate the Use of Cellular Telephones and	)	
Other Wireless Devices Aboard Airborne Aircraft	)	

To: The Commission

JOINT REPLY COMMENTS
OF CINGULAR WIRELESS
AND VERIZON WIRELESS

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SUMMARY

Cingular and Verizon support the flexible use of spectrum for the delivery of wireless services, including airborne cellular service. Nevertheless, further study is needed before rules can be adopted. The record is sparse with respect to factual issues concerning the complex technical, licensing, and security issues. A recently formed industry group is addressing these issues with the goal of producing solid factual information in advance of an FCC order. The Commission should defer consideration of a report and order until this process has been completed and a more extensive record exists. The Commission also needs to address the public safety and security issues raised in comments by the Government, which will require a further notice of proposed rulemaking.

In-flight wireless service presents complex technical and engineering issues that have not been resolved to date. The principal challenge is interference to ground networks. *Any* increase in the noise floor (even as little as 1 dB) for today's advanced wireless networks will degrade system operating levels and cause harmful interference to many users.

Three "solutions" have been offered to the interference issue: power control, noise floor jamming, and window shielding. Controlling device power is not likely to be effective, because there is no way to set current analog, GSM, TDMA, or CDMA wireless devices to operate within the required power levels. New standards for a flight-friendly mode would need to be developed, and millions of existing devices would not be compatible with this mode. Noise floor jamming is not an effective answer, either. In addition to being illegal, jammers would require power levels so high that they would cause interference to terrestrial service. No test data has been submitted showing that jammers can be effective and non-interfering. And while RF cabin window shielding may be part of a solution, the record contains no evidence such as test results or theoretical studies to that end; there is also no evidence regarding the cost or feasibility of this approach. Moreover, shielding will also attenuate signals when aircraft are on the ground, where passengers currently are free to use their devices to communicate with terrestrial networks. Given the potentially limitless sources of interference if every aircraft could contain a picocell and wireless device users, it would be virtually impossible to track down and address interference when it occurs. Registration of aircraft with picocells does not solve this problem.

Serious legal obstacles also exist to permitting new entrants to use existing CMRS licensees' spectrum for airborne service, whether or not they are licensed. The FCC has explicitly conferred exclusive rights on cellular and PCS licensees within defined service areas and spectrum boundaries, meaning that no other carriers can be allowed to provide such service in the same areas and frequency bands. Authorizing new entrants to do so would constitute an uncompensated "taking" of cognizable, valuable property interests. It would amount to a "taking *per se*" by eliminating important uses of the licensee's spectrum rights and giving them to others. It would also constitute a "regulatory taking" in accordance with the three-part test established by the Supreme Court. In addition, the authorization of new entrants into licensees' exclusive spectral and territorial service areas would constitute a breach of the covenant of good faith and fair dealing that is implicit in the FCC's relationship with its licensees. And such action would unlawfully modify CMRS licenses, because it would be both harmful to licensees and the public and would be inconsistent with long-standing spectrum policies, contrary to the public interest.

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JOINT REPLY COMMENTS OF CINGULAR WIRELESS AND VERIZON WIRELESS

Cingular Wireless LLC ("Cingular") and Cellco Partnership d/b/a Verizon Wireless ("Verizon") hereby submit their joint reply to comments filed in response to the Commission's *Airborne NPRM.*[1]

DISCUSSION

I. THE COMMISSION NEEDS A MORE COMPLETE RECORD

A. The Wireless Industry Is Actively Seeking Solutions

Cingular and Verizon support the flexible use of spectrum for the delivery of commercial mobile radio services ("CMRS"). Airborne cellular provides an example of a use of CMRS spectrum that could provide significant benefits to the public. Even though these services could provide public benefits, however, further study is needed before the Commission will be in a position to adopt rules. There are complex operational issues concerning how the service would be provided, and interference issues need to be examined further. Moreover, there are many

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[1] *Facilitating the Use of Cellular Telephones and other Wireless Devices Aboard Airborne Aircraft,* WT Docket 04−435, *Notice of Proposed Rulemaking,* FCC 04−288 (Feb. 15, 2005) (*Airborne NPRM*), *summarized,* 70 Fed. Reg. 11916 (Mar. 10, 2005); *Order,* DA 05−1015 (WTB Apr. 6, 2005).

public safety and security concerns that must be considered and addressed before airborne use of CMRS wireless devices can be authorized.

The record in this proceeding is sparse with respect to factual information regarding the complex and interrelated technical, licensing, and security issues associated with providing airborne wireless service. A number of potential solutions to the interference issue have been mentioned, but little data has been provided. There also has not been a full exploration of the most effective licensing or operational model for the provision of this service, much less the public safety and security issues that have been identified.

In the interest of overcoming the obstacles to providing picocell-based airborne service, wireless carriers have recently established an industry group, under the auspices of CTIA–The Wireless Association™, to study the relevant issues. The group has a Steering Committee and three Working Groups: Working Group 1 is addressing technical and interference issues; Working Group 2 is addressing licensing and roaming issues related to picocell operations; and Working Group 3 is addressing security-related issues. All three Working Groups held their first meetings this week, immediately after CTIA established the group. CTIA plans to invite interested parties and federal government agencies to participate in the working groups; they will not be limited to wireless carriers or manufacturers. The working groups will establish time lines for their work product. The goal will be to establish timelines that make the work product available to the FCC in advance of an FCC order in this proceeding.

The data being assembled by this industry group will provide the Commission with a solid factual basis for proceeding with its examination of airborne wireless service. Accordingly, Cingular and Verizon urge the Commission to defer consideration of a report and order concerning airborne CMRS until the group has had an opportunity to develop a factual record

that will advance the debate beyond statements of position and permit the Commission to reach an informed decision.[2]

B. Further Rulemaking Is Required to Address the Public Safety and CALEA Concerns Raised by the Government

The need for the Commission to proceed in a careful and deliberate manner is emphasized by the serious concerns first brought to light in the Justice/FBI/DHS Comments.[3] Those agencies raise a number of security and public safety concerns regarding airborne picocell-based service — including how to ensure that such airborne wireless service complies with the Communications Assistance for Law Enforcement Act ("CALEA"),[4] as well as how such service should be offered so as to enhance public safety and minimize its usability for the commission of terrorist acts. Other parties filed comments on these issues, as well.[5]

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[2] In this connection, we note that an FAA official recently announced that "regardless of the final outcome of the FCC's proposed rulemaking, the FAA's safety regulations regarding portable electronic devices onboard aircraft will remain in place. . . . [T]he FAA is not changing its rules" Statement of Nicholas A. Sabatini, Associate Administrator for Aviation Safety, Federal Aviation Administration, before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives, on "Cell Phones on Aircraft: Nuisance or Necessity," July 14, 2005, available at <http://testimony.ost.dot.gov/test/Sabatini2.htm>. *Cf.* 14 C.F.R. § 91.21 (FAA rule on portable electronic devices); FAA Advisory Circular No. 91.21–1A, *Use of Portable Electronic Devices aboard Aircraft* (Oct. 2, 2000), *available at* <http://www.faa.gov/avr/afs/acs/ac91211a.pdf>. Mr. Sabatini also testified that if an air carrier chooses to allow airborne cellphone usage, it "must determine that the use of *that particular* model phone won't interfere with the navigation or communication systems onboard the *specific type of* aircraft on which the phone will be used." Sabatini Statement (emphasis in original).

[3] *See generally* Comments of the Department of Justice, including the Federal Bureau of Investigation, and the Department of Homeland Security ("Justice/FBI/DHS").

[4] 47 U.S.C. §§ 1001-1010.

[5] *See* Comments of VeriSign, Inc. (addressing CALEA compliance issues); Comments of Association of Flight Attendants−CWA, AFL-CIO ("AFA") (addressing public safety and anti-terrorism concerns); Comments of National Consumers League (addressing public safety and terrorism concerns). In addition, many of the thousands of individuals filing informal comments voiced similar concerns.

With regard to CALEA, Justice/FBI/DHS ask the Commission to (1) rule that providers of picocell-based airborne service are telecommunications carriers subject to CALEA;[6] (2) establish how promptly a provider must provision intercepts in the case of airborne calls; and (3) require all telecommunications to or from aircraft in U.S. airspace to use mobile switching centers in the U.S.[7] The Justice/FBI/DHS proposals concerning air safety go to serious concerns about the potential use of airborne wireless communications to facilitate terrorist or criminal activity, such as hijacking, coordination of attacks, or triggering of explosive devices. The agencies ask the Commission to adopt twelve detailed requirements, some of which would apply to all air-ground transmissions, not only those at issue here.[8]

There is virtually no information on the very detailed Justice/FBI/DHS proposals, and, most importantly, the Commission has not set forth even tentative views on whether or how it

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[6] Cingular and Verizon agree that the Commission could reasonably conclude that providers of in-flight wireless service via picocells are telecommunications carriers for purposes of CALEA, insofar as the service provided constitutes telecommunications that is subject to CALEA, and not an information service, pursuant to the CALEA-specific definitions of the relevant terms, *see Communications Assistance for Law Enforcement Act and Broadband Access and Services,* ET Docket 04−295, *Notice of Proposed Rulemaking and Declaratory Ruling,* 19 F.C.C.R. 15676, ¶¶ 40-61, 146-151 (2004); News Release, *FCC Requires Certain Broadband and VoIP Providers to Accommodate Wiretaps* (Aug. 5, 2005).

[7] Justice/FBI/DHS Comments at 4-8.

[8] The agencies ask the Commission to: (1) require development and implementation of a call record database; (2) require the capability to identify the location within the aircraft of any personal wireless phone with a communication in progress; (3) require the capability to identify users who have communications in progress with users on another aircraft; (4) require the capability to interrupt a communication in progress aboard a particular aircraft; (5) require the capability to "conference" law enforcement with or to a communication in progress; (6) require the capability to redirect calls; (7) require the capability to terminate calls aboard an aircraft by all users other than "authorized users"; (8) require the capability to provide law enforcement and public safety communications between air and ground; (9) require the capability to dedicate bandwidth or service for emergency communications independent of passenger communications; (10) require the capability to ensure compatibility with Wireless Priority Service; (11) require authentication of users and identification of their seating location before they can use their devices in flight; and (12) require that measures be taken to prevent connectivity to devices in an aircraft's cargo hull. *See* Justice/FBI/DHS comments at 8-14.

believes these proposals should be accommodated. The proposals are very broad-ranging, and some appear to go beyond the scope of the *Airborne NPRM*. Moreover, virtually identical proposals have been advanced by Justice/FBI/DHS in another proceeding.[9] Concerns have been expressed in both proceedings concerning the Commission's authority to adopt the agencies' proposals.[10]

It would be particularly difficult to address these proposals meaningfully at this time, given that the Commission has not yet determined the regulatory classification of the proposed service or who will be allowed to provide it. Some commenters have urged the Commission to allow the provision of such service on an unlicensed basis, others have advocated the issuance of nonexclusive, secondary licenses or the use of foreign-issued licenses, and the Commission has even proposed the alternative of allowing all cellular licensees to provide such service nationwide on a secondary basis. Under these scenarios, it is unclear to whom law enforcement agencies should direct an intercept request or a safety-related issue pertaining to a given caller or flight.

Accordingly, it would be beneficial for the Commission to consider the Justice/FBI/DHS proposals and then solicit comment on its tentative conclusions regarding how to proceed, consistent with the requirements of the Administrative Procedure Act.[11] Any steps the Commission takes must not only be within its statutory authority but must also be rational, based on a record, with a clear connection between the object to be accomplished and the means

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[9] *See* Comments of Department of Justice, including the Federal Bureau of Investigation, and the Department of Homeland Security, IB Docket 05−20, *Service Rules to Govern the Use of Aeronautical Mobile Satellite Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service* (filed July 5, 2005).

[10] *See generally* Reply Comments of the Center for Democracy & Technology and the Electronic Frontier Foundation, IB Docket 05−20 and WT Docket 04−435 (filed August 3, 2005).

[11] 5 U.S.C. § 553.

chosen to accomplish it.[12] Verizon and Cingular urge the Commission to institute a separate proceeding or initiate a further notice of proposed rulemaking in this proceeding to consider the requests of Justice/FBI/DHS. That will give all parties a meaningful opportunity to comment on the Commission's tentative views concerning the Justice/FBI/DHS proposals and allow a decision to be made based on a fully developed record.

II. SIGNIFICANT TECHNICAL DIFFICULTIES REMAIN

Before the Commission can proceed to develop rules for airborne wireless services, many complex technical and engineering details must be resolved. In particular, it is clear from the comments that interference from airborne systems and handsets is a substantial threat that must be fully understood and solutions identified. Cingular and Verizon address these issues below.

A. Interference to Terrestrial Systems is a Serious Concern

1. Even a 1 dB Noise Floor Rise from Airborne Operation Would Interfere with Ground Networks

One commenter assumed that an interfering signal that causes a rise in the noise floor of 1 dB or less would not be found to adversely affect terrestrial CMRS network operations.[13] This is most emphatically not the case, especially with respect to advanced wireless technologies that are now widely deployed and further technological enhancements that will follow.

V−COMM, the engineering consultant to Cingular and Verizon, analyzed the impact of noise floor increases on a nationwide CMRS operator's system coverage and capacity in its comments submitted in the Interference Temperature proceeding, ET Docket 03−237. As

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[12] *Motor Vehicle Manufacturers Association v. State Farm Mutual Insurance Co.,* 463 U.S. 29, 43 (1983); *Bowman Transportation, Inc. v. Arkansas-Best Freight System Inc.,* 419 U.S. 281, 286 (1974).

[13] Boeing Comments at 13-14.

outlined therein, a 1 dB increase in the noise floor of a CMRS system nationwide would result in 12% to 15% loss in coverage and 16% loss in capacity.[14]

A 1 dB increase in the noise floor for licensed spectrum bands results in a 1 dB loss in operating margin or 1 dB loss in link budget for the CMRS network to provide service to customers.[15] The 1 dB loss in link budget is equivalent to a proportionate reduction in spectrum bandwidth. As stated above, the 1 dB increase in noise floor will result in a 16% loss in capacity for CMRS voice services and a similar loss in throughput for CMRS data services. This loss in service is equivalent to a 16% reduction in spectrum bandwidth, *i.e.,* a 10 MHz licensed bandwidth reduced to 8.4 MHz.[16] Thus, the increase in the noise floor directly impacts the ability of CMRS networks to provide service to its customers.

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[14] Comments of V−COMM, L.L.C., ET Dockets 03−237 & 03−108, at 56, Table 3 (filed April 5, 2004) ("V−COMM Interference Temperature Comments"). Other parties submitting comments in the Interference Temperature proceeding, including Lucent, Qualcomm, Sprint and Telcordia, performed similar analyses for CDMA technology and provided results in similar ranges. There was also a similar showing for GSM networks. AT&T Wireless showed that GSM systems will incur a 15% to 17% loss in coverage and a 25% loss in capacity for a 1 dB increase in noise level. Comments of AT&T Wireless Services, Inc., ET Docket 03−237, at 17-18 (filed April 5, 2004).

[15] In the UWB proceeding, the Commission concluded that a 1 dB increase in noise level for CMRS handsets in close proximity to UWB devices would not cause harmful interference. *See Ultra-Wideband Transmission Systems,* ET Docket 98−153, *First Report and Order,* 17 F.C.C.R. 7435, ¶¶ 153-54 (2002). Due to the close proximity of these devices they may be under the control of the same user, who may be able to mitigate any interference caused. However, the effect of airborne interference to terrestrial base stations is much more severe and can potentially interfere with over 1,000 simultaneous terrestrial calls, as opposed to UWB devices potentially interfering with far fewer calls in very close proximity. The airborne interference would affect service to many members of the public from afar, without a single party having control over all devices so as to facilitate mitigation of interference. Therefore, the analysis in the UWB proceeding is not a reasonable approach to assessing interference to terrestrial networks from airborne uses of CMRS spectrum.

[16] Also, for GSM systems incurring capacity losses of 25%, the 1 dB loss in link budget is equivalent to a 25% reduction in spectrum bandwidth, *i.e.,* a 10 MHz licensed bandwidth reduced to 7.5 MHz.

The costs to overbuild CMRS systems to accommodate such increases in the noise floor are substantial. In its Interference Temperature Comments, V−COMM analyzed the impact on a nationwide CMRS operator and estimated the number of additional base stations and costs required to overcome external system noise increases. V−COMM showed that 18% more base stations would have to be built and a 63% increase in total network costs would be required to overcome a 1 dB increase in noise level of the CMRS system.[17]

Moreover, an interfering airborne signal that raises the noise floor by as little as 1 dB will be sufficiently strong to allow some CMRS handsets in weak signal areas to access the airborne picocell from the ground, causing operational problems such as unintended roaming, lost incoming calls, and possible misdirection of 911 calls. The 1 dB noise floor rise threshold used by some parties to analyze interference to terrestrial systems is not sufficient to prevent CMRS handsets on the ground from acquiring and placing calls with airborne picocell systems.[18] For example, with an airborne picocell transmitting at pilot Ec/Ior of –7 dB and with the –20 dB

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[17] *See* V−COMM Interference Temperature Comments at 58-59, Tables 6 & 7. The total additional costs are for an 8-year period. The total additional cost for the nationwide CMRS operator studied was $10.3 billion dollars, over and above the existing costs to maintain the network.

[18] The 1 dB increase in noise floor is derived from an interference-to-noise ratio (I/N) of –6 dB. *See UWB Order* at ¶¶ 153-54, 131 n.207. However, this level is not low enough to prevent third generation (3G) handsets on the ground from placing and making calls with airborne picocells. CDMA and UMTS technologies utilize signals well below the noise floor of their systems, with processing gains inherent in their technologies. For example, third generation CDMA systems maintain quality calls with traffic Ec/Io in the range of –15 to –17 dB for signals with terrestrial fading characteristics. For line-of-sight airborne conditions (with minimal to non-existent fading, *i.e.,* static signal conditions) and lower quality calls, 3G CDMA calls can operate calls with traffic Ec/Io levels as low as –18 to –19 dB. Therefore, transmissions from airborne picocells operating with CDMA technology must be received with pilot Ec/Io of –20 dB at CDMA handsets on the ground to prevent CDMA handsets on the ground from connecting to and placing calls with the airborne picocell systems. *See* Qualcomm Comments at 8 n.2 ("In order to prevent successful pilot demodulation an Ec/Io of –20 dB should be considered as the design goal.").

received Ec/Io requirement, an I/N of –13 dB is required to prevent ground CDMA[19] calls.[20] This is 7 dB more stringent then the "I/N of –6 dB" criteria used by some parties to prevent a 1 dB noise floor increase. To minimize the potential for the interference caused by a 1 dB rise in the noise floor, picocells would need to operate at lower power levels and/or with sufficient window shielding to prevent handsets on the ground from communicating with airborne picocells.

In addition to the impact on the tens of millions of users of second-generation devices, noise floor increases of 1 dB will cause substantial harm to third generation networks and customers as well. These systems operate at and below the system noise floor levels and employ advanced power control mechanisms that control the subscriber unit transmit power levels approximately 1000 times per second, down to levels as low as –50 dBm.[21] The result is that all signals are received at nearby base stations at least 15 dB below the operating noise floor of the system.[22] These advanced CMRS networks routinely operate in these noise-limited conditions in all markets, and utilize system operating margins to serve 35 to 100 simultaneous calls per

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[19] The term "CDMA" is specifically used herein to refer to the cdma2000 suite of access technologies (principally comprising IS-95, 1xRTT, and EV-DO), and not to code division multiple access technology more generally, which underlies both cdma2000 and in UMTS networks.

[20] For CDMA handsets with noise figures of 5 dB, the equipment noise floor is –108 dBm. With an I/N ratio of –13 dB, the received level at the CDMA handset needs to be –121 dBm to prevent handsets on the ground from accessing and placing calls with picocells onboard aircraft in flight.

[21] CDMA devices adjust output power level 800 times per second; UMTS devices adjust output power levels 1500 times per second.

[22] CDMA signals are received between 15 dB to 17 dB below the operating noise floor of the base station (Eb/No of 6 dB and 4 dB are required for IS95 and 3G1X, respectively), and UMTS signals are received between 20 dB to 22 dB below the noise level. These received levels are successfully demodulated by the base station with the system processing gains inherent in these technologies.

channel, providing coverage, capacity, and quality for all users on the system.[23] *Any* increase in the noise floor in these CMRS systems resulting from airborne operations will degrade the system operating levels and cause harmful interference to many users on the system. CMRS networks require very low noise floor conditions to provide service to customers, and these networks can achieve such conditions only because the licensee has exclusive use and control of its spectrum within its licensed territory.

Even beyond third generation, the Commission should consider the possible effect of noise floor increases on the development of future technologies. Advances in CMRS technology and equipment have demonstrated improved spectrum efficiency with utilization of lower noise floors, lower signal levels, and equipment operating with lower noise figure values. These trends are expected to continue, and will allow future CMRS systems (*i.e.,* fourth generation) to improve spectrum efficiency with base station technologies that utilize spectrum at even lower noise floor levels than are capable today. Any increases in the noise floor from external sources have the potential to undermine these future advances in CMRS technology and equipment to the detriment of consumers.

Finally, the Commission must also consider the cumulative effects of multiple sources of interference. Separate 1 dB increases in the noise floor from multiple sources, including multiple airborne handsets, multiple aircraft, and other sources (such as UWB, PCS H-Block,) can result in substantial cumulative increases in the noise floor and devastating interference to CMRS networks, which, as stated earlier, are designed to operate at and below the system noise floor level.

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[23] Third generation CDMA systems typically serve 35 simultaneous calls per channel. UMTS 5 MHz systems utilize about 3 times the bandwidth of CDMA 1.25 MHz systems and serve about 100 calls per channel.

2. All Elevations and Antenna Patterns Must Be Considered

Boeing suggests that the only terrestrial antenna patterns that need to be considered to assess the interference potential of airborne CMRS spectrum use are those at low angles (0° to 10°), reasoning that these elevations provide line-of-sight visibility to a high proportion of the aircraft within interference range.[24] While it may be true that the majority of aircraft within interference range would be covered by that elevation range, the aircraft that would be considered under that assumption would be the most distant and least likely to cause harmful interference. It would fail to account for the aircraft most likely to interfere: those that are close enough to exceed the 10° elevation.

Moreover, many CMRS base station antenna patterns have worst-case elevation angles between 8 and 40 degrees — *i.e.,* they are most susceptible to interference at elevations of about 10° or higher, when considering the associated path losses and antenna gain values for all elevation angles.[25] As a result, Boeing significantly understates the susceptibility of terrestrial networks to airborne interference.[26] These higher elevation angles also correspond to the angles that have line-of-sight conditions for airborne handsets used at aircraft windows, in light of the

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[24] Boeing Comments at 17-18.

[25] V−COMM studied a variety of common cellular and PCS base station antennas and determined the worst case elevation angles are typically between 8 to 40 degrees, depending on the antenna, when considering the vertical gain pattern of the antenna and the path loss for the slant distance to the aircraft. *See, e.g.,* V−COMM Technical Comments at 10 ("Terrestrial base stations are most susceptible of receiving strong signals from air-to-ground systems between the vertical angles of 8 degrees to 50 degrees below the horizon (reference to aircraft)."); *id.* at 12-13 ("As indicated in the airplane signal leakage measurements, the airplane cabin leakage value of 0 dB is assumed for the angles from the horizon to 40 degrees below the horizon.").

[26] The PCS base station antenna example cited by Boeing shows a worst case of 121 dB for path loss minus antenna gain. Boeing Comments, App. at 8-9. It should be noted that other PCS antennas would be more sensitive to airborne interference than this antenna, such as the Celwave AP186515 PCS antenna, which represents 108.4 dB total link loss for elevation of 35 degrees. This PCS antenna would be 12.6 dB more susceptible to interference from airborne sources than the example antenna presented by Boeing in its comments. This PCS antenna pattern is available at <http://www.celwave.com/index.php?p=340>.

results of V−COMM's extensive airplane leakage studies.[27] Therefore, to determine the full impact of all aircraft, the elevation angles between the horizon and 40 degrees below the aircraft need to be considered. Moreover, the cumulative power received from aircraft at relatively close distances is likely to greatly outweigh the cumulative power received from all aircraft within the 0° to 10° elevation space. The latter aircraft are likely to be much farther away with consequently higher path losses.

B. Interference "Solutions" Will Not Be Effective

The principal "solutions" to interference that have been advanced are power control, noise floor jamming, and window shielding. There is not sufficient evidence to rely on these alternatives, however, given the very substantial interference that could result if they prove inadequate. For any proposed measures, careful system design and testing must be performed to ensure the onboard system does not cause interference to ground CMRS networks. At a minimum, many different aircraft designs and configurations would need to be tested with jammer installations and/or shielding to get a good understanding of the range of values for the system parameters, such as required in-cabin link budgets and received terrestrial signal levels in the cabin, which are based on aircraft leakage characteristics.

1. Limiting Subscriber Device Power Levels Is No Solution

Several commenters have claimed or assumed (without any test results, studies, or other factual support) that wireless devices can readily be limited to power levels that pose no interference threat to terrestrial service while communicating through a picocell in an airborne aircraft.[28] In fact, there are significant limitations on the capability to control handset power

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[27] *See generally* Sean Haynberg, David Stern, Dominic Villecco, V−COMM, L.L.C., *Airplane Cabin Leakage Study,* filed as Exhibit II to Cingular and Verizon Comments.

[28] *E.g.,* Boeing Comments at 26-27; SITA Comments at 16.

levels for airborne uses of CMRS spectrum to prevent harmful interference to terrestrial networks.

As shown in the V−COMM technical report accompanying the Cingular and Verizon Comments in this proceeding, the handset power level required to prevent interference to ground networks is below the minimum level for many wireless technologies. For example, in order to prevent interference to ground networks from two airborne handsets at 10,000 feet or above, the handset power limit must be not greater than −15 dBm for the cellular band, and −8 dBm for the PCS band.[29] These levels are below the minimum level for AMPS, TDMA, and GSM standard handsets,[30] meaning that the millions of current devices using these technologies would be incapable of operating at the very low power levels needed to ensure noninterference with a terrestrial network. CDMA subscriber devices are capable of operating at lower power levels than AMPS, TDMA, and GSM units,[31] but CDMA base station equipment can only control device power in a relative manner (*i.e.,* increase or decrease power), and cannot direct a device to transmit at a specific chosen power level.[32] Thus, it is not possible to control interference to

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[29] Sean Haynberg, David Stern, Dominic Villecco, V−COMM, L.L.C., *Technical Comments for Cellular Airborne NPRM,* at 14 (V−COMM Technical Comments), filed as Exhibit I to Cingular and Verizon Comments. V−COMM's report sets forth the assumptions on which this conclusion is based, including that airborne wireless devices are controlled by the onboard picocell, use of measured data from 10,000 air miles of flight tests submitted in the record of the AirCell waiver extension proceeding using the 90% strongest signal strengths in flight, and use of a level of unacceptable interference observed from measured interference tests at typical terrestrial base stations operating in a suburban market.

[30] *See V−COMM Technical Comments* at 11.

[31] *See id.*

[32] The actual power levels used by CDMA devices are controlled by the link budget to the serving base station, and the system loading and operating margins. Thus, while CDMA mobiles are power-controlled by signalling from the base station, the base station does not have strict control of the actual power level of the mobile transmitter because the base station simply provides "up" or "down" power control commands — *i.e.,* the upper limit is simply the maximum transmit power that the mobile is capable of producing, given that the cdma2000 standards do not provide parameters for limiting device power to a particular range below the

(continued on next page)

terrestrial operations simply by placing specific low power limits on airborne use of current wireless devices using any of the prevalent technologies.

Accordingly, reliance on low device power limits to ensure non-interference to ground networks from airborne use of cellular and PCS spectrum by providers other than the co-channel terrestrial network operator would not work. Development of standards for special "airplane friendly" modes with lower maximum power levels would be necessary to prevent harmful interference to terrestrial service. Only equipment meeting these new standards should be authorized for operation and be permissible to use on board an airborne aircraft, which presents a significant practical problem, in that none of the devices currently in use or on the market would meet these criteria. Accordingly, a screening process would have to be established to ensure that only compliant equipment is used while airborne, or other measures would have to be employed.

An additional challenge is posed by the fact that standard out-of-band emission (OOBE) levels for CMRS devices are controlled by current standards and designs. The RTCA is currently studying the impact of personal electronic devices and their OOBE levels on sensitive aircraft electronic equipment. If it is determined that lower OOBE are required, then additional modifications to FCC and industry CMRS standards and device designs may be needed, above and beyond the power level modifications discussed above, to support airborne uses of handsets. As with the power level modifications, the lower OOBE levels may be accomplished with type

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(footnote continued)
device's nominal maximum of about +23 dBm. (The standards for UMTS equipment, which also employ code division multiple access technology, on the other hand, do permit setting a specific maximum power limit for a given device. UMTS devices, however, are not widespread.) In theory, it may be possible to carefully design an in-cabin system such that a specified link budget would never be exceeded (with CDMA devices operating at appropriate limits), but significant margins must be utilized to account for widely varying fluctuations in path losses, signal fading, and passengers blocking signal paths to the antennas. These systems would require intensive RF studies to ensure the power levels are not exceeded and may be very complicated and difficult to achieve in practice.

acceptance of specially modified handsets supporting an airplane friendly mode, but the issue remains how to address the embedded base of devices that do not comply with the standards for this mode.

2. Noise Floor "Jamming" Alone Will Not Prevent Interference

Many commenters assumed that low-level white noise emissions in the CMRS bands would effectively limit the ability of wireless devices to attempt to communicate with terrestrial stations by raising the noise floor.[33] The proponents of such systems use a variety of euphemisms to describe the device used to raise the noise floor — SITA refers to it as a "network control unit," AirCell calls it a "masking system", and Boeing calls it an "RF management unit"[34] — but it is nothing more or less than an illegal "jammer," a device that transmits signals intended to thwart communications.[35]

Importantly, all cellular and PCS channels used in the terrestrial systems being overflown would need to be jammed in the aircraft to prevent airborne handsets from making calls on the terrestrial networks. Onboard CDMA and GSM picocells will need to transmit at

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33 *See* comments cited in note 34 below.

34 SITA Comments at 11; AirCell Comments at 4-5; Boeing Comments, Appendix at 3.

35 The use of jammers is prohibited by 47 U.S.C. § 333, which provides that "[n]o person shall willfully or maliciously interfere with or cause interference to any radio communications of any station licensed or authorized by or under this Act . . . ." *See also* 47 U.S.C. §§ 301, 302a, 47 C.F.R. §§ 2.803, 2.1203, 22.377; FCC Website, *Operations: Blocking and Jamming,* <http://wireless.fcc.gov/services/cellular/operations/blockingjamming.html>. Moreover, *AirCell, Inc.,* 17 F.C.C.R. 19586 (WTB 2002) specifically held that the use of jammers to facilitate in-flight picocell service was illegal, stating that "intentional jamming or interfering with other radio signals would constitute a violation of the Communications Act." Id. at ¶ 4.

about the same level as the jamming signals to allow successful airborne calls, as explained below.[36]

As V−COMM demonstrates in detail in the attached exhibit entitled *Noise Floor Jamming Equipment on Airplanes,* this low-level jamming will not be effective in preventing airborne devices from attempting to place calls on terrestrial networks and operating at maximum power levels. If they operate at too low levels, airborne mobiles will attempt to connect to terrestrial networks and sometimes succeed. But at the levels necessary to effectively prevent such connections, jamming devices have the potential to cause significant harmful interference to ground networks and could also affect aircraft electronic equipment.

To be effective in controlling all handsets on board at altitudes above 10,000 feet,[37] jamming signals would need to be received at –60 dBm at PCS handsets, and –45 dBm at cellular handsets, using the in-cabin measurements of terrestrial signals provided by Qualcomm in its comments.[38] Using Qualcomm's link budget for the in-cabin network design the total

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[36] *See* Sean Haynberg, David Stern, Dominic Villecco, V−COMM, L.L.C., *Noise Floor Jamming Equipment on Airplanes*, submitted herewith as Exhibit I, at Section II.D (concerning the operating power levels for in-cabin picocells with onboard jammers).

[37] Below 10,000 feet, jamming systems would need to operate at even higher power levels to be effective — about 10 dB stronger than the jammer signal level required above 10,000 feet. To be effective in controlling 90% of the CDMA handsets below 10,000 feet, the jamming signals need to be received at –55 dBm at PCS handsets, and –40 dBm at cellular handsets. And, to control all handsets below 10,000 feet, the jamming signals need to be received at –48 dBm at PCS handsets, and –35 dBm at cellular handsets.

[38] *See generally* Exhibit I, *Noise Floor Jamming Equipment on Airplanes,* at Section II.B. Measurements of terrestrial signals were provided in the Qualcomm comments (see figures 1 and 2 on page 4). Above 10,000 feet, the 90% and maximum received terrestrial signals are –65 dBm and –60 dBm for the cellular band, and –81 & –75 dBm for the PCS band, respectively. Below 10,000 feet, the 90% and maximum received terrestrial signals are –55 dBm & –50 dBm for the cellular band, and –70 and –63 dBm for the PCS band, respectively.

In addition, the jamming signal must be received 15 dB stronger than terrestrial signals to prevent all CDMA calls being placed in flight. The 15 dB figure is needed to reduce strong CDMA signals with pilot Ec/Io of –5 dB to weaker pilot Ec/Io of –20 dB, which is required to prevent CDMA calls. Qualcomm's in-flight measurements show received pilot Ec/Io up to –5

(continued on next page)

allowable path loss and fade margin is on the order of 80 dB.[39] Therefore, the jammer would need to transmit at about +20 dBm EIRP in the PCS band and +35 dBm EIRP in the cellular band to be effective in preventing all terrestrial calls in flight (assuming no window shielding is used[40]). This level, however, has the potential to cause interference to terrestrial CMRS systems.[41]

The result of V–Comm's analysis is that jamming at levels required to prevent all terrestrial calls in flight (*i.e.,* +20 dBm for PCS, +35 dBm for cellular) will cause significant harmful interference to ground networks and have the potential to interfere with aircraft

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(footnote continued)

dB for handsets in "idle mode." It also measured the "idle mode" pilot Ec/Io of –8 dB as the 90% level above 10,000 feet in the PCS band. It should be noted that CDMA handsets in the "active mode" can receive pilot Ec/Io values up to 3 dB stronger than "idle mode" pilot Ec/Io values, due to the CDMA idle mode handoff algorithm. Thus, the strongest received pilot Ec/Io level of –5 dB is used in this analysis.

UMTS calls required jamming signals 20 dB stronger than terrestrial signals, versus CDMA calls, which require 15 dB stronger signals to effectively block calls; however, the jamming power per MHz level for CDMA and UMTS calls is the same. These levels are required to prevent successful demodulation of CDMA and UMTS calls operating with Ec/Io up to –5 dB. To prevent GSM calls from occurring in flight, jammers would need to disrupt the minimum C/I allowable for successful calls (*i.e.,* C/I of 6 dB for a poor quality GSM call), and be received at about 5 dB below the terrestrial signals. Thus, the required jamming level for GSM airborne handsets is about 12 dB below the CDMA handset requirement, after adjusting for bandwidth differences.

[39] Qualcomm Comments at 20-21 (Section V, "In-Cabin Network Design"). Qualcomm assumes a link budget of 82.7 dB is required for two sector deployments to provide coverage to the entire aircraft, which assumes a path loss of 62.7 dB and fade margin of 20 dB for the in cabin network. For one-sector deployments, the same link budget is assumed to provide coverage to about 12 meters of the aircraft cabin. The in-cabin fade margin of 20 dB is required to account for multipath fades, which occur from both patch antennas and leaky coax.

[40] In addition, modified CMRS handsets may be able to be programmed to look for aircraft picocell systems first (when powered up at cruising altitudes), use an "airplane friendly" mode with an LED indicator or other phone icon, and may not require extensive shielding and jamming systems.

[41] *See* Exhibit I, *Noise Floor Jamming Equipment on Airplanes,* at 7 n.20 (summarizing conclusions regarding forward channel interference from jammers from V−COMM Technical Comments at 17).

electronic equipment.[42] Nor will jamming at levels below these amounts be effective in controlling all handsets and preventing terrestrial call attempts in flight at maximum power levels. Aircraft systems using other methods (*e.g.,* RF window shielding) in conjunction with low-level jamming may prove to be effective in controlling all handsets on board, after adequate testing. Therefore, *any* aircraft picocell deployment will require additional measures to be effective, such as using window shielding to attenuate the terrestrial signals in the cabin to prevent calls from being placed on the terrestrial system at maximum power levels.[43]

3. Window Shielding Alone Will Not Prevent Interference

Several commenters claimed or assumed that RF shielding of aircraft cabin windows can be relied upon to prevent interference to terrestrial CMRS operations. One commenter claimed that shielding can provide 10 dB of attenuation.[44] These bare assertions, however, cannot be credited, because they are not supported by evidence such as test results or even theoretical studies. Nor has any evidence been submitted regarding the cost or feasibility of retrofitting fleets of airliners with shielded windows.

Certainly, RF shielding applications on aircraft cabin windows should be studied to determine the effectiveness of reducing the signal leakage from the aircraft cabin and

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42 *See id.* at 7-8.

43 Window shielding has the *potential* (not yet validated by extensive testing) to improve the performance of jammer-based systems in two ways: (1) it reduces the terrestrial signals in the cabin, which assists in preventing terrestrial calls at maximum power; and (2) it reduces the jamming signal leakage from the aircraft toward the ground networks. *But see* Section II.B.3.

44 SITA Comments at 17. Verizon and Cingular note that standard window shielding materials sold for application to existing windows in buildings typically provide 20 to 30 dB of isolation; greater levels of shielding are possible by using grounded metal mesh-embedded plastic in lieu of glass. *See, e.g.,* EMF Safety Superstore website, <http://www.lessemf.com/plastic.html>; Instrument Plastics Ltd., Optolite™ Shielded Filter Windows specification sheet, <http://www.instrumentplastics.co.uk/pdf_bin/OSF_DS.pdf>; WIN-SHIELD™ Optical Products specification sheet, <http://www.chomerics.com/products/documents/emicat/pg172winshield_optical_products.pdf>. These figures may or may not be achievable in an aircraft environment.

interference received at terrestrial networks. Airplane window shielding also has the potential benefit of reducing the received terrestrial signals in the airplane cabin, which minimizes the potential for airborne handsets to communicate with ground networks at maximum power levels.

The downside of relying on window shielding is that it will not only attenuate the passage of signals through aircraft windows when in flight, but it will also attenuate the passage of CMRS signals when aircraft are on the ground — at terminals, on taxiways, in line for takeoff, or awaiting availability of a gate. On some airlines, passengers are currently free to use their wireless devices to communicate with terrestrial networks at these times. There are technical measures that may mitigate the loss of service to passengers aboard aircraft on the ground due to window shielding, such as the installation of microcells at various locations near terminals and taxiways, or the use of the on-board picocell as a repeater. Any study of the effects of shielding should also examine the ways to counter those effects while an aircraft is on the ground.

4. The Source of Interference Is Difficult to Pinpoint

Obviously, if there are no limits on who can provide in-flight picocell-based wireless service, there would be limitless potential sources of interference to terrestrial service. Some advocates of unlicensed picocells, therefore, suggest that registration with the Commission should be required. Boeing, for example, suggests that interference can be addressed by registration with the FCC of aircraft with picocells using CMRS spectrum, indicating that the registry could be used to determine the identity of the interfering aircraft, and to control and mitigate any interference caused by the system.[45]

A registration database, however, would be of little use in identifying and resolving interference resulting from airborne use of CMRS spectrum. The limitations of detecting co-

[45] Boeing Comments at 7.

channel interference from airborne sources using system-based detection tools were discussed at some length in an engineering report prepared by V−COMM on behalf of Cingular and Verizon and submitted in the pending proceeding concerning the extension of AirCell's waiver to provide airborne cellular service.[46] V−COMM shows therein that CMRS operators have no effective methods of detecting and identifying interference from airborne uses of CMRS spectrum. Registration of aircraft provides no useful information to identify or mitigate any interference caused. V−COMM's report states, in relevant part:

> Switch-based interference detection tools cannot measure random events of intermittent interference at random cell sites, on random channels throughout the entire cellular network. That is the type of data necessary to evaluate the impact of AirCell calls, but it is just not possible to collect such data. Switch-based tools are only effective for collecting recurring interference events at the same cell site, on the same channels, and over a sustained period of time. Switch-based tools generally collect large samples of data convoluting the results of any interference measured. For these reasons, operators do not rely on switch-based tools for measuring and resolving interference events from random sources. Since switch-based tools do not identify the source of the interference, a carrier would have no way to determine that any interference detected was a result of an AirCell transmission. Contrary to AirCell's contentions, it would be of no consequence to correlate any deviation in measured interference levels to AirCell call data. There is simply no way to prove a detected interference event was a result of AirCell transmissions. . . .[47]
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> Despite the difficulty in isolating interference from individual AirCell calls, the overall impact of the introduction of air-to-ground transmissions would be significant in the introduction of random interference throughout a CGSA and the loss of flexibility to provide service at low noise thresholds.[48]

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[46] V−COMM, Inc., Engineering Report of the AirCell Compatibility Test, at 130-33, § 9.2 ("V−COMM Engineering Report"), filed as Exhibit II to AT&T Wireless, Cingular Wireless, and Verizon Wireless, Comments in Opposition to Petition for Extension of the Waiver, *AirCell, Inc.,* Docket No. 02−86 (filed April 10, 2003).

[47] V−COMM Engineering Report at 130.

[48] V−COMM Engineering Report at 131.

The same is true of any airborne wireless system that is operated over the territory of a terrestrial wireless licensee on its frequencies, but beyond its control, whether it is unlicensed or nonexclusively licensed. If it is difficult or impossible to track interference to a single unaffiliated provider's overflights, it becomes even more so when there are multiple operators facilitating transmissions on multiple aircraft, all of which are outside the control of the terrestrial network operator who will receive the interference. Only if that network operator has the ability to control the spectrum usage in the flights over its territory is it possible for the potential interference to be effectively managed and minimized.

III. PERMITTING UNLICENSED OR NONEXCLUSIVELY LICENSED AIRBORNE PICOCELLS WOULD BE UNLAWFUL

Aside from the technical obstacles posed by use of picocells, there are several legal and regulatory issues that must be addressed prior to the authorization of airborne cellular or PCS services. Primarily, these issues involve the implications of such authorization(s) for existing licenses and licensees. Cingular and Verizon have concluded that it would be unlawful for the Commission to authorize third parties to operate airborne services using existing cellular or PCS frequencies or to permit such operations on an unlicensed basis.

Several commenters argued that the Commission should allow the operation of picocells by parties other than the licensee for a particular band in the area where an aircraft is flying. Boeing and AirCell, for example, advocate unlicensed picocell operation,[49] while SITA advocates operation pursuant to non-exclusive licenses (on U.S. aircraft) or foreign-issued licenses (on non-U.S. aircraft).[50] Other commenters joined Cingular and Verizon in

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[49] Comments of The Boeing Co. at 4-8; Comments of AirCell, Inc. at 6-8; *accord* Comments of Northwest Airlines, Inc. at 2.

[50] Comments of SITA (Societé Internationale de Télécommunications Aéronautiques) at 33-37. *See also* Comments of Ericsson Inc at 7 (supporting non-exclusive licensing for

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demonstrating reasons why existing wireless licensees should be exclusively authorized to operate airborne picocells on their licensed frequencies within their service areas.[51] No commenter supported the alternative of granting all cellular licensees secondary authority to operate airborne picocells nationwide.

The initial comments filed by Cingular and Verizon provided detailed legal, engineering, and policy reasons for why airborne picocell operations must be under the control of the terrestrial wireless licensee whose licensed frequencies are being used in any given area. The following sections further address the legal issues associated with airborne mobile licensing in light of the issues raised in the comments.

A. Authorization of Airborne Picocell Operation by Parties Other than the Overflown CMRS Licensee for a Given Band Would Be an Unconstitutional "Taking" without Just Compensation

As Cingular and Verizon pointed out in their initial Comments, the Commission has explicitly conferred "exclusive" rights on cellular and PCS licensees within their respective service areas and spectrum boundaries, without regard to altitude.[52] This exclusivity means, the Commission has said, that "*no other carriers will be allowed to provide cellular or PCS service in the same frequency band, in the same area, and at the same time.*"[53] Cellular and PCS licensees have invested substantial sums in reliance on this exclusivity, developing their networks to provide intensive, broad coverage and introducing new, higher-capacity

(footnote continued)
operation above an unspecified altitude, among several alternatives); Comments of Rockwell Collins at 8 (supporting blanket licensing of picocells to their manufacturers).

[51] *See* Comments of CTIA–The Wireless Industry Association™; Comments of Sprint Corporation; Joint Comments of Cingular and Verizon.

[52] Cingular and Verizon Comments at 4-6.

[53] *Ultra-Wideband Transmission Systems,* ET Docket No. 98−153, *Memorandum Opinion and Order and Further Notice of Proposed Rule Making,* 18 F.C.C.R. 3857, ¶ 74 (2003) (*UWB Reconsideration Order*).

technologies. Permitting a new entrant to transmit a signal on a CMRS licensee's frequencies in that licensee's territory in a way that will affect the CMRS licensee's present or future operations cannot be reconciled with the licensee's right to exclusive use and control of its spectrum and fundamentally changes the nature of the CMRS licensing scheme.[54]

While an FCC license is not "property" *per se,*[55] courts have nevertheless found that licenses convey rights that do constitute cognizable, valuable property interests that the FCC may not lawfully impair.[56] Thus, a license is not just "a non-protected interest, defeasible at will."[57] An FCC licensee's interests are defined by the terms and conditions of each license and the governing FCC rule parts. The most relevant components of this bundle of rights for a CMRS licensee are the right to use the spectrum to the maximum extent feasible[58] and the right to

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[54] We note, in this connection, that the Commission's rules grant a CMRS licensee exclusive use of not only the base station frequencies but also the associated mobile frequencies. *See* 47 C.F.R. §§ 22.905, 24.229. The licensee of the base station is thus also the licensee of any mobile unit communicating through the base station and is responsible for its technical rule compliance. *See* 47 C.F.R. § 22.927. Given the territorially exclusive licensing scheme within a spectrum block, the Commission has only one entity to look to for ensuring compliance with its interference rules. Eliminating exclusive licensing by allowing new entrants to operate airborne stations would not only affect the incumbent licensees' rights, but would also impede the Commission's ability to police interference issues. This is especially troubling, given the fact that it may be nearly impossible to trace interference to its airborne source, as discussed in Section II.B.4 above.

[55] *See* 47 U.S.C. § 301; *FCC v. Sanders Bros. Radio Station*, 309 U.S. 470, 475 (1940); *see Prometheus Radio Project v. FCC*, 373 F.3d 372, 428-429 (3d Cir. 2004).

[56] *See, e.g., In re Atlantic Business and Community Development Corp.*, 994 F.2d 1069, 1073-74 (3d Cir. 1993) ("We do not think *Sanders Brothers* holds that an FCC license has none of the attributes of property. The Communications Act itself seems to imply the existence of a limited property right in an FCC license once it is granted.") (citations omitted); *L.B. Wilson, Inc. v. FCC*, 170 F.2d 793, 798 (D.C. Cir. 1948) ("the right under a license for a definite term to conduct a broadcasting business requiring — as it does — substantial investment is more than a mere privilege or gratuity.").

[57] *Orange Park Florida T.V., Inc. v. FCC,* 811 F.2d 664, 674 n.19 (D.C. Cir. 1987).

[58] *See Regulatory Treatment of Mobile Services*, GN Docket 93-252, *Third Report and Order*, 9 F.C.C.R. 7988, 8042, ¶ 95 (1994).

exclude others from using the same spectrum within the licensed geographic area.[59] Based on the grant of these rights, cellular and PCS licensees have invested tens of billions of dollars acquiring spectrum, constructing networks, and upgrading their operations and services as technology advances.

The FCC's ability to defeat these rights to serve a public interest objective is constrained by the Fifth Amendment's prohibition of any government "taking" of private property rights for public use without just compensation.[60] Government action that appropriates the use and enjoyment of property from the owner is deemed a "taking *per se,*" while actions that reduce or eliminate uses of an owner's property, without actually appropriating the property itself, can constitute a "regulatory taking."

By allowing another (airborne) operator to transmit an appreciable signal on an incumbent CMRS licensee's spectrum within its licensed territory— even a signal that raises the noise floor by only 1 dB, as discussed above — the Commission would be destroying the exclusivity of the incumbent's license and thereby preventing the licensee from taking advantage of rights it currently possesses. Whether construed as *per* se or regulatory, this would constitute an unconstitutional taking of property without just compensation.

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[59] *See Public Utility Commission of Texas*, 13 F.C.C.R. 3460, 3503, ¶ 89 (1997); *Regulatory Treatment of Mobile Services,* 9 F.C.C.R. at 8042; *see also BellSouth v. FCC*, 162 F.3d 1215, 1223 (D.C. Cir. 1999). The FCC has recognized that a service area includes not only horizontal coverage but also vertical coverage, and that cellular carriers are entitled to the same interference protection from a neighboring carrier's mobile air-to-ground units as from mobile terrestrial units. *See AirCell, Inc.*, 14 F.C.C.R. 806 (WTB 1999), *aff'd*, 15 F.C.C.R. 9622 (2000), *remanded in part sub nom. AT&T Wireless Services, Inc. v. FCC,* 270 F.3d 959 (D.C. Cir. 2001).

[60] U.S. CONST., amend. 5.

1. *Per Se* Taking

The deprivation of licensees' exclusive right to operate radio transmitters within their licensed service areas and frequency bands and the grant to others of the right to operate at any appreciable level, even on a secondary basis, would amount to an appropriation of property rights and would constitute a taking *per se,*[61] giving rise to "a categorical duty to compensate" the licensee so deprived.[62] Moreover, the appropriation of the use of property is a taking *per se* whether the government keeps the right to use the property itself or transfers that right to a third party for use for a legislatively-determined "public purpose."[63]

Authorizing new airborne operator rights in licensed CMRS spectrum would clearly take the spectrum property of existing licensees under these principles. Such action would entitle third parties to use spectrum, and prohibit current licensees from excluding such users, through some variation in the terms of spectrum usage for time, geography, power or frequency that licensees heretofore had the exclusive right to exploit. The fact that the rights taken are intangible or purely economic is no bar to finding an unlawful taking.[64] Granting third parties the right to use the spectrum in some way will inevitably clash with the licensee's efforts to mine the spectrum to its fullest extent. That will, in turn, either take value from the usability of the licensee's existing capital investments or require investment in additional facilities to lessen the

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61 *See Tahoe-Sierra Preservation Council, Inc. v. Tahoe Regional Planning Agency,* 535 U.S. 302, 321 (2002); *see also United States v. Cauchy,* 328 U.S. 256 (1946); *Portsmouth Harbor Land & Hotel Co. v. United States,* 260 U.S. 327, 329-30 (1922).

62 *Tahoe-Sierra,* 535 U.S. at 322.

63 *See Kelo v. City of New London*, Case No. 04-108 (U.S. June 23, 2005) (a city's plan for economic development of an area by a private developer justified condemnation of citizen's residential property); *see also Loretto v. Teleprompter Manhattan CATV Corp.,* 458 U.S. 419 (1982).

64 *See Bluefield Waterworks & Improvement Co. v. Pub. Serv. Comm'n of W. Va.*, 262 U.S. 679, 692 (1923); *Duquesne Light Co. v. Barasch*, 488 U.S. 299, 307-08 (1989); *United States v. Pewee Coal Co.*, 341 U.S. 114, 117-18 (1951) (plurality opinion); *FERC v. Pennzoil Producing Co.*, 439 U.S. 508, 517 (1979).

impact of the new users.[65] In either event, the authorization of new users will take "the capital prudently devoted to the public utility enterprise by the utilities' owners."[66]

2. Regulatory Taking

Even if the authorization of third parties to use already-licensed spectrum for airborne service does not constitute a *per se* taking, it would certainly constitute a regulatory taking that is, likewise, permitted only if just compensation is paid. The Supreme Court applies a three-part test to determine whether government action that regulates the owner's use of property is a regulatory taking, considering (i) the nature of the governmental action; (ii) the severity of the economic impact of the regulation; and (iii) interference with the owner's reasonable investment-backed expectations.[67] Recently, the Court made clear that the focus is "directly upon the severity of the burden that government imposes upon private property."[68]

Authorization of new users in licensed spectrum would be regarded as a regulatory taking under these factors. First, the character of the action would be invasive and unusual. Granting access to third parties to licensed spectrum would directly intrude on the existing licensees' ability to exploit that same spectrum more fully. It would also grant new rights to exploit that spectrum to third parties — a right previously held exclusively by the licensee.[69] The FCC has repeatedly recognized a licensee's right to continued use of licensed spectrum, or its equivalent,

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65 *See* V−COMM Interference Temperature Comments (discussing impact of new entrants into cellular/PCS spectrum on existing licensees and level of capital investment necessary to overcome introduction of such new interferers into under an Interference Temperature or Cognitive Radio regime).

66 *Duquesne,* 488 U.S. at 309.

67 *Penn Central Transportation Co. v. City of New York*, 438 U.S. 104, 124 (1978).

68 *Lingle v. Chevron USA, Inc.,* 125 S.Ct. 2074, 2082 (2005).

69 *Cf. Kaiser Aetna v. United States*, 444 U.S. 164, 179-80 (1979); *Loretto*, 458 U.S. at 433-35.

a policy which introduction of new airborne service entrants would reverse without apparent justification.[70]

Second, the economic impact of the proposed rule on licensees would be severe. The proposed new use would not only result in interference in a real sense with the operation of cellular (and PCS) service within the licensed bands, but also would deprive the licensees of the ability to more fully exploit those bands for their own benefit. In either case, significant additional expenditures would be necessary for the existing licensee to realize its full use of the spectrum.

Third, the proposed use would undermine licensees' reasonable, investment-backed expectations. Current licensees acquired licenses that the FCC explicitly denominated "exclusive," in many cases paying substantial sums for those exclusive rights. In addition, licensees have invested significant sums to develop the spectrum so acquired – investments that were premised on the reasonable expectation of exclusivity. Indeed, the FCC encouraged such investment by not adopting restrictive technical standards and by denominating the spectrum as exclusive for the use of the licensee, so that the reasonable licensee would expect regulatory certainty that would justify its efforts to expand usage of the spectrum. The courts have held that government action that had analogous impacts on intangible property rights was a regulatory taking.[71]

Because of the serious takings problems created by authorizing one or more new airborne operators within the (currently) exclusive spectral and territorial space of existing CMRS licensees, it would be unlawful for the Commission to implement such a scheme. In *Bell*

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[70] *See, e.g., Redevelopment of Spectrum to Encourage Innovation in the Use of the New Telecommunications Technologies*, ET Docket 92-9, *Notice of Proposed Rulemaking*, 7 F.C.C.R. 1542, 1545, ¶¶ 22-24 (1992).

[71] *See Ruckelshaus v. Monsanto Co.,* 467 U.S. 986 (1984).

Atlantic Telephone Cos. v. FCC,[72] the D.C. Circuit made clear that the Commission may not adopt a rule that constitutes or approaches an uncompensated taking unless Congress has clearly and unambiguously delegated such authority. As a result, the Commission is barred from allowing unlicensed or nonexclusively licensed provision of airborne service in spectrum that is currently subject to exclusive CMRS licenses.

B. Authorization of Airborne Entrants in Already-Licensed Spectrum Would Breach the FCC's Contractual Obligations to CMRS Licensees

A spectrum license is a contract with the FCC in which the licensee is authorized to exploit a government resource (spectrum) to the benefit of both parties with complementary contractual obligations to enable that result.[73] By granting the license, the FCC furthers its statutory obligation to establish a nationwide communications system by radio, while the licensee either offers a commercial service or uses the resource for its own internal purposes.

Accepting the right to use cellular or PCS spectrum also commits the licensee to various responsibilities, including payment of auction bids, investment in and building out physical facilities, abiding by applicable FCC rules and providing service to consumers. But, as an inducement to make the investment to build out and provide service, licensees enjoy a reasonable expectation of and rely on the continued ability to use the spectrum exclusively and free from increased harmful interference. Moreover, cellular and PCS licensees have always enjoyed the expectation that they can use the spectrum to the greatest extent possible, based on the interference environment at the time of licensing.

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[72] 24 F.3d 1441 (D.C. Cir. 1994).

[73] *See Installment Payment Financing for Personal Communications Services (PCS) Licensees,* WT Docket 97-82, *Second Order on Reconsideration of the Second Report and Order,* 14 F.C.C.R. 6571, 6581 n.66, ¶ 17 (1999); *see also NextWave Personal Communications, Inc. v. FCC*, 200 F.3d 43, 60 (2d Cir. 1999) ("The close of the auction established the FCC's obligation to grant NextWave the Licenses if the company fulfilled the statutory eligibility requirements.").

Like other contracts with the government, a spectrum license comes with the potential for subsequent changes in government rules. However, courts have recognized that an implied covenant of good faith and fair dealing places limits on the government's ability to change the terms of an agreement through subsequent legislation (or rulemaking) to the detriment of the private party.[74] In the case of a spectrum license, the FCC would breach the covenant of good faith and fair dealing if it were to devalue the licensee's beneficial use and enjoyment of the authorized spectrum by allowing new and interfering uses. For example, as described above, allowing an increase in the noise floor of 1 dB would significantly curtail the capacity of existing networks and require additional, unanticipated investment to overcome the new interference.

Both the *Winstar* and *Centex* cases found that a contractual relationship between the government and a third party imposes upon both parties an implied covenant of good faith and fair dealing "that includes the duty not to interfere with the other party's performance and not to act so as to destroy the reasonable expectation of the other party regarding the fruits of the contract."[75] Specifically, the *Winstar* and *Centex* cases dealt with agreements that savings and loan associations ("S&Ls") entered into with the government as part of a deal to take over other ailing S&Ls. The Federal Savings and Loan Insurance Corporation, realizing the burden that would be placed on the government if these ailing S&Ls collapsed, made specific representations to healthy S&Ls of certain financial benefits in order to entice them to take over the ailing thrifts – promises that were effectively negated through subsequent legislation by Congress.[76] When

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74 *See United States v. Winstar*, 518 U.S. 839 (1996); *Centex Corp. v. United States,* 395 F.3d 1283 (Fed. Cir. 2005).

75 *Centex*, 395 F.3d at 1304.

76 The *Winstar* case dealt with the promise from the FSLIC that these S&Ls would be able to apply "supervisory goodwill" towards their capital reserve requirements. *See Winstar*, 518 U.S. at 848-849. The *Centex* case dealt with a specific representation that these S&Ls would be

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Congress enacted this legislation, the thrifts sued on breach of contract claims, arguing that the value of the bargain that they had entered into was impaired by the subsequent action of Congress.

The courts in *Winstar* and *Centex* both found that the government was liable for breach of contract and damages. Both courts rejected the government's defenses based on the "unmistakability"[77] or "sovereign act" doctrines[78] as bars to recovery by the thrifts.[79] The Court in *Winstar* held that the unmistakability doctrine did not apply because the plaintiff S&Ls were seeking damages, rather than attempting to limit sovereign authority to pass subsequent legislation, e.g., by injunction.[80] In *Centex,* the court held that the sovereign act defense was not available, as the legislation in question could not be considered a sovereign act "because it was not generally applicable legislation in form or substance, but was specifically targeted at appropriating the benefits of a government contract."[81] The courts clarified that Congress cannot generally be precluded by contract from exercising its sovereign right to pass legislation, but a contract can "bind the government to pay damages in the event such legislation is found to

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(footnote continued)
able to obtain certain tax benefits from taking over ailing S&Ls. *See Centex*, 395 F.3d at 1288-89.

77 The unmistakability doctrine provides that absent an unmistakable provision to the contrary, contracts with the government remain subject to subsequent legislation by the sovereign. *Winstar*, 518 U.S. at 871-880.

78 The sovereign act doctrine provides that, "absent a clear statement to the contrary, a contract entered into by a private party with the government will not be interpreted to exempt the private party from the operation of a subsequent sovereign act by the government." *Centex,* 395 F.3d at 1306-07.

79 *See Winstar*, 518 U.S. at 879; *Centex*, 395 F.3d at 1306-09.

80 *See Winstar*, 518 U.S. at 880.

81 *Centex*, 395 F.3d at 1308.

breach the contract."[82] The plaintiffs sought "nothing more than the benefit of promises by the Government to insure them against losses arising from future regulatory change."[83]

The Commission's promises to cellular and PCS licensees are jeopardized as the Commission considers whether to allow airborne service. The Commission has stated that its licenses create "spectrum usage rights" that are "defined within the terms, conditions, and period of the license at the *time of issuance*."[84] Furthermore, the Commission has noted that licensees "must have certain rights and responsibilities that define and ensure their economic interests," among these "the right to be protected from interference to the extent provided in the Commission's rules."[85] And, the Commission has stated that it has a responsibility to use its regulatory authority to protect licensee usage rights:

> Under FCC licenses, performances are owed by both the licensee and the FCC. While [licensees] must obey FCC rules and make the required [auction] payments, the FCC must protect [licensees'] exclusive right to spectrum and refrain from authorizing others to use that spectrum. Courts generally conclude that analogous

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82 *Id.* at 1309.

83 *Winstar*, 518 U.S. at 881; *see also Mobil Oil Exploration and Producing Southeast, Inc. v. United States*, 530 U.S. 604 (2000); *see also Franconia Assocs. v. United States*, 61 Fed. Cl. 718 (2004). In Franconia, the government had encouraged the construction of low-income housing in rural areas by entering into mortgage contracts with property owners that limited the owners' profits during the life of the mortgage, but allowed owners to charge market rents once the mortgages were paid in full. The contracts expressly allowed prepayment of the mortgages without penalty. Congress, concerned with a shortage in low-income housing, later enacted a law that limited the mortgagors' ability to prepay, and several mortgagors sued for breach of contract. The Court of Federal Claims found for the property owners and awarded lost profits that they would have realized had they been able to prepay and charge market rents. *Franconia Assocs.*, 61 Fed. Cl. at 751-52.

84 *Principles for Promoting the Efficient Use of Spectrum by Encouraging Development of Secondary Markets, Policy Statement,* 15 F.C.C.R. 24178, 24187, ¶ 22 (2000) (emphasis added).

85 *Id.* at 24186, ¶ 20; *see also* PCS Blocks A & B, Bidder's Information Package, at 16 ("The terms contained in the Commission's Reports and Orders, Public Notices and in the Bidder's Information Packages are not negotiable . . . . [P]rospective bidders should . . . make certain they understand all of the provisions and are willing to be bound by all of the Terms before making any bid.").

> exclusive licensing arrangements made by private parties for commercial reasons are "executory."[86]

These promises by the FCC created reasonable expectations that licensees will have the rights to exclusive and maximum use of the spectrum. Moreover, by regulatory action, the FCC contributed to the licensees' expectations that they would be able to operate in this spectrum on an exclusive basis, free from harmful interference. The FCC implemented a renewal expectancy in the PCS service rules specifically to "provide a stable environment that is conducive to investment, and thereby will foster the rapid development of PCS."[87] The FCC also imposed certain requirements on the licensee to induce it to substantially invest in and build out its system, thereby further fueling an expectation of continued interference-free operations.[88] In addition, there was no suggestion in the original cellular or PCS rules or the bidders' information package for PCS that the Commission would authorize additional interfering services. And, the FCC has repeatedly awarded replacement spectrum to licensees whose authorized spectrum has been appropriated for other uses during the license terms so that the licensees could continue existing operations.

As indicated by the Commission's statement of its responsibility to protect licensee exclusive use, the rules and policies governing cellular/PCS licenses do provide a reasonable basis for the licensee to develop reliance expectations about the terms of its license and the operating environment, that is, as with the injured parties Winstar and Centex, the basis for

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86 *FCC v. NextWave Personal Communications,* Case Nos. 01−653 and 01−657 (U.S.), Brief for the Federal Communications Commission, at 34 n.10 (May 6, 2002)

87 *Amendment of the Commission's Rules to Establish New Personal Communications Services,* GEN Docket 90-314, *Second Report and Order*, 8 F.C.C.R. 7700, 7753, ¶ 131 (1993).

88 *See, e.g.* 47 C.F.R. §§ 20.15(e) (imposing requirements for number portability); 20.18 (imposing requirements for E911 capabilities); 24.203 (imposing build-out requirements), 24.903 (imposing requirements for CALEA capabilities); 64.601 et seq. (imposing requirements for telecommunications relay service).

accepting the licensee responsibilities. The courts in *Winstar* and *Centex* emphasize that the duty of good faith and fair dealing protects against meddling with the reasonable expectations of a party regarding the fruits of a contract, particularly if the other party contributed to those expectations.[89] This would include expectations with respect to both a licensee's current and future use of the spectrum, and, specifically, the ability of the licensee to use the spectrum under the general terms at which it is licensed, free from diminution of accessibility and usability of spectrum as a result of new interference, even if the noise floor increase is only 1 dB.

Under these circumstances, the FCC's subsequent adoption of a rule that would increase interference in the licensed spectrum would not qualify for the "sovereign act" defense. As noted in *Centex*, only generally applicable legislation (or regulations) qualifies as a sovereign act, not provisions "specifically targeted at the fruits of contracts enjoyed by the government's contracting partners."[90] Given that regulations injecting new uses into licensed spectrum would necessarily be specific to the spectrum involved, and indeed would require specific consideration of the impact on individual carriers' licenses before they could be adopted, they would not qualify as sovereign acts eligible for the sovereign act defense.

Obviously, a licensee cannot preclude the FCC's actions to manage spectrum, when needed, as a government resource. Nor does a licensee have an absolute right to exclude spectrum uses that would inevitably interfere with its signal at some point in free space. FCC action in accordance with these generic grants of authority does not necessarily target specific

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89 *See Winstar*, 518 U.S. at 855 (stating that it was "not obvious that regulators would accept purchase accounting in determining compliance with regulatory criteria, and it was clearly prudent to get agreement on the matter"); *Centex*, 395 F.3d at 1288 (noting that the request for bids and the agreement between the S&Ls and the FSLIB indicated that the FSLIB understood and contributed to the S&Ls expectation that they would be able to take advantage of certain tax benefits and that the expectation "was not unilateral").

90 *Centex*, 395 F.3d at 1308.

licenses. The courts in *Winstar* and *Centex* clearly recognized the government's right to legislate post-contract as does, for example, Section 316 of the Act. The fact that the FCC has the authority to modify licenses does not mean that every modification is legal, or that a modification does not come without a price for breach of contract. Such provisions of the Act do not negate the FCC's responsibility, under *Winstar* and *Centex*, to honor its contractual commitments to existing licensees and to compensate a licensee for the FCC's spectrum management decisions that impair the benefit of the bargain made with the licensee, when the FCC's post-contract regulations step over the boundary of good faith and fair dealing. [91]

Introduction of new interference into licensed cellular/PCS spectrum constitutes a breach of contract with current licensees, and the FCC would therefore be liable for damages equal to the loss suffered by the licensees as a result of the breach, that is, the loss suffered by the licensees as a result of introduction of the new interference into the spectrum.[92] Even the FCC has recognized that compensation is due licensees for similar spectrum impairments, and has attempted to fashion remedies, including, requiring the new entrants to compensate the current licensees for use of the spectrum, granting the current licensees rights of use in other spectrum,[93] and/or awarding bidding credits for use to acquire equivalent spectrum.[94] Moreover, as

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91 Thus, the *Winstar* and *Centex* cases do not simply challenge the FCC's right to modify licenses, as the FCC stated in rejecting a contract-based argument in the context of modifying PCS licensees' build-out obligations. *Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies to Provide Spectrum-Based Services*, WT Docket 02-381, *et al.*, 19 F.C.C.R. 19078, 19125-26 (2004). Rather, these cases demonstrate that fundamental changes in the ability of licensees to use the spectrum as licensed negate a licensee's reasonable expectations and impair its investment, and require compensation to the licensee.

92 *See*, *e.g.*, *Centex*, 395 F.3d at 1314.

93 *See*, *e.g.*, *Qualcomm Inc. v. FCC*, 181 F.3d 1370 (D.C. Cir. 1999).

94 *See, e.g.*, *Promoting Efficient Use of the Spectrum Through Elimination of Barriers to the Development of Secondary Markets*, WT Docket 03-66 *et al.*, *Report and Order and Further Notice of Proposed Rulemaking,* 19 F.C.C.R. 14165, 14273-74 (2004).

described above, the loss resulting from even a small increase in the noise floor is certainly measurable and can be translated into financial loss.

C. Authorization of New Entrants' Use of Exclusively Licensed Spectrum Would Unlawfully Modify Incumbent CMRS Licenses

Section 316 of the Act authorizes the FCC to "modify" station licenses "if in the judgment of the Commission, such action will promote the public interest, convenience, and necessity."[95] In establishing the existing regime for licensing and operation of cellular and PCS stations, the FCC has found "public interest" reasons to put in place many features that it would have to alter or eliminate in order to authorize new users in cellular/PCS spectrum. While the FCC has the power to make such changes over the objection of station licensees, such wholesale changes call into question the legitimacy of rationale for the new regime. For example:

- The FCC continues to recognize that the cellular/PCS industry is a tremendous success story, helping to fulfill the FCC's mandate to create a nationwide, wireless service.[96]
- The FCC has acknowledged that the public interest is served by the robust competition among cellular/PCS carriers developed under the existing rules and policies governing these services.[97] The most fundamental of those rules and policies is that the FCC has found it in the public interest to award cellular/PCS licensees exclusive rights to operate in specific frequency bands.[98]
- The FCC determined that the public interest would be served by allowing the CMRS industry to innovate and improve the technology used to provide service based so as to make maximum use of the spectrum.[99]
- Introduction of airborne services provided by unlicensed or nonexclusively licensed operators will cause interference to existing cellular (and PCS) subscribers. New interferers in the cellular/PCS bands will have an adverse impact on cellular/PCS

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95 47 U.S.C. § 316(a). Licensees affected by the modification are entitled to notice and an opportunity to object prior to implementation of the modification.

96 *Annual Report and Analysis of Competition Market Conditions with respect to Commercial Mobile Services*, WT Docket 04-111, *Ninth Report,* 19 F.C.C.R. 20597, ¶¶ 20-28 (Sept. 28, 2004) ("Ninth Report on Competition").

97 *Id. at* ¶ 222 ("U.S. consumers continue to benefit greatly from robust competition in the CMRS marketplace").

98 *See Regulatory Treatment of Mobile Services*, 9 F.C.C.R. at ¶¶ 95, 131.

99 *Cellular Communications Systems,* CC Docket 79−318, *Report and Order*, 86 F.C.C.2d 469, ¶¶ 77, 112 (1981).

licensees. These licensees will face loss of capacity and/or loss of usefulness of some facilities, which will require additional, and otherwise unnecessary, investment to overcome the new interferers.[100]

- Introduction of new interferers into the cellular/PCS bands will have an adverse impact on cellular/PCS consumers, resulting in higher prices as capacity becomes relatively scarcer and the investment needed to provide capacity increases.
- Introduction of new interferers into the cellular/PCS bands will adversely affect the FCC's auction policies by introducing regulatory uncertainty and making existing licensees and new entrants less likely to acquire spectrum for new services, ultimately devaluing spectrum offered at auction.[101]

In short, modifying existing cellular/PCS licenses to enable authorization of additional entrants into the spectrum is not necessary, is harmful to the existing licensees and the public, and is inconsistent with the FCC's long-standing spectrum policies governing these services. Such action does not serve the public interest.

IV. THERE IS NO RECORD TO SUPPORT USE OF CELLULAR SPECTRUM FOR AN AIR-TO-GROUND "PIPE"

No parties submitted supporting comments for the proposed air-to-ground "pipe" applications in cellular spectrum.[102] Even AirCell, which currently uses cellular spectrum in this manner pursuant to a waiver, did not comment in support of this application of cellular spectrum.[103]

The use of cellular spectrum for air-to-ground applications would increase the potential for harmful interference to terrestrial networks due to the aircraft's external antenna having a complete view of all base stations within the radio horizon — much more extensive visibility

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100 *See supra* Section II.A.1 (discussing impact on coverage and capacity of existing cellular/PCS systems from introduction of even 1 dB increase in noise floor).

101 *See* 47 U.S.C. § 309(j)(3)(A)-(B) (FCC should use auctions to encourage development and deployment of new technologies and to ensure dissemination of licenses among a wide variety of applicants).

102 Likewise, no parties suggested extending this concept to use PCS or SMR spectrum in this manner.

103 AirCell Comments at 1-2.

than airborne handsets or picocells onboard aircraft. In addition, these applications can utilize much higher antenna gains (*i.e.,* 10 dBi gain or higher, as opposed to 0 dBi handset antenna gains), further increasing the risk of harmful interference to terrestrial networks.

V−COMM's technical comments, attached to Cingular and Verizon's Comments in this proceeding outlined that the proposed 0 dBm level is substantially too high for ATG service sharing cellular spectrum, and will cause harmful interference to terrestrial networks. Per page 2 of the V−COMM Comments:

> In regards to the air-to-ground "pipe" application in cellular spectrum using an output power level of 0 dBm (as proposed in the NPRM), the analysis indicates that terrestrial base stations will receive air-to-ground signals substantially above the level shown to cause unacceptable interference to terrestrial networks. Therefore, the output power level of 0 dBm is substantially too high for the proposed air-to-ground services, and can cause harmful interference to terrestrial networks with aircraft at any altitude.
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> For example, the air-to-ground signals will be received in the range of 6 to 29 dB above the base station unacceptable interference level, for the altitudes of 5,000 feet and below. At 10,000, 20,000 and 35,000 feet, the interference is received up to 14 dB, 10dB, and 6 dB, respectively, above the unacceptable interference level for the terrestrial base stations. This represents the interference received for just one air-to-ground signal used on one aircraft in view of the terrestrial base station (with an output power limit of 0 dBm & unity gain aircraft antenna). If additional air-to-ground signals or aircraft are present, or if increased power or antenna gain is used in the air-to-ground system, the received interference levels can be significantly higher than indicated in this analysis. For these reasons, the FCC needs to take into account the gain of the aircraft antenna, the number of aircraft within view, and the power level of the air-to-ground system to ensure harmful interference is not caused to terrestrial systems.[104]

CONCLUSION

For the reasons stated here and in our opening Comments, the Commission should not authorize the unlicensed or nonexclusive licensed use of CMRS spectrum for airborne service. If

[104] V−COMM Technical Comments at 2.

the Commission finds that in-flight picocell-based CMRS is consistent with the public interest, such service must be provided only under the control of the CMRS license holder for the spectrum block and area where the service is being rendered.

Respectfully submitted,

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