Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of	)
	)
AIRCELL, INC.	)
	)
Petition, Pursuant to Section 7 of the Act, for a Waiver of the Airborne Cellular Rule, or, in the Alternative, for a Declaratory Ruling	)
	)
	)

ORDER ON REMAND

Adopted: November 26, 2002 **Released: February 10, 2003**

By the Commission: Commissioner Martin concurring and issuing a statement; Commissioner Abernathy not participating.

A. Introduction and Summary

1. This Order on Remand completes our review of several orders by the Wireless Telecommunications Bureau (Bureau) granting to AirCell, Inc. and its cellular licensee partners (collectively, AirCell) waivers of section 22.925 of the Commission's rules.[1] The waivers enable AirCell subscribers to operate, under the authority of AirCell's partners' cellular licenses and on a secondary non-interference basis, specially designed cellular telephones in airborne aircraft, which section 22.925 would otherwise prohibit. After the Commission affirmed the Bureau's orders in a Memorandum Opinion and Order in this proceeding (*AirCell MO&O*),[2] a number of cellular carriers appealed the *AirCell MO&O* to the United States Court of Appeals for the District of Columbia Circuit (the Court).[3] On November 9, 2001, the Court substantially affirmed the *AirCell MO&O*. However, the Court remanded the matter to the Commission for a fuller explanation of one technical aspect of the Commission's decision.[4] After denying a subsequent request by the appellants for rehearing, the Court issued its mandate on January 29, 2002. In this Order on Remand, we reaffirm our conclusion that

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1 47 C.F.R. § 22.925.

2 *See*, In the matter of AirCell, Inc., Petition, Pursuant to Section 7 of the Act, for a Waiver of the Airborne Cellular Rule, or, in the Alternative, for a Declaratory Ruling, *Order*, 14 FCC Rcd. 806 (WTB 1998) (*AirCell Bureau Order)*, reconsideration granted in part, denied in part, *Order on Reconsideration*, 14 FCC Rcd. 19430 (WTB 1999) (*AirCell Reconsideration Order*), application for review denied, *Memorandum Opinion and Order*, 15 FCC Rcd. 9622 (2000) (*AirCell MO&O*).

3 The parties who petitioned for reconsideration of the waiver were: AirTouch Communications, Inc., Ameritech, AT&T Wireless Services, Inc., Bell Atlantic Mobile, BellSouth Cellular Corp, GTE Wireless Inc., and SBC Wireless, Inc. By the time the court appeal was filed, a number of these entities had combined, such that the appellants in this proceeding were AT&T Wireless Services, Inc., BellSouth Cellular Corp, SBC Wireless, Inc., and Cellco Partnership (dba Verizon Wireless). Since that time, BellSouth Cellular Corp and SBC Wireless, Inc. have become Cingular Wireless.

4 *AT&T Wireless Services, Inc., et al., v. FCC*, 270 F.3d 959, 968 (D.C.Cir. 2001).

operation of the AirCell system is not likely to cause harmful interference to terrestrial cellular systems and provide a more complete explanation for that conclusion. We therefore reaffirm the Bureau's waivers.[5]

2. The main issue regarding which the Court instructed the Commission to provide fuller explanation concerns a technical benchmark we called the "interference threshold level" (ITL).[6] As used in this proceeding, for a given environment, the ITL is the highest level of noise and interference power that can be received by a cellular base station receiver without any interference being caused to the weakest telephone call that could still be considered an acceptable quality call.[7] In this case, parties on both sides of the proceeding submitted ITL calculations as part of their technical arguments regarding the likelihood of the AirCell system causing harmful interference. The Commission considered these submissions and also calculated our own ITL. We then used our ITL to help us evaluate whether an AirCell airborne mobile telephone transmission received as an unwanted signal by a non-affiliated cellular base station would be powerful enough to affect the quality of terrestrial cellular calls in any meaningful way. As discussed below, we based our ITL calculations on technical parameters that are generally accepted in the industry and are well within the range of values in the record. Indeed, our calculated ITL matched not only that presented by supporters of the AirCell system, but also the value put forth by AT&T Wireless, one of the appellants. The Court, however, concluded that the Commission had not adequately explained its rejection of a lower ITL advocated by another of the appellants, AirTouch. To address the Court's concern, we further explain below that we rejected the AirTouch ITL calculation because it was based on technical assumptions more conservative than the industry consensus, did not take into account the received power level of typical cellular telephone calls, and was marred by a mathematical error.

3. The Court also instructed the Commission to explain how it reached its conclusion without assessing the probability of AirCell and a terrestrial carrier using the same frequency in the same area simultaneously, which could affect the likelihood of harmful interference. As explained below, in reaching its conclusion that the AirCell system is not likely to cause harmful interference, the Commission did not factor in any probability evidence because the Commission concluded that, even if these events *were* to occur simultaneously, the AirCell system would not cause harmful interference to terrestrial cellular networks because of that system's built-in safeguards.[8] As a result, the Commission did not need to consider probability evidence in order to extrapolate from the test data in the record.

B. Background

4. Section 22.925 of the Commission's rules (the airborne cellular rule) prohibits the operation of cellular telephones while airborne. The Commission adopted this rule because of the potential for

[5] Following the Court's remand of the AirCell MO&O, the Commission and its staff have received correspondence and pleadings from various parties to the proceeding. As we neither solicited nor granted leave to file additional pleadings in this docket, we need not consider them here. The record compiled in the underlying proceeding was a sufficiently adequate base on which to rest the Commission's decision, and as this Order on Remand merely explains that decision in greater detail on the basis of that record, we need only look to that record.

[6] AirTouch and the appellants refer to this as the "interference tolerance level."

[7] As explained below (*see* ¶ 22), although a noise and interference power level slightly above the ITL indicates the possibility of some degradation to the desired signal, it must be substantially above the ITL in order to cause *harmful* interference, which a secondary service (such as AirCell's) is not permitted to cause to a primary service (such as the appellants').

[8] The AirCell system incorporates a number of safeguards, such as dynamic power control, to prevent harmful interference. In addition, the waiver requires that AirCell maintain a central control point and shut down the system immediately if monitoring shows a malfunction or other event likely to cause harmful interference. *AirCell Bureau Order* at Appendix A.

harmful interference to terrestrial cellular networks when a wireless telephone is able to transmit to a large number of base stations simultaneously, as is the case when that telephone is airborne.[9] Such an effect is made possible by the architecture of a cellular system, which is based on re-use of frequencies. Section 22.925 was designed to address the particular circumstance of airborne use of a mobile phone with sufficient power to reach multiple base stations in this manner. Apart from this prohibition, our rules explicitly provide that cellular base station receivers are not afforded any protection against interference from mobile units.[10]

5. AirCell developed a system of specially designed telephones and ground equipment that allows users to access the existing networks of cellular licensees with whom AirCell has partnered without causing such interference. Because AirCell's partners' ground stations are located in rural areas, where ambient RF noise levels are lower, AirCell's specially designed customer end equipment can operate at very low power and still maintain reliable communications with the ground stations.[11] AirCell also employs special, horizontally polarized antennas which further reduce the potential for harmful interference with the vertically polarized antennas commonly used in terrestrial base stations. Additional measures to prevent interference include dynamic power control, a single command point at which the system can be shut down, and frequency coordination with non-participating carriers.[12] AirCell's partner licensees operate the system on a secondary basis with ground equipment co-located at their base stations. Traffic from AirCell's airborne terminals is handled through these partners' facilities.

6. On October 9, 1997, after conducting operations pursuant to an experimental license,[13] AirCell filed a petition for waiver with the Bureau in order to deploy its system commercially,[14] to which a number of cellular carriers filed oppositions.[15] As part of the pleadings submitted to the Bureau, both AirCell and its cellular carrier opponents cited data from two days of operational tests that had been conducted jointly by AirCell and the opposing carriers in July 1997 at sites in Texas and Oklahoma to assess how the AirCell system would perform in a real-world environment. The first day of testing, on July 10, 1997, was conducted with all of the built-in safeguards in the AirCell system operating normally, while on the second day, July 11, 1997, certain of these safeguards were deliberately disabled and abnormal flights patterns were introduced into the test protocol. On September 22, 1998, the

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9 *See,* Airborne Use of Cellular Telephones and the Use of Cell Enhancers in the Domestic Public Cellular Radio Service, CC Docket 88-411, 7 FCC Rcd. 23 (1991).

10 47 C.F.R. § 22.352(c)(3).

11 This principle is analogous to being able to hear a whispered conversation from across a quiet room, while even a louder conversation might not be intelligible from a few tables away in a noisy restaurant.

12 Dynamic power control allows the system to adjust the power continuously so that only the minimum output required is used. By having a single command point, AirCell is quickly able to shut off any transmissions that are deemed to be causing harmful interference, should that occur.

13 AirCell initially began testing the concept for airborne cellular service in 1992 under the authority of various Experimental (Part 5) and Special Temporary Authorizations, and has continued refining its hardware product to the present time. *See* Call Sign KS2XAT: *Experimental Special Temporary Authorization,* File No. S-1246-EX-92 (December 15, 1992). *See also* Call Sign KI2XCS: *Experimental Radio Station Construction Permit and License,* File No. 4555-EX-PL-94 (December 28, 1994); *Experimental Special Temporary Authorization,* File No. S-2374-EX-96 (March 22, 1996); *Experimental Radio Station Construction Permit and License,* File No. 5349-EX-MR-96 (June 22, 1996); *Experimental Radio Station Construction Permit and License*, File No. 5349-EX-RR-1998 (Jan. 3, 2002).

14 AirCell, *Petition*, Pursuant to Section 7 of the Act, for a Waiver of the Airborne Cellular Rule, or, in the Alternative, for a Declaratory Ruling, filed October 7, 1997 (*AirCell waiver petition*).

15 *See* n.3.

opposing carriers conducted a further test without AirCell's participation at a site in Florida, which they contended showed a high potential for harmful interference.

7. On December 24, 1998, after reviewing all the test data, the Bureau granted a limited waiver of section 22.925 to AirCell and its partners for a period of two years.[16] The Bureau concluded that the test results demonstrated that the AirCell system would not cause harmful interference to cellular operations under normal operating conditions. In reaching this conclusion, the Bureau did not give significant weight to test data that assumed abnormal flight conditions and the disabling of those parts of the AirCell system whose express purpose was to prevent such interference.[17] The Bureau also imposed limitations on the operation of the AirCell system to protect further against the risk of interference. Specifically, the waiver provided that airborne service could be provided only on a secondary basis to regular cellular communications, requiring the AirCell system to cease operations immediately if harmful interference occurred.[18] The Bureau also restricted operation of the AirCell system to six channel pairs per ground station, required the use of non-standard control channels, and required advance notice to and coordination with non-participating cellular carriers within 270 kilometers of any AirCell operations.[19]

8. The opposing carriers filed a Motion for Stay and Petition for Reconsideration of the Bureau waiver order, and AirCell filed a petition for reconsideration of the 270-kilometer notification requirement. The Bureau subsequently granted AirCell's petition and reduced the notification requirement to 151 kilometers,[20] and expanded the waiver to include additional partner carriers.[21] Over the following thirteen months, the opposing carriers filed additional Applications for Review and Motions for Stay of the various Bureau orders. These pleadings, as well as a Petition for Clarification filed by TruePosition, Inc and Applications for Review of certain letter rulings issued by the Office of Engineering and Technology (OET), were consolidated and addressed by the Commission in the *AirCell MO&O*, which affirmed these Bureau orders and the OET letter rulings.[22]

9. In the *AirCell MO&*O, the Commission extensively reviewed the data from the tests conducted on July 10-11, 1997 and September 22, 1998 that had been previously reviewed by the Bureau.[23] In upholding the Bureau decision, the Commission specifically rejected the data from the July 11 and September 22 tests, upon which the appellants relied, as unreliable and based on unrealistic test

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16 *AirCell Bureau Order*.

17 *AirCell MO&O* at ¶19.

18 A secondary service may cause no interference, must cease operation if it cannot fix any interference problem that arises, and must accept interference from the primary service (in AirCell's case, the terrestrial cellular licensees).

19 *AirCell Bureau Order* at Appendix A.

20 *AirCell Reconsideration Order* at ¶¶ 12-16.

21 *AirCell, Inc., Pine Belt Cellular, Inc. Tennessee RSA No. 3 Limited Partnership, WESTEX Telecommunications, Inc., XIT Cellular, ETEX Cellular Co. Inc., Cellular Network Partnership, and North Alabama Cellular, LLC,* Petitions for Waiver of the Airborne Cellular Rule, 14 FCC Rcd. 13151 (WTB 1999); *AirCell, Inc., ALLTEL Communications, Inc., American Rural Cellular, Inc., Centennial Cellular Corporation, CenturyTel Wireless, Inc., Kentucky RSA 4 Cellular General Partnership, and Smith Bagley, Inc. d/b/a/ Cellular One of Northeast Arizona*, Petitions for Waiver of the Airborne Cellular Rule, 15 FCC Rcd 1639 (WTB 1999).

22 The Commission's affirmation of the OET letter rulings is not at issue on remand.

23 *See AirCell MO&O* at ¶ 20.

conditions.[24] The Commission further found that the data from the July 10 test supported the Bureau's conclusion that operation of the AirCell system is not likely to cause harmful interference to terrestrial cellular systems. In its analysis, the Commission rejected an interference analysis prepared by Dr. William C.Y. Lee on behalf of AirTouch – which purported to show that the AirCell system would cause harmful interference to an underlying cellular system over 30 percent of the time – as based on unrealistic assumptions, including the use of an unreasonably low interference threshold.[25]

10. On November 9, 2001, the United States Court of Appeals for the D.C. Circuit generally affirmed the *AirCell MO&O*, including its rejection of the July 11, 1997 and September 22, 1998 test data.[26] These data, therefore, are not matter for consideration in the instant order. As discussed above, however, the Court remanded the matter to the Commission for fuller explanation of the Commission's interpretation of the July 10, 1997 test data.[27] Specifically, the Court found that, in concluding that these data indicated that the AirCell system was not likely to cause harmful interference, the Commission failed to provide a reasoned justification for its use of a particular interference threshold level and its rejection of Dr. Lee's analysis. The Court also instructed the Commission to explain how it reached its conclusion that the AirCell system would not cause harmful interference without undertaking a probability study of the likelihood of simultaneous AirCell and cellular operations on the same channel in the same vicinity.

11. In limiting its remand to these narrow issues, the Court rejected the bulk of the opposing carriers' arguments. The opposing carriers had argued that, in granting the waiver, the Commission had unlawfully modified licenses held by the opposing carriers, and that, under the Communications Act of 1934,[28] AirCell must be required to apply for a license to provide a new service. The Court found no merit in either argument, holding that the waiver grant was consistent with the licensing scheme set forth in the Act as well as the Commission's rules. The Court similarly rejected the opposing carriers' argument that the Commission acted in an arbitrary and capricious manner in granting the waiver. As the Court noted, the Commission was entirely within its discretion to grant a waiver of its own rule if, as it found, such a waiver would not frustrate the purpose of the underlying rule and would be in the public interest.[29]

C. Discussion

12. *Use of an ITL to evaluate interference potential.* A central issue in this proceeding is whether the record indicates that airborne operation of the specially-designed cellular telephones supplied by AirCell to its subscribers is likely to cause harmful interference to terrestrial cellular telephone calls.[30] In addressing this issue, a majority of the parties to this proceeding, including AirCell

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[24] In addition, the Bureau deemed the September 22 test to be unreliable because of numerous operational flaws. For example, the test employed the wrong type of antenna, and the opposing carriers failed to record the power output of the airborne unit. *Id.*

[25] *Id.* at ¶ 21.

[26] *AT&T Wireless Services, Inc., et al., v. FCC*, 270 F.3d at 967 (D.C. Cir. 2001).

[27] *Id.* at 968.

[28] *See,* 47 U.S.C. §§ 301, 316.

[29] 270 F.3d. at 964.

[30] Section 22.925 of the Commission's Rules, waived for AirCell and its partners in this proceeding, generally prohibits airborne operation of cellular telephones in order to prevent possible harmful interference to cellular communications on the ground. This potential for harmful interference arises because a signal transmitted from an airborne cellular telephone covers a very wide geographic area on the ground, and could therefore be received not only by the cell site serving it, but also by numerous cell sites re-using the same channel at some considerable distance away. By contrast, the transmissions of a cellular telephone on the ground are normally received only by (continued....)

and a number of its opponents, made use of a criterion they termed the "interference tolerance level" (ITL).[31] In conducting its own analysis of the interference potential of the AirCell system as represented by the record, the Commission used essentially the same criterion under the term "interference threshold level." As used in this proceeding, the ITL for a given environment is the highest level of noise and interference power[32] that can be received by a cellular base station receiver without any interference being caused to the weakest telephone call that could still be considered an acceptable quality call. It is calculated based on various assumptions about the quality of cellular service expected, the capabilities of the cellular system's and subscribers' equipment, and the RF environment in the area of a particular cellular base station.

13. *The Commission's derivation of the ITL.* The Commission derived its ITL by starting with the minimum power level needed for a good-quality cellular telephone call, and factoring in a buffer to protect that call. As this approach recognizes, in order for a call of good quality to be made and maintained, its signal level must be higher by a certain degree than any other natural or manmade signal (noise and interference) in that area, on that frequency. In technical terms, this means that the ITL is derived by taking the minimum signal strength necessary for delivery of a good cellular call and subtracting the ratio of signal to noise-plus-interference, *i.e.*, the necessary margin (in dB) by which the strength of the "desired" signal (the cellular call) must exceed the strength of all "undesired" signals (noise and interference). This is expressed in the following equation:

$$ITL = C_{min} - R \qquad \text{Equation 1}$$

where ITL is the interference threshold power level in dBm
C_{min} is the minimum signal necessary for a good quality call, in dBm
R is the ratio of signal to noise-plus-interference, in decibels (dB)

Thus, the ITL represents the combined power level – *i.e.*, of the operation of the AirCell or other "unwanted" radio system, plus other ambient noise and interference, measured at the input to the "victim" cellular base receiver – below which no interference will be caused to a terrestrial cellular call received at that base station.[33] AirCell and appellant AT&T Wireless also used Equation 1 or its equivalent in analyzing the test data in the record.

(...continued from previous page)
the cell sites nearest to it. Reception of a signal transmitted from the airborne cellular telephone at cell sites other than the one serving it could potentially interfere with other cellular calls on the same channel. A signal transmitted from a cellular base station to an airborne cellular telephone does not pose the same risk of interference, because channel use at base stations is coordinated among licensees. For this reason, the parties and the Commission evaluated the potential for AirCell to cause interference by focusing on the unwanted reception, by non-AirCell partners' cellular base station receivers, of signals transmitted by airborne AirCell telephones.

[31] Rather than using the ITL method, TEC Cellular (an independent lab contracted by AirCell) and BellSouth (an appellant) compared the Texas/Oklahoma test data to actual received signal strength measurements of terrestrial cellular calls made at the Texas/Oklahoma test sites or an area in southern Florida.

[32] Here we use "noise" to mean the natural electromagnetic environment around the receiver, *i.e.*, the electrical power at the receiver input attributable to random molecular motion and other natural phenomena. Although the term "noise" is considered in some references to include interference, here we use the term "interference" to mean other purposeful transmissions, *i.e.*, the electrical power at the receiver input attributable to reception of energy from emissions, other than the desired signal, radiated by radio transmitters. *See, e.g.,* American National Standard definition of noise power at http://www.atis.org/tg2k/_noise_power.html.

[33] As explained below (*see* ¶22), although a noise and interference power level slightly above the ITL indicates the possibility of some degradation to the desired signal, it must be substantially above the ITL in order to cause *harmful* interference, which is what a secondary service (such as AirCell's) is not permitted to cause to a primary service (such as the appellants').

14. Applying Equation 1, the Commission used the values of −100 dBm for (C_{min}) and 17 dB for (R) to derive an ITL of −117 dBm for rural areas as the basis for its interference analysis.[34] These values are fully supported by the record and industry practice. Specifically, the value of −100 dBm used for (C_{min}) for rural areas is consistent with values found in the technical literature[35] and used by parties on both sides of this proceeding,[36] and is at the approximate midpoint of the range of values submitted into the record.[37] In fact, the Commission's use of −100 dBm for (C_{min}) is also consistent with the published textbook of Dr. Lee, AirTouch's expert,[38] which states that in noise-limited (rural) areas, −100 dBm is properly used as the lower handoff threshold, *i.e.*, the received signal strength below which a cellular system would attempt to continue carrying a call only if there were no cell site with better reception to which to hand it off.[39] Similarly, the Court observed that the value of 17 dB for (R) is an industry standard that is not disputed in the record.[40]

15. *AirTouch's derivation of the ITL.* In contrast to the Commission and all other parties, including the other appellants, AirTouch used a much lower ITL of –124 dBm as the basis for its interference analysis. Based in part on this proposed ITL, AirTouch asserted, in a report by Dr. William

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[34] *AirCell MO&O* at ¶50. In the *AirCell MO&*O, the Commission indicated that, given the operating parameters used, the possibility of AirCell causing interference to terrestrial cellular service is limited to rural areas. In urban and suburban areas, where the RF environment is significantly noisier than in rural areas, a good quality call requires substantially greater signal power, *i.e.*, a higher (C_{min}) value. In this proceeding, there is general agreement in the record that the RF noise typically found in urban and suburban areas is sufficient to mask AirCell signals when the system is operating normally, and the interference analyses presented by both AirCell supporters and opponents therefore focused on the potential for AirCell to cause interference in very rural areas. In such rural areas, it is generally assumed that the only sources of noise are those internal to the base station receiving equipment, and the minimum signal power (C_{min}) only has to be strong enough to reliably exceed the combination of thermal noise and receiver noise by the desired ratio. Some petitioners argued that AirCell will cause interference in suburban and urban areas, but these arguments were based on scenarios involving abnormal AirCell operation (*e.g.*, AirCell units transmitting with more power than authorized, unusual flight patterns, or failure of AirCell transmitter power control).

[35] *See* "Wireless Communications: Principles and Practice" (2d. ed.), Theodore S. Rappaport, Chapter 3, "The Cellular Concept – System Design Fundamentals," p. 63 (Prentice Hall, 2002). Rappaport gives a range of −100 to −90 dBm for C_{min}, depending on the circumstances. As explained above in note 34, the low end of that range (−100 dBm) would generally apply to quieter, rural areas, while the high end (−90 dBm) would apply to noisier, urban areas.

[36] AirCell submitted a value of −100 dBm, and appellant AT&T Wireless submitted a value of −100.4 dBm.

[37] The highest value proposed for C_{min} was −88 dBm, submitted by GTE/BellSouth, while the lowest was −110 dBm, submitted by TEC Cellular, an independent consultant retained by AirCell. GTE/BellSouth stated that the −88 dBm figure was based on actual measurements and experience in the southern Florida area rather than engineering theory. The Commission did not address the accuracy of GTE/BellSouth's empirical data, but we note that the southern Florida area may well be a noisier RF environment than most rural areas, thus requiring more signal strength to deliver a quality signal than should be assumed for purposes of assessing the risk of interference where the RF environment is quiet. We also believe that TEC's value for minimum signal (–110 dBm) is too low. TEC bases its value on use of an (R) value of only 13 dB, rather than the 17 dB industry standard. We note that an (R) value of 13 dB is not comparable to the industry's normal design criteria, and we do not believe that it is sufficient to guarantee a good quality call. TEC Cellular also does not use a reliability factor, in contrast to other parties.

[38] *See* "Mobile Cellular Telecommunications Systems," William C.Y. Lee, Section 7.6.5, "Transmitting and receiving antennas at the cell site."

[39] *Id.* at Section 9.1.2, "Two types of handoff," and Section 9.2, "Initiation of a handoff." This reference indicates that a cellular system typically begins to consider handoff when the mobile signal drops below –90 dBm.

[40] As the Court observed, "AirCell claims, and the petitioners do not appear to dispute, that the industry standard for this ratio is 17 dB." *AT&T Wireless Services, Inc., et al., v. FCC*, 270 F.3d at 966 (D.C. Cir. 2001).

C.Y. Lee and Mark Shultz (Lee/Shultz Report), that operation of the AirCell system would cause a significant level of harmful interference to cellular systems over 30% of the time.[41] In the *AirCell MO&O*, we stated that AirTouch's interference analysis was based on unrealistic assumptions, most notably an unrealistically low ITL.[42] Below we provide greater detail regarding the flaws in AirTouch's analysis.

16. Alone of the parties to this proceeding, AirTouch derived its ITL by calculating *up* from the noise floor rather than *down* from the minimum signal level necessary to deliver a good cellular call (the method used by the Commission). In other words, AirTouch arrived at a value of −124 dBm by starting with a value for its system noise floor and calculating how strong an AirCell signal could be before it would raise that noise floor by more than a certain amount. We decline to adopt AirTouch's method or result because AirTouch made overly conservative assumptions at several steps in the analysis, did not adequately justify the "certain amount" by which it asserted AirCell should not be allowed to raise the noise floor, did not take into account the power level of typical cellular calls, and made a significant mathematical error.

17. A cellular carrier's system noise floor is typically calculated by beginning with the level of thermal noise[43] and adding to it both environmental noise[44] and internal noise contributed by the system's own operation.[45] AirTouch began by taking the generally agreed value of −129 dBm for the thermal noise floor. AirTouch then assumed the quietest possible location for the cell site, with zero environmental noise. By adding these two values, AirTouch arrived at an environmental noise floor identical to the thermal noise floor, *i.e.*, −129 dBm. However, when seeking to determine the likely effect of AirCell transmissions on cellular telephone calls, we do not regard it as reasonable to assume that a cell site will experience zero environmental noise. Even in a rural environment, such an

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41 "The AirCell Texas Test Results and the Interference Impact on AirTouch Wireless Properties, Final Report, December 15, 1997," Dr. William C.Y. Lee, Vice President and Chief Scientist & Mark Schultz, Technology Director, Strategic Technology Group, AirTouch Communications, Inc., section 1 at 2 and section 6 at 17. Lee and Schultz also state that the AirCell system will "impact the AirTouch quality of service" more than 30% of the time. *Id.* at section 3.5 at 12. However, as explored in greater detail below (*see* ¶21), an effect on quality of service that is calculable based on measurements and theory, but so small as to be unnoticeable by the carrier and its subscribers, does not equate to *harmful* interference, which is the issue in this proceeding. Moreover, although the Lee/Schultz Report mentions the 30% claim three times, there is no explanation in the report as to where it comes from, and the basis for this claim is not apparent from the data presented in the report.

42 *AirCell MO&O* at n.67.

43 Thermal noise is caused by random electron motion in conductors and it is impractical and generally unnecessary to reduce it (by cooling) in cellular systems. Calculation of thermal noise power is straightforward, and the various parties and the Commission agree on a value of –129 dBm for thermal noise power, assuming the standard cellular AMPS receiver bandwidth of 30 kHz and an ambient temperature of 293°K. Thermal noise power is calculated using a well-known radio engineering equation, $N_0 = kTB$, which shows that thermal noise power (N_0) in Watts is dependent only upon the receiver bandwidth (B) in Hertz and the absolute ambient temperature (T) in degrees Kelvin. In the equation, (k) represents Boltzmann's constant (1.38×10^{-23} Joules / °Kelvin). *See* ANS definition of "thermal noise" at http://www.atis.org/tg2k/_thermal_noise.html.

44 By "environmental noise," we mean RF noise created by various devices, principally out-of-band emissions from other radio transmitters, vehicle ignition systems, electric power lines, electric lighting and signage, and electrical motors.

45 The internal noise caused by the flow of electricity through the active devices in a receiving system is taken into account using the "noise figure" of the system, which is a ratio (specified in dB) representing the degradation of the signal-to-noise ratio caused by noise generated within the receiving equipment itself. The noise figure varies with the configuration, type, and quality of the receiving equipment used, and is normally measured and specified by the manufacturer of the equipment. *See* ANS definition of the term "noise figure" at http://www.atis.org/tg2k/_noise_figure.html.

assumption is not reflective of the typical noise environment in which cellular carriers operate or for which they design, except perhaps at the remotest of cell sites in their system. We believe that a realistic assessment of the interference potential of the AirCell system must be based on criteria that reflect typical terrestrial cellular operations, not singular or aberrational situations.

18. Next, AirTouch added 2 dB as its own system noise figure, arriving at a system noise floor of −127 dBm. This figure of 2 dB is significantly below the range of 5 to 8 dB that the Commission attributes to system noise.[46] AirTouch based this lower figure on the use of the highest-fidelity cell site configuration, one which uses "masthead electronics"[47] to permit the use of a taller communications tower and thereby increase the range of the mobile units and thus a site's coverage area. By using this approach, AirTouch implicitly assumed that all cell sites have a similar, high-fidelity configuration. However, the record does not support the implication that use of masthead electronics at cell sites is a universal or standard practice for the cellular industry, even in rural areas.[48] We also note that, if AirTouch's value of −124 dBm were used as the ITL for a rural cell site that does not use masthead electronics, the thermal noise floor and receiver noise figure alone would violate it, without AirCell or any other external signal being present.[49] As in the case of the environmental noise floor, therefore, we do not believe this to be a reasonable assumption, and we find that AirTouch's analysis is therefore likely to overstate the potential impact of adding AirCell's signal to the RF environment.

19. Having derived a system noise floor of −127 dBm, AirTouch then asserted that AirCell should not be allowed to increase that noise floor by more than 4.76 dB, which is AirTouch's asserted fade margin or reliability factor.[50] Using these figures for system noise floor and fade margin, AirTouch calculated that AirCell should not be allowed to raise the noise floor above −122.24 dBm.[51] Using the latter figure, AirTouch then calculated that the ITL (in AirTouch's usage, the power level of an AirCell or other "unwanted" transmission which will raise the noise floor to exactly −122.24 dBm) is −124 dBm.[52]

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[46] We note that appellant AT&T Wireless Services attributed 5 dB to system noise, and that AirTouch itself attributed 8dB to system noise in the case of a cell site using standard electronics rather than the "masthead electronics" described below.

[47] All cell sites experience the loss of some of the power of the desired incoming signal as it travels down the feed line from the antenna mounted on the tower to the base station. In a cell site engineered with masthead electronics, the signal-to-noise ratio is preserved by installing special semiconductors with the antennas to amplify the desired incoming signal, in order to pre-compensate for losses in the transmission line down the tower.

[48] *See* AirCell Reply Comments, AirTouch rebuttal at 20.

[49] Calculate as follows: −129 dBm + 8 dB = −121 dBm, which exceeds –124 dBm by 3 dB. As noted above, AirTouch specified 8 dB as the noise figure of its cell sites that do not employ masthead electronics.

[50] Several of the parties included a reliability factor in their analyses to compensate for signal fading along a terrestrial path, and we agree that it is a reasonable engineering practice to include such a factor providing a margin for fading within a terrestrial mobile link budget. *See* ANS definition of "fade margin" at http://www.atis.org/tg2k/_fade_margin.html. A link budget is an equation (or series of calculations) generally used by radio telecommunication system engineers to determine how much transmitting power is needed at one end of a path (link) in order to produce a specified received signal power at the other end of the path (link). The link budget includes factors, sometimes estimated or assumed, for all system gains and losses, including propagation path loss, passive equipment loss, and transmit and receive antenna gains. *See, e.g.*, http://web.singnet.com.sg/~help1/link.htm and http://www.umtsworld.com/technology/linkbudget.htm.

[51] Calculate as follows: −127 dBm + 4.76 dB = −122.24 dBm.

[52] Calculate as follows: −127 dBm (AirTouch's asserted system noise floor) + −124 dBm (AirTouch's asserted ITL, *i.e.*, the highest AirCell power level that AirTouch deems acceptable) = −122.24 dBm (the highest total ambient power level AirTouch appears to consider acceptable). As discussed below, AirTouch does not (continued....)

20. We find that AirTouch has failed to present sufficient justification for its assertion that AirCell should not be permitted to raise the noise floor by more than 4.76 dB, because AirTouch failed to demonstrate any link between this value and cellular call quality. In effect, AirTouch is willing to allow AirCell to "use up" AirTouch's fade margin, but the record does not indicate that, if AirCell were to "use up" *more* than that fade margin, there would be any effect upon AirTouch's calls. Because AirTouch calculated up from the noise floor, instead of down from the minimum power level of typical cellular calls, the record provides no reasonable basis on which to assert that an AirCell transmission that raises the noise floor above −122.24 dBm will affect a typical cellular call.

21. Moreover, even assuming AirTouch's basic approach, AirTouch erred in the way it used its reliability factor (4.76 dB) in its calculations. AirTouch's assessment of the effect on cellular calls of an increase in its system thermal noise floor (in terms of its target minimum ratio of signal to noise-plus-interference (R) of 18 dB) appears to be mathematically in error, because AirTouch apparently did *not* include the reliability factor in establishing the received power level of a minimal quality cellular call.[53] Thus, general use of a −124 dBm ITL was further predicated on the unrealistic assumption that rural cellular calls are typically carried at a median received power level of −109 dBm,[54] which is 9 dB below the lower handoff threshold cited in AirTouch expert Dr. Lee's book. Adding AirTouch's 4.76 dB reliability factor in would raise the call level to −104.24 dBm, which would raise AirTouch's masthead electronics ITL from −124 dBm to −119.24 dBm and its non-masthead electronics ITL from −122 dBm to −117.24, values used by some of the other parties and which we deem reasonable. In summary, we find that the technical criteria and assumptions AirTouch used to derive its −124 dBm ITL are unduly conservative, and the treatment of its reliability factor in its calculations incorrect. We believe that these factors explain why AirTouch's rural area ITL was far lower than that of any of the other parties in this proceeding, including those submitted by other AirCell opponents.

22. Finally, even granting all of AirTouch's assumptions up to this point, for AirTouch's analysis to have been correct, any AirCell transmission that is detectable by standard cellular equipment (*i.e.*, that results in a measurable increase in interference) would necessarily have to create *harmful* interference to terrestrial cellular operations, which is the standard in this proceeding. Yet AirTouch has failed to demonstrate that *harmful* interference would in fact occur. Suppose that total noise and interference were to exceed the ITL by a small amount, such as 1 or 2 dB. While measurable with sensitive test instruments, this small excess would likely go unnoticed by the average caller, whereas a larger excess (*e.g.,* 3 to 6 dB) could produce objectionable interference resulting in noisy calls that would be annoying to that same caller. "*Harmful* interference," which by definition is "interference which ... seriously degrades, obstructs, or repeatedly interrupts a radio communications service,"[55] would be indicated only by a very substantial (*e.g.,* 7 dB or more) excess over an ITL based on an (R) value of 17 dB,[56] *i.e.*, at a power level of −110 dBm or higher.[57] Thus, the accepted value of 17 dB for (R) is

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sufficiently justify why the power level −122.24 dBm is significant, or how any of this calculation relates to the power level of typical cellular calls.

[53] Instead, AirTouch added its reliability factor to the system thermal noise floor, which seems inappropriate because both thermal noise and receiver noise are local to the cell site receiver and thus neither is subject to the signal fading for which the reliability factor is supposed to compensate.

[54] Calculate as follows: −127 dBm (AirTouch's stated system noise floor) + 18 dB (AirTouch's preferred value for (R)) = −109 dBm.

[55] Radio Regulations of The International Telecommunication Union, Article S1, Section VII, paragraph S1.169; *see also* 47 C.F.R. § 21.

[56] "Final Report, AirCell Flight Test, July 10-11, 1997," C.J. Hall, P.E. and Ivica Kostanic, TEC Cellular, Inc., at 3 ¶ 4 (stating that a drop in C/N+I from 17 dB to 16 dB will probably pass without being heard, while a drop to 10 dB will certainly be heard). *See also* "Analysis of AirCell Flight Test Data and its Effects on Terrestrial (continued....)

significantly more buffer than is necessary to prevent harmful interference; the additional buffer is designed into the system in order to meet a target percentage of calls that will be judged "excellent" or "good." Because AirTouch and other AirCell opponents did not make this distinction between interference and *harmful* interference, they incorrectly implied that any excess of noise and interference over the ITL, no matter how transient or slight, is harmful interference.[58]

23. *How the choice of ITL affected AirTouch's analysis of the test data.* In its technical submission, AirTouch summarized the data from various of the July 10-11 test flights in tables showing, in separate columns, the percentage of data points exceeding its ITL (–124 dBm), and the calculated AirCell received signal mean power value and standard deviation about this mean.[59] AirTouch provided three such tables summarizing the July 10, 1997 data (AirCell functioning normally) and one table summarizing the July 11, 1997 data (AirCell dynamic power control disabled). As noted above, the Court affirmed our rejection of the July 11, 1997 data and any analysis based thereon, and we will not further discuss the fourth table.

24. The first two tables show, for sixteen straight-line test flights at various altitudes between 5,000 and 35,000 feet, data from two types of cellular receiving antennas installed at the Madill, Oklahoma test site: an omnidirectional antenna favoring vertically polarized waves, and a directional panel antenna oriented to favor horizontally polarized waves. Examination of these first two tables reveals that the mean power values of the AirCell received signal calculated by AirTouch exceeded the AirTouch ITL of −124 dBm in only two of the 32 data sets, and then by only 0.26 dB, an insignificant amount.[60] None of the mean power values in these two tables exceeds an ITL of –117 dBm; in fact, the

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Cellular Operations," James E. Stinehelfer, Daniel B. McKenna, and Kenneth J. Jochim, October 9, 1997 at 4-5 (in particular, chart showing AMPS circuit merit scores for C/N+I ratios between 10 and 19 dB). *See also* "The AirCell Texas Test Results and the Interference Impact on AirTouch Wireless Properties, Final Report, December 15,1997," Dr. William C.Y. Lee, Vice President and Chief Scientist and Mark Schultz, Technology Director, Strategic Technology Group, AirTouch Communications, Inc., section 4.2 at 13 (stating that dropped calls start occurring if an interfering signal exceeds −106 dBm). *See also* "AirCell Impact on AT&T's Terrestrial Cellular Systems, Warika/Madill Tests on July 10-11, 1997," AT&T Wireless, December 15, 1997, section 6.5 at 12 (stating that, while C/N+I of less than 17 dB may cause some interference, C/N+I of less than 10 dB will result in sustained interference, loss of SAT, and eventually dropped calls).

[57] Calculate as follows: −117 dBm (the ITL) + 7 dB = −110 dBm.

[58] The Commission acknowledges that footnote 67 of the *AirCell MO&O* is somewhat confusing in this regard, appearing to echo AirTouch's implication that the threshold for determining *harmful* interference is the ITL (regardless of whether –124 dBm or −117 dBm is used), rather than the higher signal level (−110 dBm) that would cause "interference which … seriously degrades, obstructs, or repeatedly interrupts a radiocommunications service…."

[59] AirTouch stated that it processed the raw test data and calculated cumulative distribution functions, removing non-test data and adding a 2 dB offset, which it claimed was necessary to compensate for use of a 10 kHz rather than a 30 kHz measurement bandwidth. Lee / Shultz Report at 7. Because the test signal consisted only of a carrier modulated by the supervisory audio tone (SAT), without continuous voice modulation, it is not clear that use of the 2 dB offset is appropriate. As argued by AirCell, most of the power of the SAT modulation products should have fallen within the 10 kHz bandwidth as well as the 30 kHz bandwidth. *See* AirCell Reply Comments, "Analysis of the AirTouch Comments" at 8-11. Thus, while a 2 dB offset might correctly compensate for the contribution of the noise floor, it overcorrects the measured AirCell signal. Because the AirCell signal is within the noise floor for the vast majority of samples, it would be difficult if not impossible to apply the offset only to the noise floor in post-processing. For comparison to values without the 2 dB offset, *see* essentially similar tables prepared by TEC Cellular, "Final Report, AirCell Flight Test," by C.J. Hall, P.E. and Ivica Kostanic, at 6-7.

[60] In its Table 3.2, AirTouch showed a mean value of –123.74 dBm for flights 10I and 10K, which exceeds by a small margin AirTouch's ITL of –124 dBm. If –123.74 were rounded to −124 dBm, it would equal, rather than exceed AirTouch's ITL. It should be noted that expression of the calculated mean value to a precision of 0.01 dB (continued....)

highest of these mean power values is 6 dB below –117 dBm, providing a considerable margin of confidence that no interference will occur.[61]

25. The third AirTouch table presents data from eight additional straight-line test flights with AirCell equipment operating normally at an altitude of 5,000 feet, as they affected reception at the same two types of receiving antennas installed at the Waurika, Oklahoma test site. Even using AirTouch's proposed ITL of −124, the mean power of the AirCell received signal exceeded the AirTouch ITL of –124 dBm in only three of the eight flights (by 2, 4, and 8 dB). However, if one uses the Commission's ITL of −117 dBm instead, only one of the mean power values in this table (for flight 10S) would exceed the ITL, and then by only 0.61 dB, an insignificant amount.[62]

26. Finally, in both the summary and the conclusion of the Lee / Shultz report, AirTouch broadly stated that "AirCell's operations will create a significant level of harmful interference to existing cellular systems over 30% of the time."[63] Even accepting at face value AirTouch's data tables based on an ITL of −124 dBm, however, it is not clear from the Lee / Shultz Report what the mathematical foundation for this claim would be.[64] The July 10 test data do not show AirCell received power sustained at anywhere near the –110 dBm level that would constitute harmful interference[65] to a cellular telephone call being received at –100 dBm, the minimum power necessary for an acceptable quality call in a rural quiet area.[66] Moreover, as demonstrated above, use of an ITL of −117 dBm (instead of AirTouch's proposed −124 dBm) eliminates any suggestion that normal operation of the AirCell system is likely to cause harmful interference.[67]

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far overstates the accuracy of the source measurements, particularly given the disputed bandwidth compensation factor. The total of the level accuracy specifications for the HP 8591E spectrum analyzers used to obtain the data measurements is shown as ±3.3 dB; however, these analyzers were calibrated using a more accurate source prior to the tests, resulting in data accuracy of ±1 dB. See TEC Cellular, "Final Report, AirCell Flight Test" by C.J. Hall, P.E. and Ivica Kostanic, at 35.

61 In the tables, the 6 dB margin typically equates to the addition of 2 or 3 standard deviations above the mean, which further decreases the likelihood that individual data points might exceed the ITL.

62 A power ratio of 0.61 dB is 1.15:1, about 15%.

63 *See* n.37.

64 AirTouch stated in section 4.2 of the Lee / Shultz Report (page 13) that "this data shows that 2% of the time, AirCell is above –106 dBm for 6 second periods. This is the level that drop calls start occurring." The data to which this referred, however, was "all of the data taken in Texas," including the July 11 data with AirCell power control disabled. And 2% is not 30%.

65 *See* ¶ 21 and n.53.

66 *See* ¶ 13.

67 We further note that, even if we were to incorporate AirTouch's asserted noise figure of 2 dB for cell sites using masthead electronics (see ¶17) into the Commission's method of deriving the ITL as represented by Equation 1, the resulting calculation would not support AirTouch's analysis – even for those specially sensitive cell sites. Our value of –100 dBm for the median received power level of a minimally acceptable call (*see* ¶ 13) is based in part on a value of 5 dB for the system noise figure. Using AirTouch's masthead electronics noise figure (2 dB) instead would reduce the median received power level of a minimally acceptable call to –103 dBm, and by use of Equation 1 this would provide an ITL of –120 dBm, not –124 dBm. Nothing in the AirTouch tables described in §§ 22-24 above suggests that the AirCell system is likely to cause harmful interference even when analyzed using an ITL of –120 dBm. To begin with, as explained above (*see* n.55), we do not believe that AirTouch was justified in adding a 2 dB offset when it processed the data. As a result, we believe that each of the mean power values in AirTouch's tables is 2 dB too high. Even without this adjustment, none of the mean power values in the first two AirTouch tables exceeds an ITL of –120 dBm. Only one of the mean power values in the third AirTouch table exceeds an ITL
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27. *The use of a probability study.* In the last paragraph of its opinion, the Court stated that it was unable to discern how the Commission could reach a conclusion on the question of harmful interference in the absence of a probability study.[68] Indeed, during the course of the proceeding, AirCell submitted two papers into the record containing assessments as to the likelihood of interference based on probability factors rather than analysis of the measured AirCell signal power levels alone.[69] Both of these papers contained concurrency calculations whose apparent purpose was to demonstrate that the probability of a simultaneous occurrence of all of the events necessary for interference from AirCell is extremely low. Appellants argued that these probability analyses comprised a major part of AirCell's non-interference claim, and speculated that, if the Commission did not take these probability studies into account, it may have factored in some undisclosed probability study of its own devising.[70]

28. The Commission does not dispute the proposition that simultaneous use in a rural area of any given cellular channel by both an airborne AirCell caller and a terrestrial caller is likely to be a relatively infrequent event. In reaching its decision, however, the Commission did not need to rely on any assessment of the probability of such simultaneous channel use. Instead, the Commission chose to use a "Murphy's law" approach, that is, it assumed that such simultaneous channel use, albeit unlikely, *would* occur, and considered what the consequence of such an occurrence would be, based on analysis of the measured received power of the AirCell signal.[71] Given our conclusion that harmful interference would not result even in such a worst-case scenario, there was no need for the Commission to engage in any event probability analysis of the test data in the record.

D. Conclusion and Ordering Clause

29. The Court remanded the *AirCell MO&O* to the Commission to explain our reasoning with regard to one technical issue, *i.e.* the use of a particular ITL in concluding that the AirCell system is not likely to cause harmful interference to terrestrial cellular systems. As demonstrated above, the Commission calculated its ITL from technical values that are commonly accepted by industry, and its ITL matches values used by both proponents and opponents of AirCell in this proceeding. By contrast, the ITL proposed by AirTouch was based on unduly conservative assumptions, was inconsistent with analysis presented in Dr. Lee's own textbook, and incorporated a significant mathematical error. Moreover, because AirTouch conflated the concepts of "interference" and "harmful interference," even if AirTouch's analysis had been based on reasonable assumptions and accurate calculations, it would not have supported the conclusion advanced by AirTouch as to the probability that the AirCell system would cause harmful interference to terrestrial cellular systems. Finally, because the Commission assumed, in a

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of –120 dBm, but with the 2 dB adjustment that value exceeds the ITL by only 1.61 dB, an amount insufficient to cause harmful interference.

[68] 270 F.3d at 968.

[69] See "AirCell Test Results and Implications," John R. Doner, September 20, 1997, at 8-18. *See also* "Evaluation of the AirCell Test Plan and Data Collected on July 10, 1997," Roger D. Madden, October 1, 1997, at 23-24.

[70] This speculation was without foundation. In taking its decision, the Commission did not rely upon any calculation of the likelihood of simultaneous occurrence of conditions necessary for an interference scenario.

[71] *AirCell MO&O* at n.60. The "worst case" is one in which the AirCell-equipped airplane is at maximum distance from an AirCell partner site and is located directly above a "victim" site. In this configuration, the AirCell system is transmitting at its maximum designed power, and the system is located maximally close to the "victim" site. The Commission found that, even in this configuration, AirCell operation was not likely to cause harmful interference to the terrestrial cellular operation because of the design of the AirCell system, including the use of low power levels and the downward "null" cast directly below the plane by its antenna design and placement. *Id.* at n.63.

worst-case scenario, that certain events would occur simultaneously during operation of the AirCell system – and nevertheless found that operation of the AirCell system is not likely to cause harmful interference to terrestrial cellular systems – the Commission did not need to factor in studies of the probability that those events would in fact occur simultaneously.

30. ACCORDINGLY, IT IS ORDERED that, pursuant to section 4(i) of the Communications Act of 1934, 47 U.S.C. §154(i), and for the reasons contained in the *AirCell MO&O* and expanded upon herein, the decision of the Commission in the *AirCell MO&O* IS AFFIRMED.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch,
Secretary.

SEPARATE STATEMENT OF
COMMISSIONER KEVIN J. MARTIN, CONCURRING

Re: *AirCell, Inc., Petition, Pursuant to Section 7 of the Act, for a Waiver of the Airborne Cellular Rule, or, in the Alternative, for a Declaratory Ruling*, Order on Remand

I write separately – and concur in this item – because I am concerned with the manner in which the Commission analyzes harmful interference. The Commission has not developed a consistent methodology for such analyses, instead using a case-by-case, *ad hoc* approach. Not only does this approach cause a great deal of uncertainty for spectrum users and markets alike, it also creates another problem: the appearance of results-oriented decisionmaking.

Too often, a person reading a Commission order could be left with the impression that the Commission first makes a decision on whether to license some new technology and then creates a justification *post hoc* by manipulating the way it judges harmful interference. In this Order, for example, the Commission chose an interference threshold level of -117 dBm from a range of permissible choices after all testing had been conducted. This threshold level just happened to work perfectly when applied to the limited set of test data that the Commission retained (the Commission rejected the remaining test data). While I in no way wish to suggest that the Commission did, in fact, manipulate its methodology in order to achieve a desired result, there is a real risk that someone reading this item might be left with that impression.

The Commission's recent Order on Multichannel Video Distribution and Data Service (MVDDS) suffers from the same problem. *See Amendment of Parts 2 and 25 of the Commission's Rules To Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, Memorandum Opinion and Order and Second Report and Order, ET Docket No. 98-206, RM-9147, RM 9245 (rel. May 23, 2002). There, the Commission seemed determined to license MVDDS, adopting interference standards that assured that conclusion. In the Commission's process of analyzing the degree of interference MVDDS would cause, the definition of harmful interference appeared to change, yet consistently allowed for MVDDS operation. In the end, as I noted in my separate statement on that Order, the interference rules the Commission ultimately adopted appeared completely arbitrary. *See id.*, Statement of Commissioner Kevin J. Martin, Dissenting in Part and Approving in Part. Among other things, the Order set EPFD levels that were not keyed to guaranty any specific level of interference protection and that would allow an increase in interference to DBS of more than 30 percent in some instances. *See id.* An objective person reading this Order could reasonably conclude that the Commission was determined to allow MVDDS to share DBS spectrum and developed interference rules to support that decision.

Orders such as these not only exacerbate regulatory uncertainty, they risk undermining public confidence in the Commission's work. We can and should do better. At the very least, we should develop a consistent framework for judging harmful interference. In particular, we should adopt a policy of identifying what degree of interference will be considered harmful prior to conducting engineering tests of how much interference a new service causes.