Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
AIRCELL, INC.	)	Docket No. 02-86
	)	DA 03-721
Petition for Extension of Waiver	)	

To: The Commission

COMMENTS IN OPPOSITION TO PETITION FOR EXTENSION OF WAIVER

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I. V-Comm, Inc., Engineering Response to AirCell's Request for Waiver Extension
II. V-Comm, Inc., Engineering Report of the AirCell Compatibility Test
III. V-Comm, Inc., Engineering Analysis of the FCC Order on Remand

SUMMARY

AirCell has petitioned the Commission: (i) to renew its waiver of the airborne cellular rule, which expired in June 2002, indefinitely or for an extended term of ten years; (2) to expand its authority with an increase in channel capacity and placement of facilities on commercial airliners; and (3) to remove the current limitation on its use of digital cellular channels. Its petition should be denied.

AirCell Has Not Justified Analog Airborne Waiver Renewal. At the outset, AirCell's existing analog waiver should not be renewed because AirCell has made no showing that a renewed waiver is justified. Under the standards in *WAIT Radio v. FCC* and the Commission's own rules, AirCell has a substantial burden to show that a waiver is warranted. AirCell has not made any showing at all. AirCell merely relies on the Commission's previous grant of a waiver in the *AirCell Order.* That order, however, found that only an initial, limited-term waiver was warranted on the record then existing. The Commission said that renewal of the waiver would depend on an evaluation of reports from the AirCell "partners" regarding the first year of operations under the initial waiver. The vast majority of AirCell's partners filed no reports. The handful of reports that were filed did not contain any of the information needed to evaluate AirCell's interference potential in the light of operational experience. In fact, the only useful information in any of the reports was data showing that AirCell's service is barely used — only a few minutes per day of traffic is handled by the average cellsite. The minimal usage helps explain why AirCell's partners have not received any interference complaints. Even if the network had been used more extensively, the interference that occurred would not likely have been traceable to AirCell operations.

An Extended 10-year or Permanent Waiver Term Is Not Warranted. AirCell's request for a permanent waiver or an extension lasting at least ten years is completely baseless. AirCell's interference potential needs to be seriously reviewed on the basis of a substantial record before its service becomes ubiquitous and entrenched. A longer term might serve AirCell's business purposes, but it would be contrary to the public interest.

A Waiver Covering Commercial Airlines Is Not Justified. AirCell's petition makes clear that it intends to market its service to commercial airlines. The Commission has never addressed the interference issues posed by AirCell use aboard commercial aircraft. The record developed in 1997 involved limited tests, using only small general aviation propeller aircraft. There is simply no test data on which the Commission can base a waiver covering service to commercial airlines.

No Increase in Channels Is Justified. AirCell asks to increase the number of cellular channels it can use per ground station from 6 to 19. This request has no basis whatever. AirCell's current usage is minimal at best — only a few minutes of traffic per day at the average cellsite. Even allowing for growth, no increase in channels is needed, and AirCell provides no basis for projecting growth in demand. In fact, the traffic projection contained in AirCell's technical analyses, 200 Erlangs nationwide, can easily be met with its existing sites and channel allotments. Moreover, that traffic projection has hardly changed from five years earlier, and it is much higher than the actual usage.

AirCell Fails to Demonstrate Digital Cellular Systems Will Be Protected from Harmful Interference. AirCell includes engineering reports concerning its interference potential with TDMA and CDMA digital service. These reports are seriously flawed and do not demonstrate that AirCell can operate without causing harmful interference to digital service.

First, AirCell did not conduct any new fight tests; it relied exclusively on the very limited data from a single day of flight tests in 1997. The 1997 data was supposed to provide "worst case" signal strength data but, actually presents AirCell's interfering signals in the best possible light, due to the orientation of the nulls in both the aircraft and the base station antenna patterns. Thus, the 1997 data minimizes the received signal strength of AirCell interference and is not a valid basis for projecting interference to either analog or digital terrestrial service. That fact alone disqualifies the engineering reports submitted by AirCell as a basis for a digital channel waiver.

Second, AirCell's engineering reports reveal that noise levels were injected in the tests at levels that are much higher than typical terrestrial cellular system noise floors. There is no support for the noise levels injected; AirCell's engineering consultant did not conduct a noise study and ignored the noise floor data that had been measured in the 1997 test. V-Comm has conducted a noise floor study covering a wide variety of cellular environments that shows actual noise floor levels to be well below the figures used in the AirCell engineering reports — AirCell overstated the noise floor by 9 to 23 dB for TDMA, and the noise levels assumed for CDMA (8 to 26 dB too high) would leave little or no capacity for serving calls. The result of injecting high, unrepresentative noise levels during the test is to degrade perfectly acceptable terrestrial signals and mask the effect of AirCell interference received at or below the injected noise level.

Third, the TDMA and CDMA tests that AirCell's consultant used as a basis for predicting no harmful interference were flawed due to a variety of other inappropriate test conditions and assumptions, such as static, laboratory-environment test conditions, with abnormal and unrepresentative technical parameters. Moreover, the "drive test" used in the TDMA engineering report was performed without any actual or simulated AirCell interference, and there was no drive test at all for CDMA.

Fourth AirCell and its consultant performed no tests at all concerning digital technologies other than TDMA and CDMA, even though the petition asks for the removal of restrictions on AirCell's use of all digital cellular channels. AirCell performed no tests regarding GSM, a digital technology currently in use by AWS and Cingular. It performed no tests of other digital technologies that are deployed or being deployed, such as CDPD and the various third-generation ("3G") digital technologies. Given the substantial differences between these untested technologies and the two technologies that were tested, even if the TDMA and CDMA testing were valid, there would be no basis for finding that AirCell will not cause harmful interference to digital service. AirCell's failure to test other technologies requires denial of its request to use digital channels.

V-Comm's Tests Show AirCell Will Cause Widespread Harmful Interference. Because of the lack of reliable data, Commenters contracted with V-Comm, a respected telecommunications engineering consultant, to conduct independent tests of AirCell's interference potential respecting analog, TDMA, and CDMA cellular service. V-Comm conducted a two-phase test to

assess the level of AirCell interference, including real-world, representative flight test and drive test data. V-Comm followed up that test with a case study to assess how widely the interference would be felt from a given AirCell airborne transmission.

The V-Comm tests were designed to measure the effect of typical AirCell signals on typical terrestrial systems. In Phase 1 of the test, received AirCell signal strengths were measured in flight tests in the New York-New Jersey-Philadelphia corridor, so as to be representative of the signal strength actually received in an area with substantial aviation traffic. First, V-Comm measured the received signal strength of AirCell transmissions under a variety of conditions, with dynamic power control disabled so as to determine the maximum potential interference levels, propagation losses, and antenna patterns. Second, V-Comm performed flight tests with dynamic power control enabled, to determine how dynamic power control affected received AirCell signals in practice. V-Comm found that AirCell signals were received at a wide variety of signal strengths, after taking dynamic power control into account. In particular, at the higher dynamic power levels (which are most commonly used in practice), AirCell signals are received at levels of -94 to -113 dBm, comparable to terrestrial customer traffic, which would cause "severe degradations" in service quality and "significant harmful interference." Even at the lowest dynamic power level, V-Comm found, AirCell signals are received at levels in the -114 to -129 dBm range, which are "strong enough to cause harmful interference" to terrestrial calls at typical levels. V-Comm also found that AirCell units are more likely to transmit at high power levels when distant from their serving station and within close range of unaffiliated carriers' receivers, causing harmful interference. It found that even after accounting for the effects of dynamic power control, AirCell signals are often received at levels that can cause harmful interference.

In Phase 2 of its compatibility test, V-Comm injected various levels of simulated AirCell interference into cellsite receivers during actual drive tests with analog, TDMA, and CDMA units under real-world operating conditions. The received signal strength during the drive tests closely resembled actual customer usage. This permitted V-Comm to determine the nature and extent of the interference that occurs at various levels of received AirCell interference. *No noise was injected during the test; the actual system noise floor was used.*

The results of the Phase 2 tests were as follows:

Injected Interfering Signal Level	AMPS Tests – Effects to System Performance	TDMA Tests – Effects to System Performance	CDMA Tests – Effects to System Performance
Baseline, with no injected interference	Reference Level	Reference Level	Reference Level
-126 dBm	"No effect"	"No effect"	"No effect"
-123 dBm	C/I 4 dB dec.	"No effect"	"No effect"
-120 dBm	C/I 7 dB dec. MOS 0.1 dec.	C/I 3 dB dec. BER 0.2% inc.	Tx Pwr 1.6 dB inc.
-117 dBm	C/I 9 dB dec. MOS 0.2 dec.	C/I 5 dB dec. BER 0.5% inc.	Tx Pwr 1.7 dB inc.

-114 dBm	C/I 12 dB dec. MOS 0.2 dec.	C/I 10 dB dec. BER 1.1% inc. MOS 0.3 dec. Blocked Calls 4% Capacity Loss 7%	Tx Pwr 3.1 dB inc.
-111 dBm	C/I 16 dB dec. MOS 0.4 dec.	C/I 11 dB dec. BER 1.8% inc. MOS 0.4 dec. Blocked Calls 7% Capacity Loss 8%	Tx Pwr 3.5 dB inc. Blocked Calls 11%
-108 dBm	C/I 17 dB dec. MOS 0.7 dec. Dropped Calls 4% Capacity Loss 5%	C/I 12 dB dec. BER 1.7% inc. MOS 0.2 dec. Blocked Calls 28% Dropped Calls 50% Capacity Loss 30%	Tx Pwr 3.8 dB inc. Blocked Calls 33% Overflowed Calls 33% Capacity Loss 33%

In the analog test, V-Comm concluded that harmful interference at the suburban site clearly occurred at -114 dBm in the drive test, and that calls under less favorable conditions, such as in-building calls or calls in the outer parts of a larger cell, would occur in the -117 to -123 dBm range. In the TDMA test, V-Comm concluded that harmful interference occurred at the suburban test site at levels of -120 to -117 dBm, and that calls made in-building or at the outer parts of a larger cell would encounter interference at lower levels. In the CDMA test, V-Comm concluded that harmful interference is expected to occur within the -114 to -120 dBm range.

Finally, V-Comm conducted a case study of how AirCell usage aboard a typical flight will affect the terrestrial service along its route. V-Comm analyzed a flight path from Dulles Airport to Teterboro (N.J.) Airport, near New York City, to illustrate how broadly terrestrial service would be affected, using a variety of antenna and technology variables. For purposes of the case study, V-Comm used -114 dBm to represent the received AirCell signal strength that would be considered harmful interference, because this level unquestionably cause harmful interference effects in its analog, TDMA, and CDMA tests. The case study demonstrates that AirCell will cause harmful interference to a great many cellsites along the flight corridor. For example, if slant-45 receive antennas are used, 223 analog or TDMA cellsites or 1564 CDMA cellsites would receive interference along the corridor, representing 223 analog calls, up to 11,150 TDMA calls, or 31,280 CDMA calls that would receive harmful interference due to a single AirCell unit's operation. If AirCell deployment and usage increases from the current minimal levels, there will be a widespread impact on terrestrial service. For example, there are about 113 commercial flights each day on the same route used in the case study, and thousands of other flights in the same area. Widespread AirCell usage in the Washington-New York corridor would affect hundreds of times the number of calls that the case study showed would receive harmful interference.

V-Comm's Approach vs. the Remand Order. The validity of V-Comm's tests is unaffected by the approach taken in the FCC's *Remand Order,* which was based on very limited data. V-Comm has compiled a much broader, more comprehensive record. With this submission, the Commission has sufficient data to make a record-based determination of factors that were based previously on textbook assumptions in the *Remand Order,* such as minimum acceptable received signal strength. Moreover, V-Comm's tests substantiate the ways in which terrestrial cellular signals are affected by AirCell interference in a real-world environment. Unlike the *Remand*

Order, which relied on assumptions about harmful interference, the V-Comm tests are an evidentiary basis for distinguishing when AirCell interference is harmful. Furthermore, even at the harmful interference threshold assumed in the *Remand Order,* V-Comm shows that there will be widespread harmful interference to terrestrial cellular operations.

Because AirCell has failed to make a reasoned, sustainable showing that its service will not interfere with terrestrial cellular operations — digital *or* analog — and because V-Comm's tests have removed any doubt but that harmful interference *will* occur on a widespread basis, the petition for extension of waiver should be denied in its entirety.

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COMMENTS IN OPPOSITION TO
PETITION FOR EXTENSION OF WAIVER

AT&T Wireless Services, Inc. ("AWS"), Cingular Wireless LLC ("Cingular"), and Cellco Partnership d/b/a Verizon Wireless ("Verizon") (collectively, "Commenters") hereby submit their comments in opposition to the Petition for Extension of Waiver ("Petition") filed March 28, 2002 by AirCell, Inc. ("AirCell") and several of its participating carriers ("Partners").[1]

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[1] The co-signers of the Petition are: ALLTEL Corporation; Cellular Network Partnership, a Limited Partnership d/b/a Pioneer Cellular; Centennial Communications Corporation; CenturyTel Wireless, Inc.; Commnet of Delaware L.L.C.; Commnet Wireless, Inc.; Corr Wireless Communications, L.L.C.; ETEX Communications, L.P.; California RSA No. 3 Limited Partnership, d/b/a Golden State Cellular; Kentucky RSA 4 General Partnership; Northeast Communications of Wisconsin, Inc., d/b/a Cellcom; Pine Belt Cellular, Inc. d/b/a Pine Belt Wireless; Rural Cellular Corporation; Smith Bagley, Inc.; Southern Illinois RSA Partnership d/b/a First Cellular of Southern Illinois; South Caanan Cellular Communications Co.; Tennessee RSA No. 3 Limited Partnership; United States Cellular Corporation; Western Wireless Corporation; Texas RSA 8 South Limited Partnership d/b/a Wes-Tex Cellular; Texas RSA 1 Limited Partnership d/b/a XIT Cellular; and Yorkville Communications, Inc.

Two of the Commenters, AT&T Wireless Services, Inc. ("AWS") and Cingular Wireless LLC ("Cingular"), have subsidiaries or affiliates that are AirCell participating carriers as the result of acquisitions (former Vanguard and Comcast systems) that did not join in AirCell's petition and do not seek extension of their waivers. AirCell states that these subsidiaries have "ongoing contractual obligations to AirCell" and "expects that they will operate pursuant to those obligations and consistent with the original waiver conditions and/or any extention [sic]." Petition at 7 n.16. AWS and Cingular will comply with their contracts, consistent with the terms of their licenses and applicable rules. AWS and Cingular are not contractually obliged to seek waivers or extensions of existing waivers. AirCell is not authorized to seek waiver extensions on behalf of AWS and Cingular subsidiaries, and the extent of any contractual duties that AWS and Cingular owe to AirCell is a "private, contractual matter outside the Commission's competence." *Northcoast Communications, LLC,* DA 03-1102, ¶ 4 (WTB April 8, 2003)

The waiver at issue was originally granted in December 1998, was affirmed by the Commission in June 2000, and was remanded for further explanation by the United States Court of Appeals for the District of Columbia Circuit in November 2001.[2] The waiver was to have expired on June 9, 2002.[3]

AirCell's Petition sought extension of the waiver term and expansion of its scope. Specifically, the Petition asks the Commission: (i) to renew its waiver of the airborne cellular rule, which expired in June 2002, indefinitely or for an extended term of ten years; (ii) to expand its authority with an increase in channel capacity and placement of facilities on commercial airliners; and (iii) to remove the current limitation on its use of digital cellular channels.

The petition was initially placed on public notice for comment on April 24, 2002.[4] On May 3, 2002, the pleading cycle was suspended and the existing waivers were continued in force temporarily under their existing terms and conditions, pending action in response to the Court of Appeals' remand. On February 10, 2003, the Commission issued its *Remand Order* and thereafter, on March 11, 2003, the pleading cycle on the Petition was reopened.[5]

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[2] *AT&T Wireless Services, Inc. v. FCC,* 270 F.3d 959 (D.C. Cir. 2001) (*AWS v. FCC*), *remanding AirCell, Inc.,* 15 F.C.C.R. 9622 (2000) (*AirCell Order*), *aff'g AirCell, Inc.,* 14 F.C.C.R. 18,430 (WTB 1999) (*Reconsideration Order*); 14 F.C.C.R. 806 (WTB 1998) (*Bureau Order*).

[3] The Commission has previously emphasized that rule waivers were granted to specific cellular licensees participating with AirCell. *Bureau Order* at ¶ 25-26. Nevertheless, both the Commission and AirCell have referred to these waivers as though they were granted to AirCell. *See AirCell Order* at ¶ 54; Petition at 1. In the interest of simplicity, Commenters will generally follow this convention and refer to these waivers as though they were granted directly to AirCell. The subsidiaries of AWS and Cingular that previously received waivers, however, do not seek renewal of those waivers; accordingly, any discussion of renewal of the "AirCell" waiver expressly excludes waivers for the AWS and Cingular subsidiaries.

[4] Public Notice, *Wireless Telecommunications Bureau Seeks Comment on Petition Filed by AirCell, Inc. for Extension of Waiver,* Docket 02-86, DA 02-949 (April 24, 2002).

[5] *AirCell, Inc., Order on Remand,* FCC 02-324 (Feb. 10, 2003), *petition for review pending sub nom. AT&T Wireless Services, Inc., et al. v. FCC,* Case No. 03-1043 (D.C. Cir. filed Feb. 26, 2003); Public Notice, *Wireless Telecommunications Bureau Seeks Comment on Petition Filed by AirCell, Inc. for Extension of Waiver,* DA 03-721 (Mar. 11, 2003).

BACKGROUND

A. The Waiver Grant

In the *AirCell Order* and the Bureau orders that preceded it,[6] the Commission waived 47 C.F.R. § 22.925, which bans airborne usage of cellular phones, to permit AirCell to provide airborne cellular service via the base stations of AirCell's participating cellular licensees. The Commission based its decision on consideration of data from test flights using two Cessna general aviation aircraft on July 10, 1997 in an isolated area of Texas and Oklahoma, using the "data gathered on the [July 10] Texas test to characterize the normal operation of the AirCell system" for purposes of interference evaluation.[7] It called this test "a 'worst case' scenario" because of the "lack of any urban noise to mask the AirCell signal."[8] It concluded that "the data from the [July 10] testing show that there is little likelihood of harmful interference."[9]

The Commission rejected evidence by Commenters that the tests showed significant interference would occur. In particular, the Commission rejected the analysis of AirTouch's expert, cellular pioneer Dr. William C.Y. Lee, who found that AirCell's signal strength frequently exceeded -124 dBm, which represented the level of interference AirTouch's rural systems could tolerate, and that co-channel operation by AirCell would cause a significant level of harmful interference to terrestrial traffic on these systems. It said Dr. Lee had used "an unrealistically low interference threshold" that was "too conservative, and that an interference threshold of minus 117 dBm is more realistic for typical analog systems."[10] It concluded that "use of the latter

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6 *See* note 2, *supra.*

7 *AirCell Order,* 15 F.C.C.R. at 9630. The Commission decided not to consider data from test flights conducted on July 11, 1997 for evaluating AirCell's interference potential.

8 *Id.* at 9630 n.60.

9 *Id.*

10 *Id.* at 9631 & n.67.

threshold would have led to a finding that AirCell would cause a significant level of harmful interference 0% of the time."[11] Nowhere did the FCC explain why it selected -117 dBm as its interference threshold or how the use of that threshold to analyze the test data led to the conclusion of no harmful interference.

Given its finding that AirCell would not cause harmful interference, the Commission granted AirCell a two-year waiver to provide its service on a secondary basis, subject to conditions that, among other things, limited it to channels not used for digital cellular service and limited it to six channels per ground station. The Commission emphasized that "non-participating cellular licensees are not required to . . . alter their operations to accommodate AirCell operations in any way."[12]

B. Review in the D.C. Circuit

Commenters challenged the waiver in the D.C. Circuit. The Court granted review with regard to the FCC's interference conclusions that formed the basis of the waiver. The court found that the Commission had not explained its choice of the -117 dBm interference threshold or its conclusion, through the application of its chosen interference threshold to the "raw test data" in the record, that there would be "'a significant level of harmful interference 0% of the time' in the real world."[13] The Court observed that the FCC had not adequately addressed the evidence contrary to its findings: "Because *there is too much evidence in the record suggesting a contrary conclusion,* . . . the court is unable to discern why the Commission considered one

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[11] *Id.* at 9631 n.67. The Commission also stated that "AirCell's probability study was not a factor" in reaching its decision. *Id.* at 9632.

[12] *Id.* at 9635, *quoting Bureau Order,* 14 F.C.C.R. at 816-17 (internal quotation marks omitted).

[13] 270 F.3d at 968, *quoting* 15 F.C.C.R. at 9631 n.67.

interference threshold preferable to another or how it could extrapolate from the July 10, 1997, test data in the absence of a probability study."[14]

Rather than vacate the decision, the Court remanded the case for the Commission to provide a record-based explanation of its selection of the -117 dBm threshold and its conclusion, based on analysis of the test data under that threshold, that there would be no harmful interference.[15] It added: "The omission of an explanation of its choice of an interference threshold is particularly troubling because the July 10, 1997, test data, which was the only test data on which the Commission apparently relied, did not represent the full range of operational conditions in which AirCell's phones are likely to be used."[16]

C. The FCC's Remand Proceeding

On March 8, 2002, after the Court's mandate had issued, Commenters filed comments with the FCC that directed the agency's attention to important facts and test data in the record.[17] The filing pointed out that the existing record contained uncontradicted real-world test data from TEC Cellular ("TECC"), AirCell's consultant, showing that, among other things, (1) the prevailing noise level at the test sites was considerably lower than the FCC had asserted to the Court (-127 dBm or lower, based on actual received noise levels, rather than the FCC's -117 dBm); (2) the actual received terrestrial cellular signal strengths at the test sites were often at or below -117 dBm, and about half of the cellular signals were received at strengths at or below -100 dBm; and

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[14] *Id.* at 968-69 (emphasis added).

[15] *AWS v. FCC,* 270 F.3d at 968.

[16] *Id.*

[17] AT&T Wireless Services, Inc., Cingular Wireless LLC, and Verizon Wireless, Comments on Remand from the United States Court of Appeals for the District of Columbia Circuit, *AirCell, Inc.* (filed March 8, 2002) ("Remand Comments").

(3) the actual received strength of AirCell signals at the test sites exceeded the FCC's -117 dBm interference threshold on numerous occasions.

Based on record evidence such as the foregoing, Commenters submitted, the Commission would be unable to provide a reasoned explanation for its selection of a -117 dBm interference threshold and its determination that AirCell would not cause harmful interference, based on applying that threshold to the test data. AirCell did not dispute any of these points; it filed nothing in response.

On February 10, 2003, the Commission issued its *Remand Order*. In it, the Commission explained that its -117 dBm interference threshold was derived by setting the minimum necessary received signal strength at -100 dBm and subtracting 17 dB (the C/I ratio representing acceptable call quality) from it. This threshold did not represent the maximum interference deemed non-harmful, unlike what its previous order had indicated. Instead, the Commission explained, it considered interference to be harmful only when it exceeded this threshold by 7 dB — *i.e.,* in evaluating the test data, the Commission only considered AirCell signals to cause harmful interference if they were received at -110 dBm or higher. Solely on this basis, the Commission concluded that AirCell signals would not cause harmful interference. The *Remand Order* did not take Commenters' Remand Comments into consideration and did not mention the data that AirCell's contractor, TECC, had collected at the test sites regarding ambient noise level or terrestrial received signal strength — data in the existing record. It provided no details of its analysis of the AirCell test data under either the previously announced -117 dBm threshold or its new -110 dBm threshold. Commenters have sought judicial review of this order.[18]

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[18] *AT&T Wireless Services, Inc., et al. v. FCC,* Case No. 03-1043 (D.C. Cir. filed Feb. 26, 2003).

D. AirCell's Request for Extension

AirCell filed its Petition for Extension of Waiver on March 28, 2002, about two months before the waiver was scheduled to expire. The Petition provided little data for evaluating whether a new, extended waiver was necessary. Even though the *AirCell Order* said that consideration of any further waiver would be based on evaluation of reports from AirCell's participating carriers, the "reports" were merely one- or two-page letters devoid of any content; neither the reports nor the AirCell Petition itself contained any data from the preceding two years of operation.[19] Instead, AirCell and its partners relied exclusively and expressly on the FCC's previous noninterference finding, which the Court had remanded as unsatisfactory, and AirCell incorrectly claimed it had been sustained by the Court. Based on that remanded finding and the alleged lack of any evidence of actual interference, AirCell asked that the waiver either be made permanent or be extended for another ten years. AirCell did not submit any further test data regarding analog interference, relying solely on the 1997 test record.

AirCell's Petition also asked for the lifting of the restriction on transmissions over cellular channels used for terrestrial digital service.[20] AirCell submitted laboratory-simulation test data prepared by Wireless Systems Engineering, Inc. ("WSE") purporting to show that its service would not interfere with either CDMA or TDMA digital service. It provided no flight test data.

Finally, AirCell asked that the Commission increase the waiver's channel limit from 6 to 19. It based this on an alleged "severe operational need" for additional capacity. It provided no evidence concerning the demand for its service, the amount of traffic carried, its growth rate, or

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[19] Three of these reports contained virtually no information, and none at all concerning usage level. One report, on the other hand, provided data showing that its towers handled only a minimal amount of AirCell traffic — the average site provided less than two minutes of AirCell airtime per day. None of the reports contained any data concerning received AirCell signal strength.

[20] One Partner co-signing the AirCell petition, Western Wireless, did not join in the digital waiver request. *See* Petition at 22 n.49.

its blocking level. Instead, AirCell claimed that it needed the additional capacity because it was planning to expand its service from general aviation to commercial airlines. The *AirCell Order* did not address the issue of service to commercial aircraft; AirCell maintained that such service was therefore permitted.

E. V-Comm's Reports

Commenters engaged a respected wireless engineering consultant, V-Comm, to analyze AirCell's Petition as well as to conduct an extensive series of tests of AirCell's potential to interfere with analog and digital terrestrial cellular service. V-Comm has produced several reports, which are included as Exhibits hereto. Exhibit I, entitled "Engineering Response to AirCell's Request for Waiver Extension" ("V-Comm Engineering Response"), is a report on V-Comm's evaluation of AirCell's submission. Exhibit II, entitled "Engineering Report of the AirCell Compatibility Test" ("V-Comm Report"), is a report on AirCell's independent test of AirCell's interference potential regarding analog and digital service. The latter report includes a detailed test plan, a noise level study, and a received signal strength study. Finally, Exhibit III is an "Engineering Analysis of the FCC Order on Remand" ("V-Comm Remand Analysis").

DISCUSSION

I. THE EXISTING ANALOG WAIVER CANNOT BE RENEWED

The first issue that must be addressed is whether AirCell's waiver for airborne service on analog cellular channels should be renewed. If the waiver is not renewed, then there is no need to consider whether the existing terms of the waiver need to be modified.

As we show herein, there is no basis for renewing the waiver. AirCell and its partners do not even attempt to make out the showing required of those seeking a waiver under *WAIT Radio* and the Commission's rules. They do not supply the minimal information that the Commission said would be necessary to have their extension request considered. Neither the previous grant

of the waiver nor the record underlying that grant warrants renewal. Equally important, renewal of the waiver must be denied because, as shown by V-Comm's tests, AirCell will cause harmful interference to terrestrial analog cellular operations.

A. AirCell Does Not Satisfy the *WAIT Radio* Waiver Standard

1. *WAIT Radio* and the FCC Rules Place a Heavy Burden on AirCell to Demonstrate Non-Interference

Under *WAIT Radio,* "the essence of waiver is a narrow, particularized exception to a rule based on a showing by a particular party that such an exception will not subvert the rule under that party's unique circumstances."[21] *WAIT Radio* requires the Commission generally to enforce its rules, and thus parties requesting waivers have a "high hurdle even at the starting gate. 'When an applicant seeks a waiver of a rule, it must plead with particularity the facts and circumstances which warrant such action.'"[22] The Commission has incorporated these principles into its rules governing waivers. Under Section 1.925(b)(3), one who requests a waiver must show that:

> (i) The underlying purpose of the rule(s) would not be served or would be frustrated by application to the instant case, and that a grant of the requested waiver would be in the public interest; or
>
> (ii) In view of unique or unusual factual circumstances of the instant case, application of the rule(s) would be inequitable, unduly burdensome or contrary to the public interest, or the applicant has no reasonable alternative.[23]

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[21] *WAIT Radio v. FCC,* 418 F.2d 1153, 1159 (D.C. Cir. 1969), *cert. denied*, 409 U.S. 1027 (1972).

[22] *Id.* at 1157, *quoting Rio Grande Family Radio Fellowship Inc. v. FCC,* 406 F.2d 664 (D.C. Cir. 1968); *see also Northeast Cellular Telephone Co. v. FCC,* 897 F.2d 1164, 1166 (D.C. Cir. 1990) (waivers granted only when it is shown that "particular facts would make strict compliance inconsistent with the public interest.").

[23] 47 C.F.R. § 1.925(b)(3)(i)-(ii).

The purpose of the airborne cellular rule, Section 22.925, is to address "the need for non-interference in all cellular transmissions."[24] The Commission explained that "[i]f a cellular telephone is used in an airborne aircraft, it will have a much greater transmitting range than a land-based cellular telephone and its signal will be received at a multiplicity of cell locations within the market, causing harmful operational interference," and could cause "serious interference . . . to cellular systems in other markets as well."[25] The Court reviewed the previous AirCell waiver based on this understanding,[26] and the Commission reiterated these concerns in its *Remand Order,* acknowledging that the rule was adopted "because of the potential for 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 the telephone is airborne."[27]

Clearly, then, AirCell and its Partners must, *at a minimum,* demonstrate that their airborne usage of analog cellular channels will not cause harmful interference to terrestrial cellular operations, and that the public interest will be served by granting an extension of their analog waiver. Without such a showing, their waiver request cannot be granted.

2. The *WAIT Radio* Standard Is Not Satisfied

AirCell and its Partners have not carried their burden of justifying a renewed waiver. No showing is made that the purpose of the rule "would not be served or would be frustrated by application to the instant case" or that in the "unique or unusual factual circumstances of the instant

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[24] *Airborne Use of Cellular Units,* CC Docket 88-411, *Report and Order,* 7 F.C.C.R. 23, 23 (1991) (*Airborne*).

[25] *Id.*

[26] *AWS,* 270 F.3d at 965 (rule's purpose is to address the "serious risk of harmful interference to terrestrial systems from the greatly enhanced transmitting range of ordinary cellular telephones used aboard airborne aircraft.")

[27] *Remand Order* at ¶ 4.

case, application of the rule(s) would be inequitable, unduly burdensome or contrary to the public interest."

Instead of making a showing that a waiver is justified in accordance with these standards, they simply rely on the Commission's previous grant of a waiver in the *AirCell Order*. That order, however, found that AirCell had justified only a two-year waiver.[28] In fact, the Commission expressly rejected AirCell's request for a longer or permanent waiver:

> We agree with the Bureau's setting of an initial two-year term for the waiver, but we believe it is appropriate to re-start that term. We are sympathetic to AirCell's contention that any decision on its future operation should be based on a reasonable period of actual operation. Because of the substantial uncertainties attendant on this proceeding, we believe that the two-year term of this waiver should be reset to begin on the effective date of this Order. Only in that way can we ensure that there will be enough operational experience to judge the technical characteristics of this system. Therefore, we will affirm the Bureau's grant of a two-year waiver, but reset the term to begin on the effective date of this Order.[29]

The Commission's reference to the need for "enough operational experience to judge the technical characteristics of this system" makes clear that AirCell cannot obtain a renewed waiver simply on the basis of the *AirCell Order*. In fact, the Commission indicated specifically what kind of evidence would be needed for consideration of a renewed waiver:

> One year after the effective date of this Order, which affirms the grant of the waiver allowing cellular licensees to provide cellular service to airborne terminals in accordance with these conditions, cellular licensees may each submit a comprehensive report to assist the Commission in evaluating whether continuation of the waiver is in the public interest. Reports from participating licensees should include a description of their experiences with the provision of cellular service to airborne terminals, including feasibility, quality of service, customer satisfaction, incidents of interference, if any, and how any such incidents were successfully resolved.

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[28] *See AirCell Order,* 15 F.C.C.R. at 9624-25, 9628, 9646 & n.160, 9652.

[29] *Id.* at 9649.

> Unless the Commission shall determine otherwise as a result of evaluation of these reports, the waiver will terminate two years after the release of this Order.[30]

The Commission further indicated that it expected these reports to "be submitted on the basis of a year's experience under the waiver, as reset by this Order, *i.e.*, based on experience through one year from the effective date of this Order."[31]

As we discuss in the next section, the minimal "reports" that were filed do not contain the information the Commission needs. Tellingly, AirCell and its Partners do not claim to have supplied the required information; that is why they fall back on the FCC's finding in the *AirCell Order* that there will not likely be harmful interference. This was only a preliminary, predictive interference analysis rendered on the basis of very limited information, however — and the Commission has subsequently called into question how it performed that analysis.[32] In fact, the Court criticized the Commission for its reliance on very limited, unrepresentative data.[33] The Commission, in any event, made clear that any further waiver would have to be based on far more extensive data, foreclosing the renewal of the waiver simply because it was originally granted. Because AirCell and its Partners have not made the showing required by *WAIT Radio* and the FCC's rules,[34] the extension request must be denied.

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[30] *Id.* at 9652.

[31] *Id.* at 9646 n.160.

[32] *See Remand Order* at ¶¶ 12-14, 22 & n.58, 26.

[33] *AWS,* 270 F.3d at 968 ("The omission of an explanation of its choice of an interference threshold is particularly troubling because the July 10, 1997, test data, which was the only test data on which the Commission apparently relied, did not represent the full range of operational conditions in which AirCell's phones are likely to be used.").

[34] AirCell and its Partners make public interest arguments in favor of a renewed waiver, *see* Petition at 10-16, 37-39, but the public interest is only one part of the waiver standard. They make no attempt to show that a renewed waiver will further, or at least not contravene, the purpose of the rule.

B. The AirCell Partners' "Reports" Do Not Justify Renewal

1. The Reports Contain None of the Needed Information

The Petition includes several "reports" from AirCell Partners in response to the *AirCell Order*'s invitation to submit reports based on the first year of operation under the waiver.[35] As discussed above, the Commission said that the Partners' reports "should include a description of their experiences with the provision of cellular service to airborne terminals, including feasibility, quality of service, customer satisfaction, incidents of interference, if any, and how any such incidents were successfully resolved,"[36] in order to gather "enough operational experience to judge the technical characteristics of this system."[37]

AirCell states, misleadingly, that "[t]he one-year filings by AirCell's cellular licensee partners . . . all report interference-free airborne operations."[38] In fact, most of AirCell's Partners — 17 of the 22 Partners who joined in AirCell's Petition seeking renewal of their waivers[39] — filed no reports at all. In other words, nearly all of AirCell's Partners made no claim of interference-free operations. The five Partners' reports that were filed, included as Attachment B to the Petition, are so minimal as to be useless for evaluating AirCell's renewal request. There is no indication that any of them did any testing regarding interference to other systems' operations; at

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[35] *See* Petition, Attachment C. While the reports appear to have been filed in mid-2001, Commenters first learned of them when the Petition was filed in March 2002. None of the reports was served on Commenters, and they were not available for review in the Commission's AirCell file, which was checked regularly for new filings.

[36] *AirCell Order,* 15 F.C.C.R. at 9652.

[37] *AirCell Order,* 15 F.C.C.R. at 9649.

[38] Petition at 19.

[39] AirCell appears to be uncertain how many Partners it has. Twenty-two Partners co-signed the Petition, and those are listed in its Appendix B along with two companies (Vanguard Cellular Financial Corp. and Comcast Cellular Communications, Inc.) that were acquired by AWS and Cingular, respectively. (The subsidiaries of AWS and Cingular have not sought renewal of the waiver, did not join in AirCell's Petition, and did not, therefore, file reports.) Even though its list comprises 24 carriers, AirCell says that its network "is currently supported by 21 cellular licensees who participate actively in the AirCell service." Petition at 7. It never explains the discrepancy.

most, they include a sentence saying they have received no interference complaints. The following table summarizes the reports:

ALLTEL Corporation	no report
Cellular Network Partnership, a Limited Partnership d/b/a Pioneer Cellular	no report
Centennial Communications Corporation	no report
CenturyTel Wireless, Inc.	1-page letter citing AirCell operations at 7 sites; no complaints of interference.
Commnet of Delaware L.L.C.	no report
Commnet Wireless, Inc.	no report
Corr Wireless Communications, L.L.C.	no report
ETEX Communications, L.P.	no report
California RSA No. 3 Limited Partnership, d/b/a Golden State Cellular	no report
Kentucky RSA 4 General Partnership	no report
Northeast Communications of Wisconsin, Inc., d/b/a Cellcom	1-page letter (from NEW-CELL, INC. dba CELLCOM) citing AirCell operations at 2 sites; no reports of interference
Pine Belt Cellular, Inc. d/b/a Pine Belt Wireless	no report
Rural Cellular Corporation	no report
Smith Bagley, Inc.	no report
Southern Illinois RSA Partnership d/b/a First Cellular of Southern Illinois	no report
South Caanan Cellular Communications Co.	no report
Tennessee RSA No. 3 Limited Partnership	no report
United States Cellular Corporation	2-1/2 page letter listing 37 sites, 25,000 total minutes of use; no reports of interference
Western Wireless Corporation	1-1/2 page letter citing AirCell operations at 23 sites; no complaints of interference
Texas RSA 8 South Limited Partnership d/b/a Wes-Tex Cellular	no report
Texas RSA 1 Limited Partnership d/b/a XIT Cellular	no report
Yorkville Communications, Inc.	no report

As can be seen from the table — and is obvious from the reports themselves — there is no technical information at all in the reports. None present any data concerning quality of service or customer satisfaction. All the Commission knows for certain from these reports is that AirCell service is feasible and some AirCell Partners have not received interference complaints.

Moreover, one report indicates that there is virtually no traffic carried by AirCell's system, which may be one reason there were no interference complaints, as discussed below.

The reports clearly do not provide the Commission with "enough operational experience to judge the technical characteristics of this system."[40] The vast majority of the Partners submitted no report at all. Those carriers' requests for renewed waivers must be rejected as completely baseless, because the Commission said that "[u]nless the Commission shall determine otherwise *as a result of evaluation of these reports,* the waiver will terminate two years after the release of this Order."[41] Those that did submit reports, on the other hand, provided no useful information supporting a waiver. Under these circumstances, the waiver cannot be renewed for any of AirCell's partners.

2. The Lack of Interference Complaints Cannot Justify Waiver Renewal, Given the Minimal Usage of the AirCell System

AirCell and its Partners argue that the lack of interference complaints justifies renewal of the waiver.[42] This cannot be seriously maintained, because there has been almost no usage of AirCell's system, and consequently there has been little opportunity for generating interference complaints. The only usage data in the reports is from United States Cellular, AirCell's largest-scale partner. It says its 37 sites provided 25,000 total minutes of use by AirCell customers over the course of a year. That represents an average of less than two minutes per day at each site.[43] This figure is comparable to usage data at AirCell sites operated by Cingular and AWS.[44]

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40 *AirCell Order,* 15 F.C.C.R. at 9649.

41 *Id.* at 9652.

42 *See* Petition at 3, 19.

43 25,000 minutes / 37 sites / 365 days = 1.8512 minutes/day per site.

44 *See* V-Comm Engineering Response, § 2 & n.3 ("AirCell's usage data, for 5 potentially busy AirCell sites in the northeast for the first quarter of 2003, indicates average utilization per AirCell base

(continued on next page)

With only two minutes of AirCell traffic per day, it is no wonder that there have been no interference complaints. Airborne units that do not transmit do not interfere. With only minimal operational usage, any interference generated by AirCell's airborne units would not be statistically significant enough to notice even if every transmission resulted in dropped calls.[45] Accordingly, the fact that AirCell's Partners have not noticed any interference or received any complaints is meaningless. It certainly provides no basis for making a determination regarding AirCell's interference potential or for renewing the waiver.[46]

3. Interference Would Not Be Traceable to AirCell and Its Partners Even If It Occurred Often

A lack of interference complaints would not be indicative that AirCell is not causing harmful interference even with a higher traffic load. The complaint process relied on by the Commission to address interference issues is completely unworkable. When a customer encounters a dropped call or other interference, the carrier would need to be notified of the problem promptly, identify the cell serving the customer, determine that a plane within the cell's line of sight is communicating via an AirCell unit, and know which AirCell partner's host site is serving the aircraft, before a complaint can be made. Even if interference could be identified and tracked

(footnote continued)

station of approximately 3 minutes of use per day, and 2 calls per day. . . . This usage data is provided by AT&T Wireless and Cingular Wireless, which operate a total of five AirCell sites in the northeast.").

[45] Two minutes represents less than one-quarter percent of the fourteen-hour peak calling period (7 AM - 9 PM). (Calculated as: 100% × 2 minutes / 840 minutes = 0.2381%.)

[46] Because AirCell's Partners have dedicated channels for AirCell use, they are not using those channels for terrestrial traffic at the cellsites where the AirCell transmitters are located and will not encounter interference to their own operations there. At other cellsites, they could be using the AirCell channels for terrestrial traffic, but there is nothing to indicate that this is the case. It is unlikely, given that AirCell's strategy from the beginning has been to partner with largely rural cellular systems with channels that are unused. Even if some Partners have used their AirCell channels for terrestrial traffic, however, they are unlikely to receive significant interference, because, as V-Comm has found, "[t]he AirCell phone is more likely to transmit at lower power when it is close to its serving site and within its own market area." *See* V-Comm Report, § 3.3.

in real time, and traced to a particular airplane, it would not be possible, in most cases, for the victim carrier to identify which ground station is serving the airplane at that time, in order to make a complaint, since there may be multiple cellular systems operating as AirCell partners within 94 miles of a site receiving interference.[47] AirCell interference to terrestrial operations would essentially be impossible to identify and trace to AirCell even if seriously harmful interference occurred often, as explained by V-Comm.[48]

C. Request for 10 Year or Unlimited Length Waiver Duration Is Baseless

AirCell and its Partners' request that the waiver be renewed for ten years or be made permanent must be denied. As the Commission indicated in its *AirCell Order,* any consideration of a waiver beyond the initial two years depends on having a record based on operational experience, a record that permits a serious technical evaluation of AirCell's interference. With no such record, the Commission cannot grant any renewal at all, much less a fivefold-increased term or a permanent waiver.

AirCell rehashes a number of its previous arguments in seeking an extended term.[49] The Commission, however, found only a limited initial two-year term justified. Moreover, none of AirCell's policy arguments is actually related to the length of its renewed waiver; they are simply recitations of the purported benefits of AirCell service.

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[47] According to the *AirCell Order,* AirCell ground stations can serve aircraft up to 84 miles away at 5000 feet elevation, and the aircraft's signal is detectible up to 10 miles away. *AirCell Order,* 15 F.C.C.R. at 9636-37. As discussed below, V-Comm's tests indicated that the aircraft's signal can be detected much farther away than 10 miles.

[48] *See* V-Comm Engineering Response, § 8.2, "Cellular Switch-based Interference Detection Tools Are Not A Feasible Method For Measuring Potential Interference From AirCell Transmissions."

[49] *See Petition at* 11-14, 37. Among AirCell's arguments is that it "seeks to continue its evolution into a competitive provider of air-ground service to commercial aviation passengers," an objective which it claims the FCC staff supports in the *Biennial Review 2000 Staff Report*. Petition at 14-15. The excerpt from the staff report, however, makes no mention of AirCell providing service to commercial aviation; it merely refers to AirCell as a "potential source of competition in the air-ground sector." AirCell's proposed service to commercial aircraft is discussed more fully in Section I.D below.

AirCell's primary basis for an extended term has nothing to do with the public interest. It wants a longer term for business reasons — "to allow AirCell to engage in business, financial, and operational planning"[50] — in other words, to make it easier for AirCell to sign up customers and sell units.[51] It claims that its ability to provide service is "gravely limited" by a two-year term and that the limited waiver term "has been a straightjacket [sic] on AirCell's long-term ability, limiting financial and customer investment," but it provides *no* evidence to back up its assertions. All it says is that "for AirCell to sustain its operations and continue to grow as a business, a substantial extension . . . is needed."[52]

AirCell's objective, obviously, is to have a decade or more to build up a customer base for "squatter's rights" purposes, before having to justify to the Commission again its deviation from a rule intended to safeguard "the need for noninterference in all cellular transmissions."[53] A sizeable customer base relying on AirCell's nominally "secondary" service would make it difficult for the Commission to shut down AirCell even if there is substantial harmful interference to terrestrial service.[54]

The time to consider the interference issues closely is before AirCell phones are ubiquitous. There can be no doubt that AirCell's operations have the *potential* to cause harmful inter-

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50 Petition at 38.

51 *See id.* at 38-39.

52 *Id.* at 40.

53 *Airborne,* 7 F.C.C.R. at 23.

54 The Commission's Spectrum Policy Task Force described this phenomenon in the context of unlicensed use of licensed spectrum pursuant to an easement: "[O]nce unlicensed devices begin to operate in an easement, it may be difficult legally or politically to shut down their operations even if they begin to cause interference or otherwise limit the licensed user's flexibility. Thus, as proponents of the secondary market model note, the potential for 'squatter's rights' issues to arise is another potential downside of the easement model that must be addressed." *Spectrum Policy Task Force,* ET Docket 02-135, *Report,* at 58 (SPTF Nov. 7, 2002).

ference. The first real review of AirCell's interference based on substantial operation[55] must be now, not ten years from now.

D. Waiver Extending to Commercial Aircraft Is Not Justified

The Commission has never expressly addressed whether AirCell is authorized by its existing waiver to serve commercial aircraft. As shown in the Commenters' post-remand filing, incorporated here by reference, no interference testing with commercial aircraft has ever been undertaken, and there is no basis for a waiver extending to them.[56] Now, AirCell expressly states that it plans to provide service to commercial aircraft,[57] and it has actually begun providing such service.[58]

Whether or not the initial two-year waiver encompassed commercial aircraft, the Commission has no basis at this point for permitting AirCell to serve commercial aircraft in a renewed waiver term. There is no test data pertaining to the interference potential of AirCell operations aboard commercial aircraft, which are typically much larger than general aviation planes, and usage patterns are likely to be very different in airplanes with numerous passengers. Moreover, the 1997 tests involved only small piston aircraft at low elevations; they provided no guidance regarding interference from higher-altitude jet flights, which would be more typical of commercial airline operations. As discussed below in Sections III.C-D, V-Comm has performed tests with jet aircraft along a highly-trafficked air corridor as a proxy for commercial aircraft us-

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[55] Under the terms of the *AirCell Order,* the current proceeding should have been an opportunity for evaluating AirCell's interference potential based on substantial real-world experience. Neither AirCell nor its Partners have supplied any information relevant to such an evaluation, however. If the Commission renews the waiver instead of denying it, it must provide for a full review after a new, limited-term, real-world evaluation period based on operational experience before it considers anything like a ten-year term.

[56] *See* Remand Comments at 21-22.

[57] *See* Petition at 14-15, 39, 42.

[58] *See, e.g.,* AirCell ex parte notice, filed April 7, 2003, attachment at 2 (AirCell serves Frontier Airlines and Indigo (fleet) as commercial aircraft customers).

age and finds that AirCell usage on high-altitude jet flights poses a serious threat of widespread harmful interference to terrestrial cellular operations.

E. No Increase in the Number of Channels Is Justified

AirCell is currently limited to 6 analog cellular channels per ground station. It has asked the Commission to increase this to 19 cellular channels, including those used for digital terrestrial cellular service. AirCell's claim to need more channels is baseless whether or not digital channel usage is authorized.

In the body of its Petition, AirCell provides nothing but puffery concerning the demand for its service. Instead of providing current traffic load data, held orders, and fact-based demand estimates, it simply recites new services it is considering and potential new customers it may sign up as the reasons for needing channels.[59] What it does not provide, as a justification for its request to increase from 6 to 19 channels per ground station, is a projection of how many Erlangs of traffic it will be carrying, which is essential to a determination of its need for channels.

The Petition's silence on this is understandable. As noted above, there is virtually no traffic on AirCell's existing network of stations — a few minutes per day, on average, per base station. That amount of traffic can readily be handled by one or two voice channel(s) per ground station, with plenty of capacity for more traffic.[60] AirCell currently has the ability to use up to *six* channels, of which *five* can be used for carrying communications traffic (one channel would have to be reserved for control, under the analog AMPS standard). AirCell has provided *no* basis for its demand that the ceiling be lifted to nineteen.

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[59] *See* Petition at 42.

[60] *See* V-Comm Engineering Response, § 2 ("With this level of usage [3 minutes per day], the AirCell system can serve customers with only 1 to 2 voice channels required per base station.")

AirCell does supply numerical traffic projections, but not in the body of its Petition. These projections, buried deep in technical appendices, demolish its claim to need nineteen channels per ground station. AirCell's technical consultant, WSE, states there that "AirCell expects to carry a nationwide traffic load of about 200 Erlangs in the year 2003," and that AirCell assumes this load will be evenly distributed across the United States.[61] At the time it filed its petition, AirCell had 130 sites in operation, which means it expects each site to handle an average of 1.53 Erlangs of traffic.[62] Five communications channels can handle this level of traffic loading at 2% blocking.[63] AirCell does not need as many as nineteen channels to handle this volume of peak-hour traffic and accommodate further growth. *Nineteen channels per ground station would give AirCell enough capacity to handle more than seven times its 2003 demand projection.*[64]

AirCell cannot be asking for more channels to accommodate growth in demand. Its current estimated demand is the same as it estimated five years earlier.[65] That estimate is much

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[61] WSE, *Test Report: AirCell/TDMA Compatibility Test, February 2002* ("WSE TDMA Report") (Attachment H, Appendix II to the Petition), at 117; WSE, *Test Report: AirCell/CDMA Compatibility Test, February 2002* ("WSE CDMA Report") (Attachment H, Appendix III to the Petition), at 66.

[62] *See* Petition at 8. AirCell has more sites in operation now than it did when it filed the Petition was filed a year ago, so its estimated 200 Erlangs of traffic should actually be distributed over more sites, reducing the average amount of traffic per site. V-Comm concluded, "the current 6 channel limitation is even sufficient to handle AirCell's projected full system loading of 200 Erlangs of traffic distributed across 150 base stations (1.33 Erlangs per base station), and meet industry standards for quality service levels (1% call blocking)." V-Comm Engineering Response, § 2.

[63] Computed in accordance with Erlang B formula, using Erlang B calculator available online from Westbay Engineers Limited, at <http://www.erlang.com/calculator/erlb/>.

[64] At 2% blocking, eighteen communications channels (setting aside one of the nineteen for control purposes) can accommodate 11.45 Erlangs of traffic, using the online Erlang B calculator, which is 7.48 times AirCell's 2003 projected demand of 1.53 Erlangs per site. And even 11.45 Erlangs of traffic could be accommodated in five voice channels with a poor grade of service (61% blocking rate).

[65] In 1997, TEC Cellular, then AirCell's consultant, provided virtually the same traffic load projection for 2000, using almost identical language: "Based upon AirCell growth projections, they expect to carry a nationwide traffic load of about 170 Erlangs in the year 2000. To allow a bit of margin, we'll assume 200 Erlangs." TEC Cellular, Inc. *Final Report: AirCell Flight Test, July 10-11, 1997*, at 173

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higher than actual usage, as indicated by the data supplied by United States Cellular and confirmed by V-Comm's report on usage levels at the AWS- and Cingular-operated AirCell sites.[66] AirCell's actual per-station usage is a few minutes *per day.* Even if concentrated into the busy hour, the loading is a tiny fraction of an Erlang.[67] V-Comm concludes, "The AirCell system does not require 19 channels to support its operation and the request should not be granted."[68] Accordingly, AirCell's request for an increase in channel usage from six to nineteen has no basis and must be rejected.

II. AIRCELL HAS FAILED TO DEMONSTRATE IT WILL NOT HARMFULLY INTERFERE WITH ANALOG OR DIGITAL CELLULAR SERVICE

AirCell and its Partners, except Western Wireless, claim that their airborne cellular operations will not cause harmful interference to digital or analog terrestrial cellular operations. As discussed above, AirCell makes no showing regarding analog, relying on the *AirCell Order* and its 1997 record. AirCell does include engineering reports that claim there will be no harmful interference to TDMA and CDMA digital service, based in large part on the 1997 test data. As we show herein, reliance on the 1997 data does not warrant renewal of the waiver because of significant flaws in that data and in the analysis of it. Moreover, AirCell's digital engineering reports are seriously flawed and omit any testing of GSM, a digital technology being deployed by

(footnote continued)

(TECC Report) (Exhibit C to AirCell, Inc. Petition for Waiver (filed Oct. 9, 1997)). The principal author of the TECC Report (C.J. Hall, P.E.) and the two WSE reports (Christopher Hall, P.E.) appear to be one and the same engineer, which would explain the similarity of the language; it would also explain the nearly identical, and equally flawed, probability analyses in the two reports.

66 *See* V-Comm Engineering Response, § 2 & n.3.

67 If 3 minutes of traffic is handled at a given ground station during busy hour, there is 0.05 Erlang of traffic (3 minutes / 60 minutes = 0.05 Erlang).

68 V-Comm Engineering Response, § 2.

two of the Commenters, or other new technologies. These reports cannot be the basis of a digital channel waiver.

A. The 1997 AirCell Flight Test Data Are Too Flawed to Determine AirCell's Interference Potential on Either Analog or Digital Channels

AirCell did not conduct any new flight tests to support its request for renewal of its analog waiver. As noted above, it simply relied on the questionable prediction in the *AirCell Order* that AirCell was not likely to cause harmful interference.[69] That determination, however, overlooked critical data in the record concerning terrestrial signal strength and noise levels at the test sites.[70] It also was premised on only one day of flight tests, conducted on July 10, 1997 with a very limited range of operational characteristics, which caused the Court of Appeals to express skepticism about the FCC's ability to draw broad conclusions about AirCell's interference poten-

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[69] Again, the D.C. Circuit found that the FCC failed to explain its interference analysis and remanded the case. *See AWS,* 270 F.3d 968-69. The Commission responded in its *Remand Order,* and Commenters have sought review of the latter order.

[70] The analysis in the *AirCell Order* was flawed partly because it relied on unrepresentative flight test data that artificially diminished the received airborne signal strength, as discussed below. In addition, the Commission subsequently explained that its analysis was based on the premise that the minimum acceptable received terrestrial signal strength was -100 dBm. *See Remand Order* at ¶ 14. This was not based on the record, and in fact was inconsistent with uncontested measurements of received signal strength and noise level at the test sites. V-Comm points out that at the Texas test sites "the terrestrial noise floor levels are in the range of -131 to -128 dBm, with approximately 95% of the readings at -131 dBm." V-Comm Engineering Response, § 4.1. Virtually all of the measured noise was at or below -127 dBm. *See id.* at Fig. 4-B (reproducing Figure 7.9 from the TECC Report). Moreover, about half of the terrestrial traffic at the two test sites was received below -100 dBm — the *mean* signal strength at the Madill site was below -103 dBm, and nearly half of the terrestrial traffic received at the Waurika site was received at signal strengths below -100 dBm. *See* TECC Report, Figs. 7.6-7.7, at 115-16. An examination of the latter charts from the TECC Report makes clear that a substantial proportion of the terrestrial traffic was received at -110 dBm, or even lower. A signal received at -110 dBm could well have been of acceptable quality, given that this was at least 17 dB above the noise floor. Even though Commenters brought these record facts to the Commission's attention, *see* Remand Comments at 7-13, the Commission apparently did not consider them. To the extent AirCell relies for its current waiver request on an interference analysis based on the 1997 Texas test data, however, the Commission must consider all of the relevant evidence from those tests. *See Birach Broadcasting Co.,* FCC 03-14 at ¶ 6 & n.12 (Jan. 31, 2003) (In evaluating a waiver request, an "agency must . . . consider all the relevant factors"), *citing Citizens to Preserve Overton Park, Inc. v. Volpe,* 401 U.S. 402, 416 (1971).

tial.[71] Both AirCell's analog renewal request and its request to use digital channels are premised squarely on this limited, unrepresentative data. AirCell conducted no new flight tests.

The limited nature of the July 10 test data is readily apparent. First, only two types of small propeller aircraft were flown, at a limited range of altitudes.[72] No jet aircraft were used, and neither low-altitude nor high-altitude test flights were performed. These inadequacies are even greater now, given that AirCell has acknowledged that it is vigorously pursuing commercial airlines as customers, because that would lead to greater usage in high-altitude jet aircraft, as well as in aircraft in relatively low-altitude holding patterns around major airports.

The July 10, 1997 test data also are limited in that the flights were all in a straight line toward the "victim" cellsite and broadside to the serving AirCell site; none involved flights broadside to the "victim" cellsite.[73] AirCell has previously maintained that this provided a "worst case" scenario, but it is actually a "best case" scenario. The flight paths used in the July 10, 1997 tests artificially minimized the reception of AirCell signals at interfering levels, due to the antenna gain patterns of both the airborne unit and the victim cellsite and the DPC power reduction control levels resulting from the orientation of the aircraft to the serving AirCell site. Commenters' independent consultant, V-Comm explains:

> The results of these tests are not representative of the overall effects that can be expected, and with the single flight path flying toward and passing over a victim terrestrial site, it only represents a best-case flight path scenario. With this flight path, approxi-

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[71] *AWS,* 270 F.3d at 968 (FCC's analysis described as "particularly troubling because the July 10, 1997, test data, which was the only test data on which the Commission apparently relied, did not represent the full range of operational conditions in which AirCell's phones are likely to be used.").

[72] V-Comm Engineering Response, § 3.

[73] Due to the orientation of the flights to the AirCell serving site, the highest-gain part of the airborne station's antenna pattern was oriented to the AirCell site. This increased gain in the direction of the AirCell serving site reduces the transmit level of the airborne station through operation of dynamic power control ("DPC"). Moreover, "the limited orientations and distances from the AirCell serving site, yields a limited range of mobile transmit powers." *Id.,* § 3.2.

> mately 50 dB of attenuation can be provided by the "nulls" in antenna gain patterns of the AirCell mobile antenna and terrestrial base station antenna. . . .
>
> . . .
>
> . . . AirCell characterizes the 1997 flight path as worst case when it actually represents a best-case flight path scenario . . . . The worst case orientation to the victim terrestrial site involves reviewing the associated gain factors in the horizontal & vertical antenna patterns of the AirCell VOR mobile & terrestrial base station, in addition to the shadowing effects of the AirCell VOR antenna for the individual aircraft. . . .
>
> . . .
>
> . . . [T]he broad side of the airborne mobile antenna (at 90 and 270 degrees) utilizes increased antenna pattern gain in these directions. With this increased gain toward the serving AirCell site, the AirCell mobile phone is able to maintain lower transmit power levels. As compared to flying directly toward or away from the AirCell serving site, the broad-side orientation yields approximately 8 dB lower AirCell mobile transmit levels (or 2 DPC power steps).[74]

V-Comm concludes that the July 10, 1997 AirCell flight test data are entirely too flawed to support conclusions about AirCell's interference with analog and digital cellular service:

> AirCell's 1997 analyses regarding compatibility with AMPS terrestrial systems are not representative of the overall effects that can be expected, and with the single flight path flying toward and passing over a victim terrestrial site, it only represents a best-case flight path scenario. Therefore, the AMPS terrestrial system analyses in the AirCell 1997 report should not be used to assess the overall compatibility of the AirCell system.[75]

B. The AirCell/WSE Engineering Test Reports Do Not Justify AirCell Use of Digital Cellular Channels

The reports by AirCell's consultant, WSE, contain no new flight test data. For its analysis of the received signal strength of airborne units, WSE used only data from the June 10, 1997 Texas tests, which, we have shown, understates the true signal strength received at a terrestrial

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[74] *Id.,* §§ 3, 3.1, 3.2. V-Comm provides a full explanation of how the nulls in the base station and airborne station antenna patterns, as well as the way the antennas are mounted on the aircraft, cause the 1997 test to understate AirCell's received signal strength, and thus its interference potential.

[75] V-Comm Engineering Response, § 4.2.

receiver by a large margin. This fact alone should disqualify the WSE reports as a basis for considering whether AirCell will cause harmful interference to digital (TDMA and CDMA) cellular service. In addition, the WSE reports suffer from many other deficiencies that render them useless.

Commenters' engineering consultant, V-Comm, has analyzed WSE's reports in great detail. V-Comm's analysis, as set forth in the V-Comm Engineering Response in Exhibit I, demonstrates that WSE has not set forth a sustainable engineering basis for concluding that AirCell will not cause harmful interference to digital cellular service. V-Comm summarized its conclusions regarding WSE's analysis as follows:

> The WSE cross-interference tests used noise floors that are unrealistically and significantly higher than typical terrestrial system noise floors. These noise floor levels were not backed-up or supported with measured or reliable sources. The noise floor levels selected by AirCell/WSE and injected into the base station receiver have the effect of "masking" the interference of the AirCell system, and thereby invalidate the WSE cross-interference tests and render the results irrelevant.
>
> In addition to using unrealistic noise floor levels, the WSE interference tests used other inappropriate test conditions and assumptions. Consequently, the results of their interference tests are not representative of normal terrestrial systems.[76]

1. Inappropriate Noise Floors Masked Interference in AirCell's TDMA and CDMA Tests

V-Comm's first point is that WSE injected inappropriate noise levels into the test systems, thereby hiding interference that would otherwise have been indicated. The noise levels that WSE injected were "unrealistically and significantly higher than typical terrestrial system noise floors."[77] WSE did not perform any tests to determine the appropriate noise levels. In-

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[76] V-Comm Engineering Response, § 4.

[77] *Id.,* § 4.1.

stead, it injected arbitrary levels of noise that it asserted were "typical" of rural, suburban, urban, and dense urban environments.[78] It claimed that the noise floor figures came from "the 1997 flight test report and various filings by AirCell with the Commission," without citing any source.[79] In fact, the figures presented in the TDMA report are the unsubstantiated noise floor figures used by AirCell's James Stinehelfer[80] — figures that are as much as 13 dB higher than the actual noise levels measured by TEC Cellular in the 1997 test.[81]

Given the substantial changes that have occurred in cellular operations since 1997, the validity of *any* five-year-old noise floor figure is questionable. Accordingly, V-Comm conducted a new noise floor study covering cellsites in a variety of environments.[82] V-Comm summarized the test and its results as follows:[83]

> In comparison to the AirCell & WSE noise floor levels, V-COMM performed empirical tests to study the terrestrial cellular system noise floor levels at 18 AMPS cell sites in the NJ & PA market areas. These cell sites represent a cross section of typical terrestrial sites in "Dense Urban", "Urban", "Suburban" and "Rural" market types. The results of these measurements, and a comparison to AirCell / WSE noise floor levels, are provided . . . below. The V-

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78 *See* WSE TDMA Report, § 3.3.1, at 33; WSE CDMA Report, § 3.2.1, at 25.

79 WSE CDMA Report, § 3.2.1, at 25.

80 *See* James E. Stinehelfer, *et al.,* AirCell, Inc. Analysis of AirCell Flight Test Data and Its Effects on Terrestrial Cellular Operations at 6-7 (Exhibit B to AirCell, Inc. Petition for Waiver (filed Oct. 9, 1997)). The figures used in WSE's CDMA report, which do not themselves appear in the 1997 record, are bandwidth-converted from the Stinehelfer figures.

81 Stinehelfer's figures are greatly in excess of those actually measured at the test sites: the noise floor he gave for "rural quiet" sites was -120 dBm, while the actual noise floor measurements for the two "rural quiet" test sites ranged from -128 dBm down to -131 dBm, with virtually all the noise measurements at or below -127 dBm. *See* TECC Report, Figs. 7.8, 7.9, at 117-118. Accordingly, the noise floors used by Stinehelfer are actually 7-11 dB higher than the 1997 test record would support. In addition, WSE does not employ a separate category for "rural quiet" sites, and would appear to include all such sites in the "rural" category, even though Stinehelfer assigned "quiet rural" sites a 2 dB lower noise floor than "rural." As a result, WSE would consider "rural quiet" sites to have a -118 dBm noise floor, which is 9-13 dBm higher than the actual measured noise floor for such sites in 1997. *See* V-Comm Engineering Response, § 4.1.

82 *See* V-Comm Report, § 9.17 (AMPS Noise Floor Study).

83 V-Comm Engineering Response, § 4.1 & Table 4-B (footnote omitted).

COMM study clearly shows that typical terrestrial system noise floor levels are significantly lower than noise floor levels claimed and utilized by AirCell and WSE in their petitions before the Commission.

Table 4-B Comparison of V-COMM vs. AirCell / WSE Terrestrial Noise Floor Levels

Market Type Classification	V-COMM Measured Noise Floor (dBm)	AirCell / WSE Utilized Noise Floor (dBm)	AirCell / WSE vs. V-COMM Difference (dB)
Rural	-127	-118	+ 9
Suburban	-127	-115	+ 12
Urban	-126	-107	+ 19
Dense Urban	-123	-100	+ 23

V-Comm also prepared a graph to illustrate how seriously AirCell and WSE understated the noise floor in all four environments:

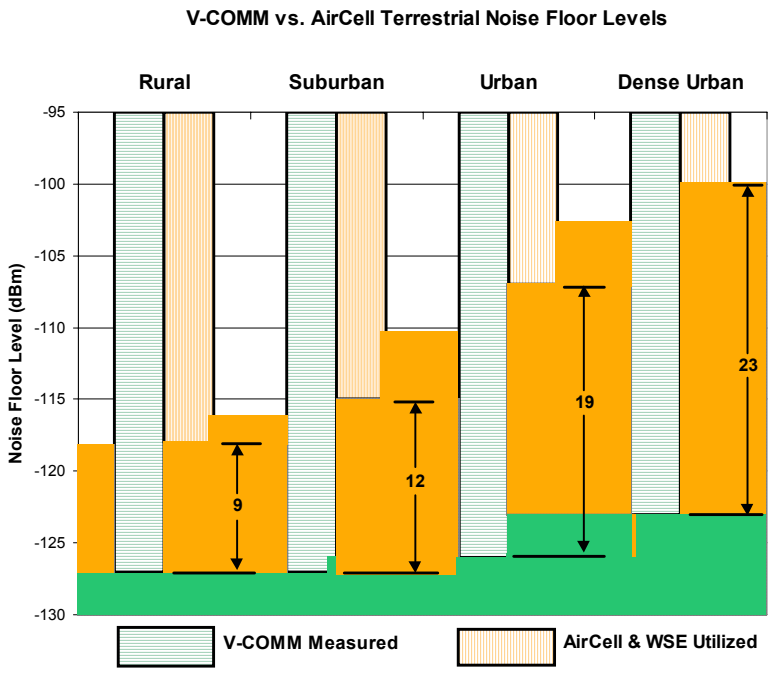

Figure 4-A, Comparison of Terrestrial System Noise Floor Levels, *from* V-Comm Engineering Response, § 4.1

V-Comm concluded that the noise floor figures employed by AirCell/WSE were "significantly higher than typical terrestrial noise floors . . . 20 times stronger than AirCell's empirical noise floor data [as measured in the TECC report] and 200 times stronger than the dense urban sites

measured in the V-COMM noise floor study."[84] AirCell/WSE's injection of these "erroneous noise floor levels" in its interference analysis "has the effect of 'masking' the interference of the AirCell system, and thereby invalidates the WSE cross-interference tests . . . . The results of these compatibility tests should not be considered in the FCC's assessment of the overall compatibility of the AirCell system."[85]

2. Other Inappropriate Test Conditions and Assumptions Invalidate AirCell's TDMA and CDMA Tests

a. TDMA Tests Invalid

V-Comm also found other serious errors in both the TDMA and CDMA tests. With respect to the TDMA tests, V-Comm summarized these other "inappropriate test conditions and assumptions" as follows:

- "Laboratory Environment" Test Condition - Using the cell site with its antenna system disconnected is not representative of the actual system operational environment. Field tests were not performed to assess the interference impact.
- Static Subscriber Signal Test Condition - Testing performed using static subscriber signal levels is not a "real world" situation, and does not take into account the effects of signal fading. A more realistic case is a model that uses the fading environment present in terrestrial cellular networks. During fades the received TDMA signal degrades, and any external interference contributes additively to the received interference, and negatively impacts the performance of the cellular system. This increases BER, and results in reaching the 2% BER threshold at lower signal levels.
- Abnormal test conditions not representative of real world systems - Cell site antennas disconnected, unrealistic noise floors injected, no effects of fading, static customer signals levels, cell site receive diversity algorithm unused, cell reverse channel power control algorithms and threshold unused.

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84 V-Comm Engineering Response, § 4.1.

85 *Id.*

- An additional flaw in WSE cross interference tests is that it assumed all terrestrial calls are already established on the cellular network, and the interference only occurs on TDMA digital voice channels. AirCell & WSE do not consider the harmful effects on TDMA digital control channels or on establishing new calls. . . . Interference to TDMA control channels can cause malfunctions to any of the TDMA control channel processes. AirCell's petition, tests and reports do not address how the AirCell system can be configured to not interfere with these critical channels in the TDMA terrestrial cellular system.[86]

V-Comm also criticized the AirCell/WSE assumption that any interference from AirCell to the TDMA system can readily be overcome through reverse-link power control: "This is only possible if the mobile has additional power available, and it is not already at maximum power. There are many subscribers served at or near maximum power in the cellular system for a variety of reasons . . . . These cellular subscribers should not be discounted simply due to being served in lower signal areas, as they too represent the primary users in the cellular spectrum."[87]

Finally, V-Comm noted that the drive test performed by AirCell/WSE was performed without any simulated AirCell signal being injected; it was just a drive test of plain-vanilla TDMA service. As a result, the drive test provided no indication whether AirCell signals would interfere: "It is unclear why WSE performs drive testing on the site . . . but did not attempt to ascertain how AirCell's interference would affect the performance of these drive test calls."[88]

V-Comm's conclusion is that the flaws in the AirCell/WSE TDMA test "result in showing a significantly lower likelihood of interference than can be expected in 'real world' systems . . . [and] should not be considered in the FCC's assessment of the overall compatibility of the AirCell system."[89]

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86 V-Comm Engineering Response, § 4.3.

87 *Id.*

88 *Id.*

89 *Id.*

b. CDMA Tests Invalid

V-Comm also found serious deficiencies in the AirCell/WSE CDMA cross-interference test. It analyzed the inappropriate noise floor figures in considerable detail, concluding that the "noise levels [used by AirCell/WSE] are significantly and unrealistically higher than those that exist in today's terrestrial systems. No experienced radio engineer would agree with these noise levels for CDMA systems (*e.g.,* -83 dBm for dense urban background noise floor in a 1.25 MHz bandwidth), since there would be little or no capacity remaining in the system to serve calls."[90] V-Comm found that AirCell/WSE had overstated the CDMA noise floors for various environments from 8 to 26 dB, and that the noise floors used by AirCell/WSE would consume from 84.2% to 99.7% of system capacity, without handling a single call.[91] Alternatively, the invalid noise floor assumptions would reduce a cellsite's coverage to 22% of its original size.[92] As with the TDMA test, the injection of these unrealistic noise levels during the AirCell/WSE CDMA test "has the effect of improperly masking the AirCell interference under study . . . [and] invalidates the results."[93]

In addition to the noise floor and the use of the limited 1997 flight test data, V-Comm found many other inappropriate test conditions and assumptions:

- "Laboratory Environment" Test Condition - Using the cell site with its antenna system disconnected is not representative of the actual system operational environment. Field tests were not performed to assess the interference impact.
- Terrestrial Subscriber Static Signal Test Condition - Testing performed using static subscriber signal levels is not a "real world" situation, and does not take into account the effects of signal fading. . . . . The effects of fading increase mobile transmit power, and

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90 V-Comm Engineering Response, § 4.4.

91 *Id.*

92 *Id.*

93 *Id.*

result in reaching the 0.5 & 2 dB thresholds at lower signal levels. A more realistic case is a model that uses the fading environment present in terrestrial cellular networks.

- Terrestrial Call Loading from multiple calls utilized static power levels. In normal situations, call loading & noise floors are varying (not static), and thus utilizes increased ranges of the mobile transmitter to keep up with dynamic changes in power levels. . . . In "real world" networks, CDMA power control algorithms, actual signal path loss, fading and dynamic call loading determine the mobile power level to serve calls.
- Abnormal test conditions not representative of real world systems - Cell site antennas disconnected, unrealistic noise floors injected, no effects of fading, static customer signals levels, cell site receive diversity & RAKE receiver algorithm unused, cell reverse channel power control algorithms and threshold unused, CDMA soft handoff algorithms and effects unused.[94]

V-Comm also criticized the AirCell/WSE CDMA test because it studied the effects of a simulated AirCell signal only on a single receiver in isolation, without considering its effects on the surrounding CDMA network. "In 'real world' situations, the presence of mobile phones increasing transmit power translates into increased interference at neighboring cell sites and adjacent sectors of the same site, which causes reduced coverage & capacity of these sites & sectors as well. This in turn, creates residual increases in mobile transmit power at the test sector, to compensate for the additional noise levels present from the mobiles served at neighboring cell sites and adjacent sectors of the test cell site. A hard-wired cable test setup to a single CDMA receiver does not include these effects."[95] Another error found by V-Comm is that the AirCell/WSE report fails to take into account the effects of interference on soft handoffs and on

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94 *Id.*

95 *Id.*

reverse-link access channels.[96] Additionally, AirCell/WSE did not perform a drive test to assess the effect of AirCell interference on CDMA.[97]

V-Comm also found that WSE and AirCell suffered from a misunderstanding of basic CDMA principles, citing their incorrect suggestion that processing gain and self-generated CDMA system noise levels act as a buffer against external interference. They also failed to understand that external interference is additive to internal self-interference, thereby reducing the power available in the system and causing it to "suffer degraded service quality levels, capacity limits or coverage."[98] For example, if AirCell interference reduces the performance of a reverse link, the mobile can only be instructed to increase power to overcome that interference if it is not already at its limit and there is sufficient power available. Many customers receiving service will already be at maximum power, for a variety of reasons. To these customers, AirCell interference will result in reduced call quality and an increase in dropped calls.

V-Comm concludes that the AirCell/WSE CDMA tests "used inappropriate test conditions and assumptions that result in showing a significantly lower likelihood of interference than can be expected in 'real world' systems. The results of these compatibility tests should not be considered in the FCC's assessment of the overall compatibility of the AirCell system."[99]

C. Failure to Conduct Tests Concerning GSM and Other Technologies

AirCell's tests were not only inadequate, but they also extended only to two digital technologies, TDMA and CDMA. AirCell performed no tests concerning its system's interference potential with respect to any other technologies. Such testing is essential for any consideration

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96 *Id.*

97 *Id.* ("It is unclear why WSE did not perform drive testing on the CDMA test site . . . to ascertain the effects of the AirCell interference to the terrestrial system under normal operating conditions.").

98 *Id.*

99 *Id.*

of removing AirCell's restriction on digital channel usage, because other technologies are being deployed today. For example, AWS and Cingular have already deployed cellular networks using GSM technology, and Verizon has widely deployed one form of "3G" technology, 1xRTT, in its cellular networks. Cellular carriers across the nation will be deploying an even wider variety of new digital wireless technologies in the course of their roll-out of 3G services. AirCell did not even perform tests of how its service affects the CDPD digital data technology that is in wide use. Nor did it provide any analysis of how its transmissions will affect the reliability and accuracy of the Phase II E-911 location technologies that the FCC has required cellular carriers to deploy.

As V-Comm points out, GSM is the current 3G migration path for TDMA carriers. GSM overlays typically use a tighter reuse pattern than analog or TDMA networks. This means that more cells will be using a given channel than is the case in analog and TDMA, and co-channel AirCell interference will therefore affect more cells.[100] The GSM standard uses different bandwidth and channelization from systems using the old TDMA standard, so the effects of interference cannot be presumed to be the same or similar.

In fact, each of the new technologies being deployed now and being planned for future deployment presents entirely different interference issues. "[A]ll utilize different air interfaces, standards, performance criteria, and voice-coders than the technologies included in this test plan. Also, bandwidth requirements, power control, frequency use, and channel assignments vary for each of these technologies. Further, C/I system requirements, reverse link topologies, data transmission schemes and methods of use (e.g., triangulation from multiple sites at lower signal levels for E911 Phase II location) differ per technology such that substantial compatibility testing

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[100] V-Comm Engineering Response, § 7.1.

is required to determine the effects of AirCell airborne interference on these terrestrial initiatives (and mandates)."[101] Given AirCell's failure to address any of these technologies, its request to be able to use digital cellular channels is fatally flawed.

III. EXTENSIVE TESTS BY V-COMM DEMONSTRATE CONCLUSIVELY THAT AIRCELL WILL CAUSE WIDESPREAD HARMFUL INTERFERENCE TO ANALOG, TDMA, AND CDMA CELLULAR SYSTEMS

Because of the lack of reliable data for analyzing AirCell's interference potential, V-Comm designed a series of tests that would provide a better basis for evaluating AirCell's interference potential with respect to both analog and digital service under a wide variety of conditions, avoiding the flaws in the 1997 analog tests. First, V-Comm conducted a two-phase test to assess the level of interference AirCell typically causes to analog, TDMA, and CDMA cellular service. Second, V-Comm conducted a case study of flights along a typical flight path that permitted an assessment of the number of cellsites that could be affected by AirCell airborne operations.

Unlike the 1997 tests, V-Comm's tests were *not* intended as a "worst-case" test. They were not designed to measure AirCell's interference to the cellular systems that are most vulnerable. Instead, V-Comm's tests were designed to measure the effect of typical AirCell signals on typical cellular systems. First, received AirCell signal strengths were measured in the New York-New Jersey-Philadelphia corridor, an area with a high level of air traffic. Next, the effect of various levels of simulated AirCell signals on traffic at a representative suburban cellsite in this area was measured, to assess the effect that AirCell traffic would actually have on the service used by typical cellular customers. And finally, the case study projected how broadly an in-

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[101] *Id.*

flight AirCell call would affect terrestrial service in the Washington-New York corridor, a heavily-trafficked flight path over systems serving millions of cellular users.

A. Description of the V-Comm Tests

The first set of tests is described in detail in V-Comm's "AirCell Compatibility Test Plan."[102] Phase 1 of the Compatibility Test consists of airborne AirCell mobile testing. Flight tests were conducted under a variety of conditions, with and without use of Dynamic Power Control ("DPC"). The flights with DPC disabled were used to determine the maximum signal strength that could be received from an AirCell-equipped plane operating at maximum legal power under a wide variety of conditions. The flights with DPC enabled were then used to determine the conditions under which various levels of DPC signal strength reduction occur.[103] V-Comm describes the advantages of the Phase 1 flight tests over the inadequate 1997 tests as follows:

> In comparison to the AirCell/TECC flight tests [relied on by AirCell/WSE], V-COMM conducted tests with significantly more flight patterns, representing many flight path orientations to the victim terrestrial site. In V-COMM flight tests, over 10,000 air miles were flown, compared to the 1997 AirCell flight data, which only included about 1,100 air miles over two days of flight testing, or approximately 850 miles for the only day of flight tests that were considered by AirCell (July 10th). AirCell's analyses and conclusions are based on that single day of flight testing, and only with flight paths that fly toward and over terrestrial sites. V-COMM's flight tests include four different types of terrestrial antenna polarities for comparison, and altitudes from 2,000 ft. to 35,000 ft. AMSL, while AirCell's flight tests did not include many terrestrial antenna types and their lowest flight altitude was 6,500 ft. AMSL (5,000 ft. AGL). V-COMM's tests included two differ-

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[102] *See* V-Comm, AirCell Compatibility Test Plan, included in V-Comm Report, § 9.18; *see also* V-Comm Report, §§ 2.2 - 2.2.4.

[103] For a further explanation of the reasons for separately conducting tests with DPC enabled and disabled, *see* V-Comm Report, §§ 2.2.2, 3.2.

> ent types of AirCell mobile antennas, while AirCell's tests included only its VOR style mobile antenna.[104]

Combining the results of the two Phase 1 flight tests permits a realistic modeling of received AirCell signal strengths at terrestrial cellular receivers under varying conditions and with various types of base station receive antennas.

Phase 2 of the Compatibility Test consists of a series of drive tests. Simulated AirCell signals are injected into a base station receiver during actual drive tests using analog, TDMA, and CDMA cellular phones, under real-world conditions. This permits measurement and prediction of the interference effects of typical AirCell signals on co-channel terrestrial cellular service.

The final stage of V-Comm's test plan is a "case study" to determine the extent of interference that may be caused by an AirCell phone used while airborne with DPC enabled. In this stage, the actual characteristics of flights (e.g., altitude, speed) along a typical flight path (using jet and piston aircraft) were determined. Then, the results of the Compatibility Test are used to estimate the number of cellsites along the flight path that would encounter harmful interference due to a call made for the duration of the flights. This facilitates an assessment of the impact of harmful interference from AirCell usage on terrestrial cellular networks.

B. The V-Comm Compatibility Test Demonstrates Harmful Interference to Terrestrial Cellular Networks

1. Phase 1 Test Results

The flight tests with DPC disabled[105] produced data concerning the maximum signal strength that can be expected from an AirCell unit. AirCell signals were received at the terrestrial cellsites at a wide variety of signal strengths for each type of antenna used:

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[104] V-Comm Engineering Response, § 6.1 (footnotes omitted). In its Table 6-A, V-Comm compares the varied operational conditions in detail.

Terrestrial Antenna Type	Received Signal Ranges
H-POL Test Antenna	-72 dBm to -126 dBm
SL45 Test Antenna	-78 dBm to -126 dBm
V-POL Test Antenna	-86 dBm to -126 dBm
OMNI Test Antenna	-89 dBm to -126 dBm
Oak Hill Cell, Sector 1	-96 dBm to -122 dBm
Swainton Cell, Sector 1	-106 dBm to -130 dBm
Swainton Cell, Sector 3	-107 dBm to -130 dBm

Table 3.2-A, Phase 1 Test Results – Received Signals Ranges per Terrestrial Antenna Type (footnotes omitted) *from* V-Comm Report, § 3.2

V-Comm captured some of the results of this test in the following graph:

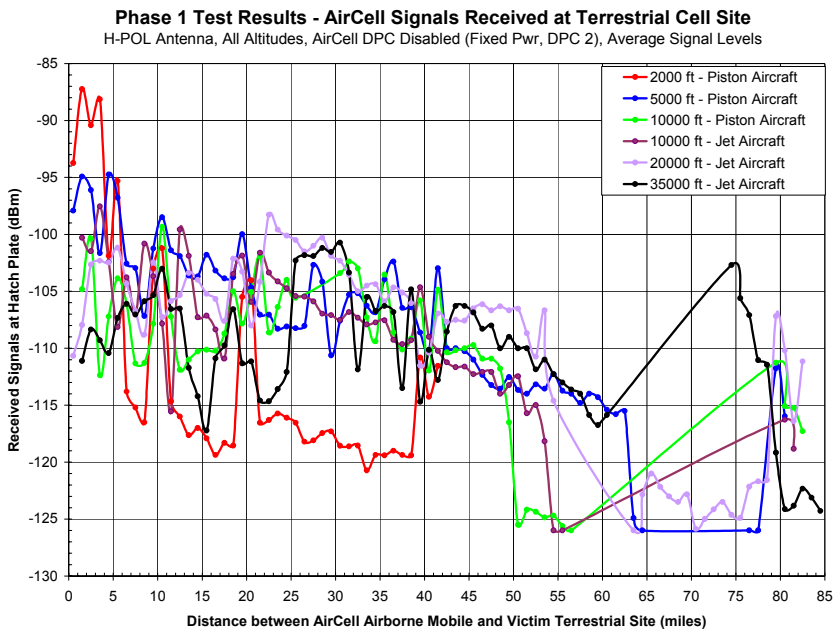

Figure 3.2-A, Phase 1 Test Results, RSSI at Terrestrial Site: H-POL Antenna, All Altitudes, DPC Disabled, *from* V-Comm Report, § 3.2

V-Comm made a number of important findings from the Phase 1 tests. It found that when the aircraft is closest to the terrestrial site (*i.e.,* 0-4 miles away), the strongest signals are received when the aircraft is at a low (2000 foot) altitude, with the signals in the -87 to -94 dBm

(footnote continued)

105 "The AirCell DPC function adjusts the mobile unit transmitting output power as a function of RSSI (received signal strength) from the serving AirCell site. The range of this variable is DPC=2 through 7, each step being a 4 dB decrement, with step 7 being lowest transmitting power, and step 2 being its maximum transmitting power. The AirCell phone transmit power levels are equal to approximately 75, 30, 12, 5, 2, and 0.75 mwatts, for DPC Level 2 through 7, respectively." V-Comm Report, § 3.3 n.24. For the tests without DPC, the DPC level was fixed at DPC level 2.

range, which would cause harmful interference to terrestrial service, even if the received strength is lowered due to the action of DPC. When the aircraft is farther away, the strongest signals are received from increasingly high altitudes, but still at strengths that are sufficiently strong to cause harmful interference even if lowered due to DPC (*e.g.,* at 5-21 miles, signals are received at -95 to -105 dBm from aircraft at 5000 feet, and at 22-54 miles, signals are received at -97 to -110 dBm from aircraft at 20,000 feet). At distances of 22 miles or more, the strongest signals are received from aircraft at the higher altitudes (20,000 and 35,000 feet). Even at considerable distances from the victim site, such as 75-80 miles, AirCell transmissions from high-altitude flights (20,000 and 35,000 feet) are received at very high, harmfully-interfering levels (-98 to -111 dBm) by a horizontally polarized terrestrial antenna.[106]

If DPC were employed, the received signal strength will be reduced by 4 dB for each DPC step beyond DPC 2 (75 mW), ranging down to DPC 7 (0.75 mW). The DPC level, however, is independent of the distance between the aircraft and the victim terrestrial site, because it is based on the mobile's signal strength as received at the AirCell site. V-Comm therefore prepared graphs illustrating how the received signal strength charts with DPC enabled would change if different DPC levels are used.[107]

V-Comm found that at the highest power levels (DPC 2 and 3), AirCell signals are similar in strength to typical terrestrial customer traffic (-94 to -113 dBm). "With this level of interference, terrestrial cellular customers will experience severely degraded C/I ratios (in some cases negative C/I values) causing significant harmful interference to the terrestrial network." Even at the lowest power level (DPC 7), "AirCell signals are also received at levels that are strong

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[106] V-Comm Report, § 3.2.

[107] *See id.,* Figs. 3.2-D, -E.

enough to cause harmful interference to the terrestrial system" — in the -114 to -129 dBm range — and at higher power levels (DPC 2-6), "the received AirCell signals are stronger, and the harmful interference to the terrestrial network is worse."[108]

a. Flight Tests with DPC Enabled

In the Phase 1 flight tests with DPC enabled, V-Comm collected data concerning the DPC levels employed (and thus the attenuation from maximum signal strength) at various flight altitudes and distances from the serving AirCell site. The AirCell site used (Marlboro, NJ) caps the DPC level at 3 (attenuated 4 dB from the maximum of DPC 2).[109] Thus, the DPC levels observed in this test varied from DPC 3 down to DPC 7.

The following chart illustrates the relative percentages of use of these DPC levels by the test flights using the Marlboro AirCell site:

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[108] V-Comm Report, § 3.2.

[109] V-Comm notes that AirCell optimizes the parameters of its ground stations on a site-to-site basis, and thus many AirCell sites are not capped at DPC level 3. For example, the Altoona, Pennsylvania site is not capped, so units served by that site can operate at maximum power, 4 dB higher than units served by the Marlboro site. V-Comm also observed that the received signal strength of mobiles served by the AirCell's Altoona, Oswego, N.Y., and Martinsburg, W.V. sites was typically 2 dB higher than that of mobiles served by the Marlboro site. Accordingly, the interference levels projected based on tests using the Marlboro are conservative; higher levels of interference can be expected from mobile units served by other sites. *See* V-Comm Report, § 7.6.

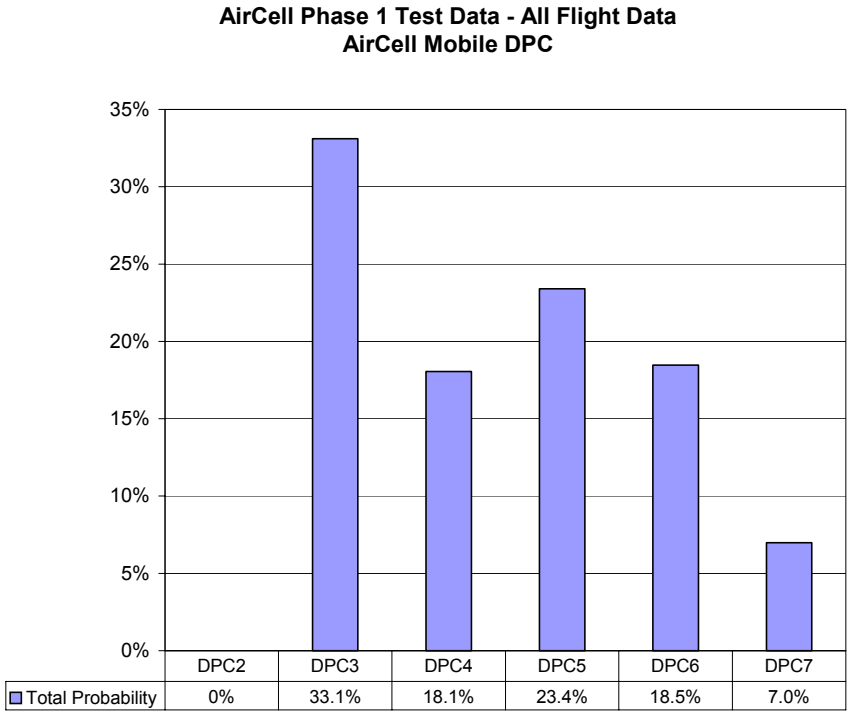

Figure 3.3-A, Phase 1 Test Results, AirCell Mobile DPC Percentages, DPC Enabled, *from* V-Comm Report, § 3.3

Other graphs in the V-Comm Report illustrate the correlation of DPC levels with the plane's distance from the serving AirCell site.[110]

V-Comm made a number of critical findings. First, "[t]he AirCell mobile unit was at its maximum power level more often than any other power level. . . [and] was at its lowest power level the least amount of time, compared to the other power levels. . . . There is a greater probability that the AirCell mobile unit will operate at its higher power levels." Second, "[t]he AirCell mobile power increases (lower DPC value) with increasing distance from its serving AirCell cell site. In general, the AirCell mobile transmits at lower power when closer to its serving cell site, and increases in power until it reaches maximum power at some distance away." Thus, AirCell is more likely to interfere with cellular systems that are not part of its network than

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110 *See* V-Comm Report, § 3.3, Figs. 3.3-B, -C.

those whose base stations it uses.[111] V-Comm summarized its other findings about the relationship between distance and AirCell transmit power as follows:

- At several altitudes . . . the maximum AirCell mobile transmit power . . . was attained within 10 miles or less from the serving AirCell Marlboro site.
- On average, maximum transmit power . . . was consistently maintained at distances approximately 55-60 miles from the serving AirCell site.
- On average, the lowest transmit power is typically reached close to the serving AirCell site, then higher power at distances of 10-30 miles, then lower power at distances of 30-45 miles, and finally increasing to maximum power at distances of 55+ miles from the serving AirCell site.
- The maximum range of the AirCell system is observed to be approximately 135 miles from the serving AirCell cell site, as observed in the flight test at 35,000 ft. The range of the AirCell system is observed to be between 72 to 93 miles from the serving AirCell cell site for flights at 4,000 and 5,000 ft., and between 97 to 106 miles for flights at 10,000 and 20,000 ft.[112]

Graphs in the V-Comm report indicate that AirCell signals are routinely received at high signal levels at terrestrial cellsites under varied conditions.[113] In short, V-Comm found that even after accounting for the effects of DPC, "AirCell signals received at the terrestrial cell sites are in the range of –102 to –130 dBm. In general, the stronger signals are received when the AirCell mobile phone is closer to the terrestrial cell sites and at higher power levels."[114]

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[111] V-Comm Report, § 3.3 ("[I]t is more likely to cause interference to terrestrial cellular systems in neighbor markets that are further away. The AirCell phone is more likely to transmit at lower power when it is close to its serving site and within its own market area.").

[112] V-Comm Report, § 3.3.

[113] *See* V-Comm Report, § 3.3, Figs. 3.3-D, -E, -F.

[114] V-Comm Report, § 3.3.

2. Phase 2 Test Results

The Phase 2 drive tests were performed at a cellsite operating normally during business hours, with actual cell-site noise levels and conditions: "The cell site is a typical suburban site co-located by Verizon Wireless and Cingular Wireless, within the Trenton MSA market, in Mercer County, NJ. In addition, three other cell sites surrounding the test cell site are also collocated by these carriers, or located nearby, and they have similar antenna configurations and coverage areas. The test cell site location allows for the testing of three technologies separately: AMPS, TDMA, and CDMA."[115] The analog (AMPS) test was performed by injecting an AirCell signal on the analog voice channel. The TDMA test was performed by injecting an AirCell signal on a TDMA channel containing one control and two voice timeslot channels. The CDMA test involved separate tests injecting one to three AirCell signals into the CDMA carrier and/or guard band.

a. The Analog Test

As shown in the graph below, the strength of the signal received during the test drive was similar to actual customers' received mobile signal strengths, measured over a 24-hour period.[116] Customers' signals are received at levels at or below -100 dBm about 45% of the time.[117] The noise floor levels at the test site were also measured over a 24-hour period, and the median noise floor was found to be -127 dBm; V-Comm notes that "[w]ith this noise floor level, AMPS cellular calls can operate at -110 dBm, with 'toll quality' (17 dB C/I). Any outside-system interfer-

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115 V-Comm Report, § 4.1.

116 V-Comm notes, however, that "at the lowest received signal levels for the terrestrial test sites, the drive route signal levels do not match the lowest customer signal levels. The lowest terrestrial customer signal levels are assumed to be used in-buildings with substantial building penetration losses and are not modeled in Phase 2 tests." V-Comm Report, § 9.9 n.59.

117 V-Comm Report, § 9.9.

ence that is received above -127 dBm has the potential to cause interference to AMPS terrestrial cellular calls operating at the -110 dB level."[118]

During the baseline test, with no injected AirCell signal, "Blocked and Dropped Calls are 0%, average MOS [(Mean Opinion Score, a measure of audio signal quality)] is 3.3, median C/I [(carrier to interference ratio, a measure of RF signal quality)] is 30 dB, 90% [90th percentile] C/I is 20 dB, and MOU is 37.6 minutes (0% Capacity Loss) for the drive test. The median operating AMPS noise floor of the suburban test site is -127 dBm, as measured over a 24 hour period . . . ."

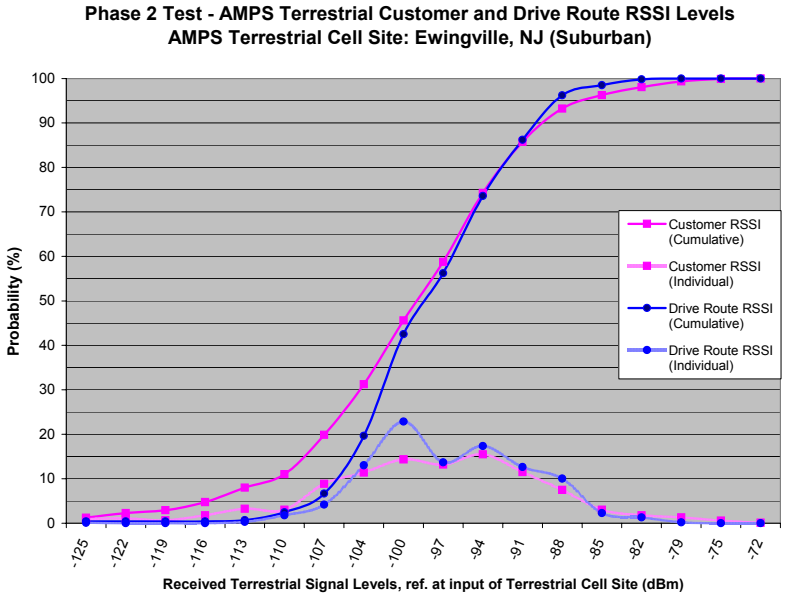

Figure 9.9-C, Phase 2 Test Results: AMPS Terrestrial Customer and Drive Route RSSI Levels, *from* V-Comm Report, § 9.9

One measure of the effect of interference is RF quality — *i.e.,* how AirCell signals affect the C/I ratio of terrestrial traffic. V-Comm found "no effect or performance degradation" when

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118 V-Comm Report, § 4.2; *see also id.,* § 9.9. C/I is the carrier-to-interference ratio. This indicates how greatly the strength of the desired signal exceeds that of the interfering signals. In the following discussion, the source of all quotations and statistics, except as otherwise indicated, is V-Comm Report, § 4.2.

AirCell signals were injected at -126 dBm, but it found that the C/I ratio of the terrestrial signal began to degrade when the AirCell signal reached -123 dBm. The median C/I is reduced to 26 dB, a 4 dB degradation from the 30 dB median C/I baseline, and the 90th percentile C/I is reduced to 18 dB, a 2 dB degradation from the 20 dB baseline. While this level of interference will not affect most typical calls significantly, V-Comm notes that "many terrestrial cell sites serve customers near their minimum acceptable levels of C/I, and a 4 dB degradation in C/I will cause a reduction in call quality and dropped calls." [119] The 90th percentile graph is shown below:

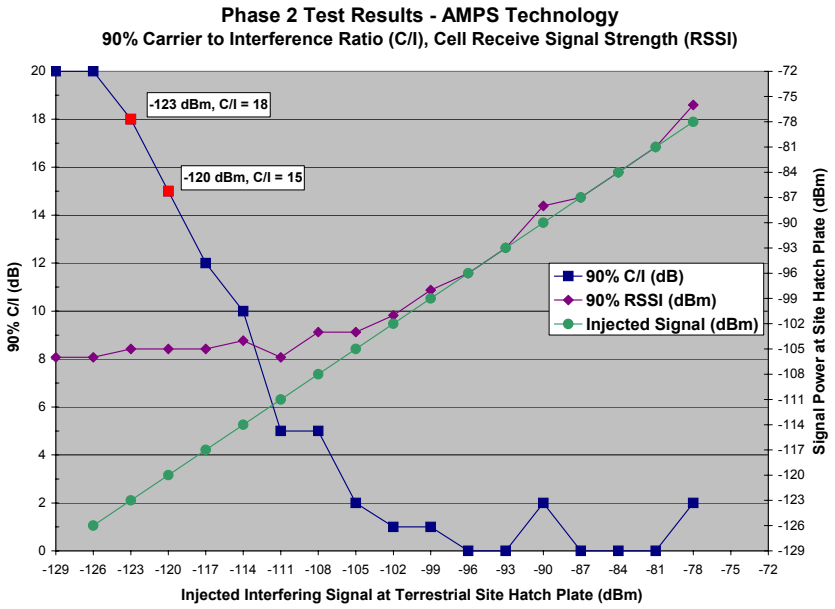

Figure 4.2-B, Phase 2 Test Results: AMPS 90% Carrier to Interference Ratio, *from* V-Comm Report, § 4.2

Graphs such as this show that the effects of AirCell interference become more pronounced as the received strength of the injected AirCell signal increases above -123 dBm. At -120 dBm, the 90th percentile C/I ratio drops to 15 dB, which represents an impairment of 2 dB

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[119] V-Comm notes that the 90th percentile C/I, which "represents the level of C/I performance that can be expected 90% of the time, for all customers[,] . . . is commonly used . . . to determine acceptable levels of coverage and system performance." V-Comm Report, § 4.2 n.35.

below the 17 dB C/I ratio most cellular systems are designed to deliver and 5 dB of impairment from the baseline 90% C/I without any AirCell signal. At -117 dBm, the AirCell signal causes the 90th percentile C/I ratio to drop to 12 dB, 5 dB below the 17 dB standard and 8 dB below the baseline. By the time the injected AirCell reaches -111 dBm, the 90th percentile C/I ratio drops to 7 dB, 13 dB below the baseline and 10 dB below the standard.[120]

The audio quality of the terrestrial signal, as measured by Mean Opinion Score ("MOS"), also degrades below the baseline of 3.3, as shown below. V-Comm notes that:

> MOS audio quality performance declines slightly from -120 to -117 dBm, however the MOS degrades noticeably at -114 dBm, and drops off sharply above that level. The 90% MOS declines below "good" audio quality, at an interference level of -120 dBm, to a MOS 2.5 for 10% of the MOS readings.
>
> At the -114 dBm injected level, the average MOS degrades by 0.2 units, . . . to a level of MOS 3.1. . . . The MOS 3.25 threshold is the minimum level for "acceptable good" quality and below this audio quality level is considered "fair." . . . At the -114 dBm injected signal level, the MOS is 3.1, . . . the audio quality . . . is degraded and harmful interference is occurring.

---

[120] The median C/I ratios decline as well. *See* V-Comm Report, § 4.2, Fig. 4.2-A. This is not as useful in determining the overall quality of service that can be expected as the 90th percentile C/I ratio, because by definition this is the quality level encountered by terrestrial traffic only half the time, while half is below this level. It does, however, show that the effects of AirCell signals will be felt by most terrestrial cellular customers, although the "typical" (*i.e.,* median) call will not be as hard-hit as the weakest 10% of calls, which is what the 90 percentile C/I ratio addresses. For example, an injected AirCell signal at -111 dBm will cause half of all calls' quality to degrade from the 30 dB C/I quality level without AirCell interference to -114 dB C/I, a 16 dB impairment, and 3 dB below the 17 dB standard of acceptability. The 90th percentile graph in Figure 4.2-B (reproduced above), on the other hand, shows that this level of AirCell signal strength will have a devastating effect on the service quality the customers can expect 90% of the time, namely a 10 dB C/I ratio.

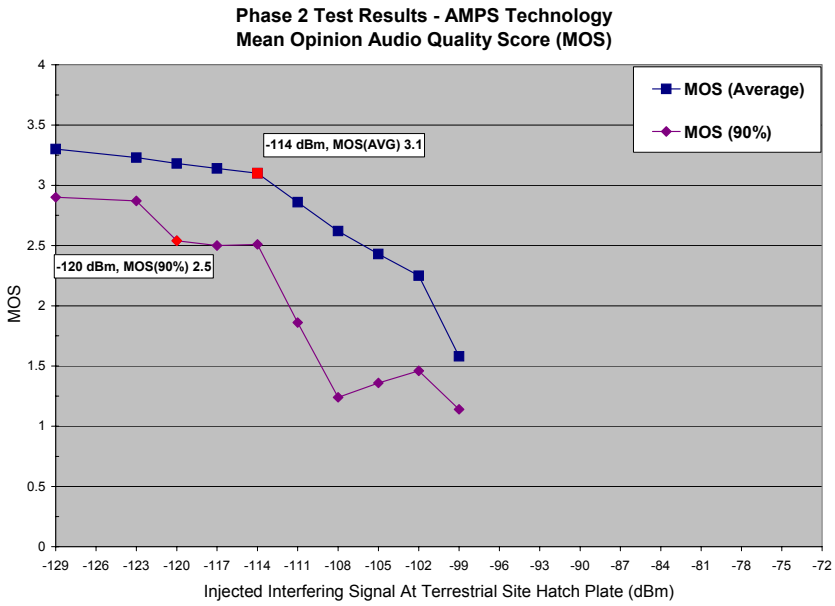

Figure 4.2-C, Phase 2 Test Results: AMPS Mean Opinion Audio Quality Score, *from* V-Comm Report, § 4.2

Finally, after AirCell signals have seriously impaired the RF and audio quality of terrestrial service, they begin causing dropped calls and interruptions in service (*i.e.,* a loss in capacity, measured in minutes of use). In the analog drive test, this began with AirCell signals of -108 dBm, which caused 4% of calls to be dropped and resulted in a 5% loss of capacity, and got much worse as the signal strength increased, as shown in the following graph:

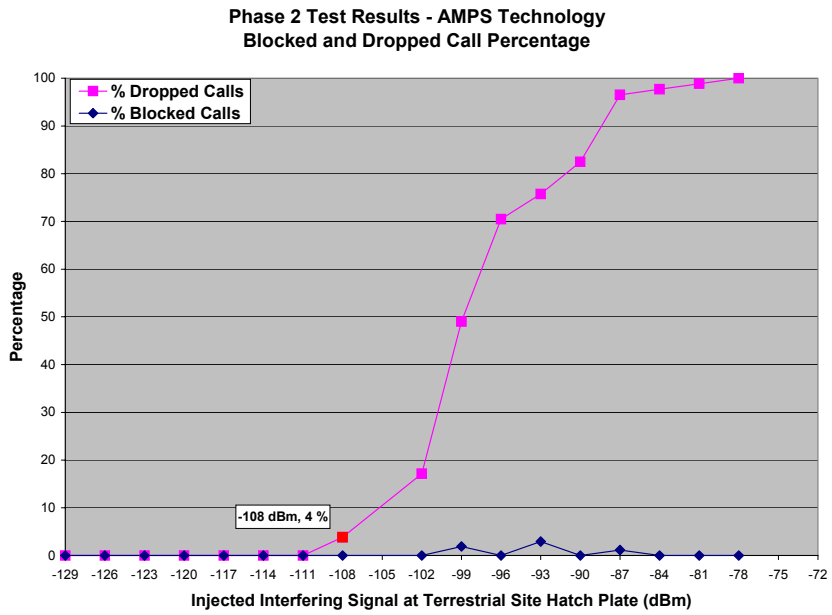

Figure 4.2-D, Phase 2 Test Results: AMPS Blocked and Dropped Call Percentage, *from* V-Comm Report, § 4.2

V-Comm's conclusions concerning the Phase 2 analog drive test are as follows:

> In conclusion, the Phase 2 test results indicate performance degradations and harmful interference to terrestrial cellular service in AMPS technology tests. At levels from -123 dBm to -117 dBm, the harmful interference degrades the performance of terrestrial AMPS cellular service for cell sites and calls operating at their minimum performance levels. At these levels, the harmful interference is expected to occur at terrestrial cell sites with larger coverage radius than the suburban test site, which are serving terrestrial mobiles at lower signal levels. In addition, this is expected to cause harmful interference to terrestrial in-building cellular calls, which operate at lower signal levels due to the signal path attenuation of the building structure. This effect is particularly significant, as the trend for terrestrial cellular phone use in-buildings is increasing.
>
> At the level of -114 dBm, the harmful interference degraded the performance of AMPS cellular service provided by the suburban test cell site. The test cell site is a typical suburban cell site, which has a coverage radius of 1.5 miles. Terrestrial cell sites with larger coverage areas, or those serving in-building calls, can expect greater signal path loss, lower received signal levels, and harmful interference that occurs with interfering signals at lower levels than the test cell site. In these cases, harmful interference to AMPS cel-

> lular service is expected to occur below the -114 dBm level, and within the -117 to -123 dBm range.

b. The TDMA Test

V-Comm's Phase 2 tests also showed AirCell will cause harmful interference to TDMA cellular networks: "The Phase 2 test results indicate performance degradations and harmful interference to the terrestrial cellular service in TDMA technology tests. The degradation is first observed with Carrier to Interference (C/I) Ratio, and then in Dropped Calls, Bit Error Rate (BER), Mean Opinion Audio Quality Score (MOS), and Minutes of Use (MOU)."[121]

In the Phase 2 TDMA test, as in the analog test, the received drive test signal strength was a good proxy for customer signal strength data.[122] Likewise, the measured noise floor was -127 dBm.[123] As a result, V-Comm noted, "TDMA cellular calls can operate at -110 dBm, with "toll quality" (17 dB C/I). Any outside-system interference that is received above -127 dBm has the potential to cause interference to terrestrial TDMA cellular calls operating at the -110 dB level." In fact, customers' signals are received at levels of -100 dBm or below about 60% of the time.[124] During the baseline drive test, with no AirCell signal injected, "Blocked and Dropped Calls are 0%, average MOS is 3.6, average BER is 0.1%, median C/I is 25 dB, 90% C/I is 15 dB, and MOU is 35.9 minutes (0% Capacity Loss) for the drive test."

V-Comm observed that:

> In the TDMA tests results with interfering signal levels in the range of -126 to -123 dBm, there is no effect or performance degradation that is observed at the terrestrial suburban test cell site. In

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[121] V-Comm Report, § 4.3. This is the source of all quotations and statistics in this section, except as otherwise indicated.

[122] *See* V-Comm Report, § 9.9, Fig. 9.9-D. As with the analog data, the TDMA drive test signal strengths did not extend as low as customer signal strengths, because the drive test did not include in-building usage. *See* note 116 above; V-Comm Report, § 9.9 n.56.

[123] *See* V-Comm Report, § 9.9 & Fig. 9.9-B.

[124] *See* V-Comm Report, § 9.9.

these tests, the performance of the terrestrial cell site is similar to the performance of the baseline test.

In the test results the C/I performance degrades at the -120 dBm level. At this injected signal level, the median C/I is 22 dB, and the 90% C/I is 13 dB. At this level, the AirCell signal would degrade the terrestrial system from the baseline (normal performance) test, and result in a reduction of C/I of 3 dB (for median) and 2 dB (for 90%). This 3 dB degradation in C/I is significant and can cause harmful interference to many cell sites within the cellular system. Many terrestrial cell sites serve customers near their minimum acceptable levels of C/I, and a 3 dB degradation in C/I will cause a reduction in call quality and dropped calls.

This degradation is readily apparent in the following graph of a TDMA call's C/I ratio at increasing levels of interference:

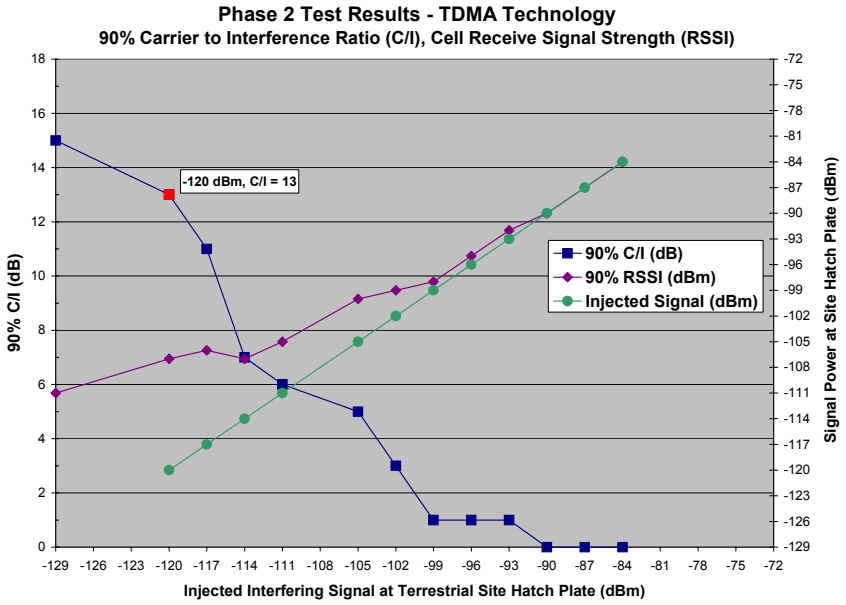

Figure 4.3-B, Phase 2 Test Results: TDMA 90% Carrier to Interference Ratio, *from* V-Comm Report, § 9.9

Next, degradation occurs in BER and MOS. V-Comm notes:

[T]he TDMA BER performance begins to degrade at the injected signal level of -117 dBm. The test results indicate a 0.5% increase in BER at -117 dBm, a 1% increase in BER at -114 dBm, over the baseline test with no injected signals. . . . The 0.5% and 1% increase in TDMA BER . . . is significant and can cause harmful interference to many cell sites within the cellular system. Many terrestrial cell sites serve customers near their minimum acceptable

levels of BER, and this performance degradation will cause a reduction in call quality. Also, , at the -117 dBm level, the percentage of service below 1% BER threshold drops by 18%, from the base line test.

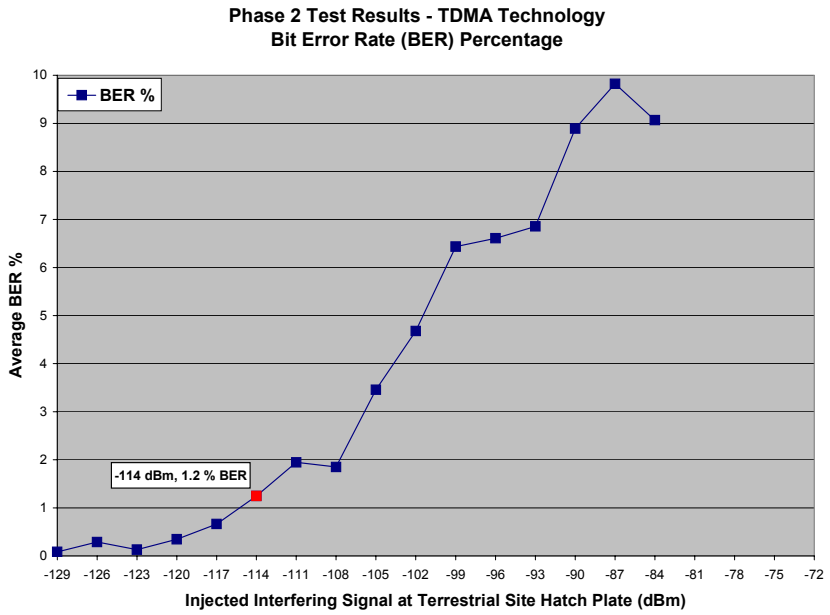

Figure 4.3-C, Phase 2 Test Results: TDMA Bit Error Rate Percentage, *from* V-Comm Report, § 4.3

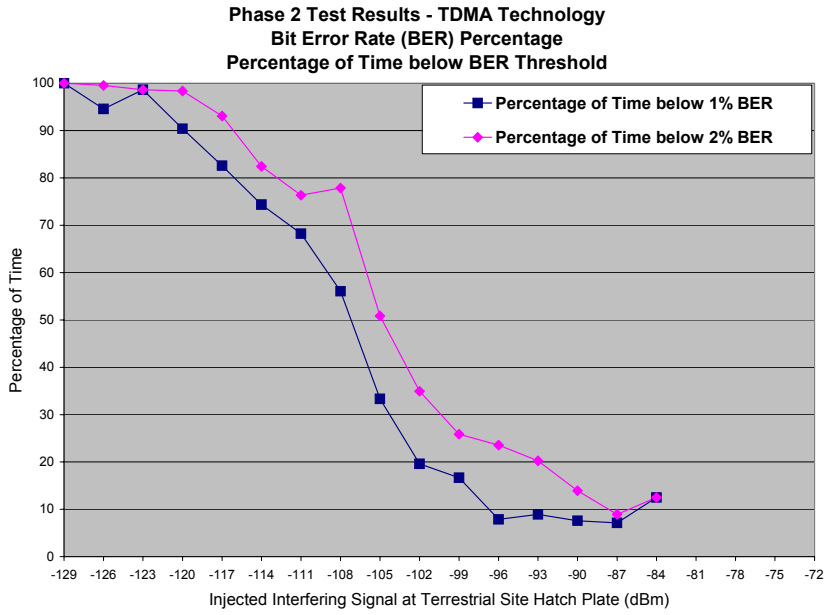

Figure 4.3-D, Phase 2 Test Results: TDMA Bit Error Rate - Percentage of Time below BER Threshold, *from* V-Comm Report, § 4.3

The audio quality, measured in MOS, begins to decline significantly at -114 dBm and gets rapidly worse at -105 dBm:

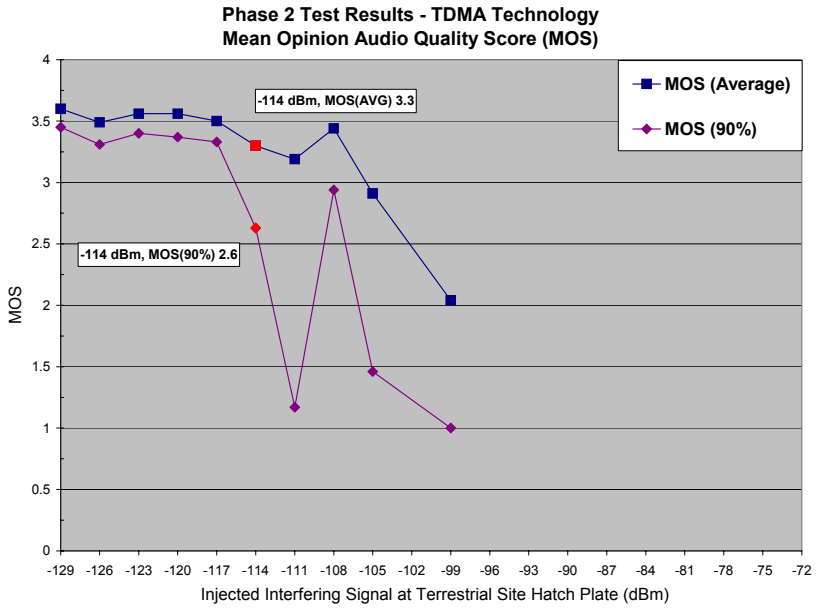

Figure 4.3-E, Phase 2 Test Results: TDMA Mean Opinion Audio Quality Score, *from* V-Comm Report, § 4.3

Further increases in AirCell received signal strength result in blocked or dropped calls and capacity impairments in addition to the foregoing impairments. V-Comm explains:

> At the -114 dBm injected signal level, the harmful interference results in a Blocked Call percentage of 4%, and a 7.3% reduction in Minutes of Use (Capacity Loss) for the drive route. At this level, the median C/I is 15 dB, the 90% C/I is 7 dB, the BER is 1.2%, 25% of BER readings are greater than 1% BER, and the average MOS is 3.3, and the 90% MOS is 2.6. At this level, the average MOS degrades by 0.3 units, below the previous tests at lower injected signal levels. At this level, the harmful interference causes serious obstructions to TDMA service; causing 4% of the TDMA call attempts to fail, and results in a 7.3% reduction in usage.
>
> At the -111 dBm injected signal level, the harmful interference results in a Blocked Call percentage of 7.4%, and a 7.5% reduction in Minutes of Use (Capacity Loss) for the drive route. At this level, the median C/I is 14 dB, the 90% C/I is 6 dB, the average BER is 2%, 32% of BER readings are greater than 1% BER, the average MOS is 3.2, and the 90% MOS is 1.2. At this level, the average MOS has degraded below the minimum level for accept-

> able "good" quality audio. At this level, the harmful interference causes serious obstructions and degradations to TDMA service; causing 7.4% of the TDMA call attempts to fail, degraded voice quality, and results in a 7.5% reduction in usage.
>
> At the -108 dBm injected signal level, the harmful interference results in a Blocked Call percentage of 28%, a Dropped Call percentage of 50%, a 30% reduction in Minutes of Use (Capacity Loss) for the drive route, and the percentage of service below 1% BER threshold drops by 43%, from the base line test. . . . At this level, there is a significant loss of coverage area that no longer serves the test mobile. The calls only go through when the test mobile is closer to the cell site, and the path loss is less. At injected signals levels above the -108 dBm level, the Dropped Calls begin to taper off due to the fact that the number of calls being blocked are increasing and thus the opportunity to drop the call is not occurring. The baseline test results with no injected signals has a performance of 0% Blocked Calls and 0% Dropped Calls. Above the -105 dBm injected signal level, the test equipment has difficulty computing the MOS values as the interference causes significant deterioration in audio quality.

The following graphs illustrate the dramatic increase in blocked/dropped calls and the decrease in capacity:

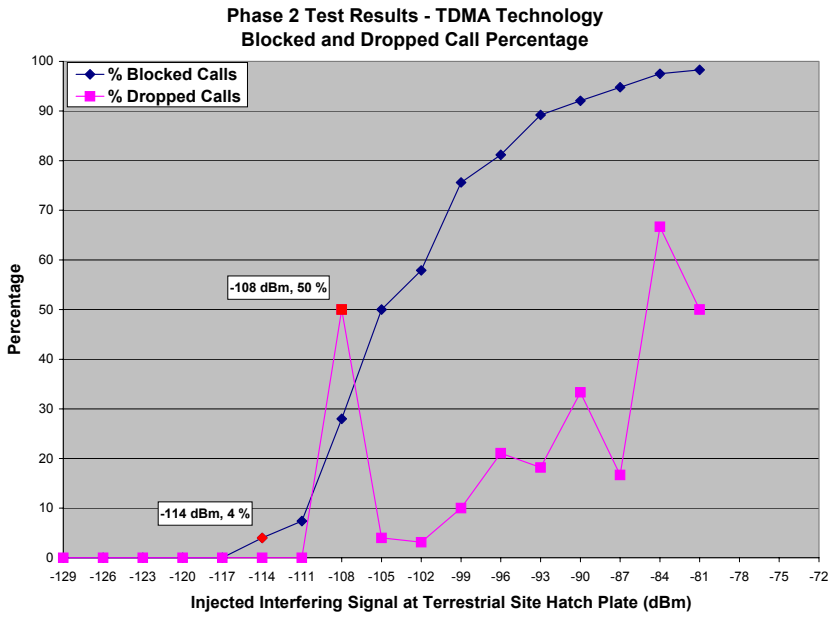

Figure 4.3-F, Phase 2 Test Results: TDMA Blocked and Dropped Call Percentage, *from* V-Comm Report, § 4.3

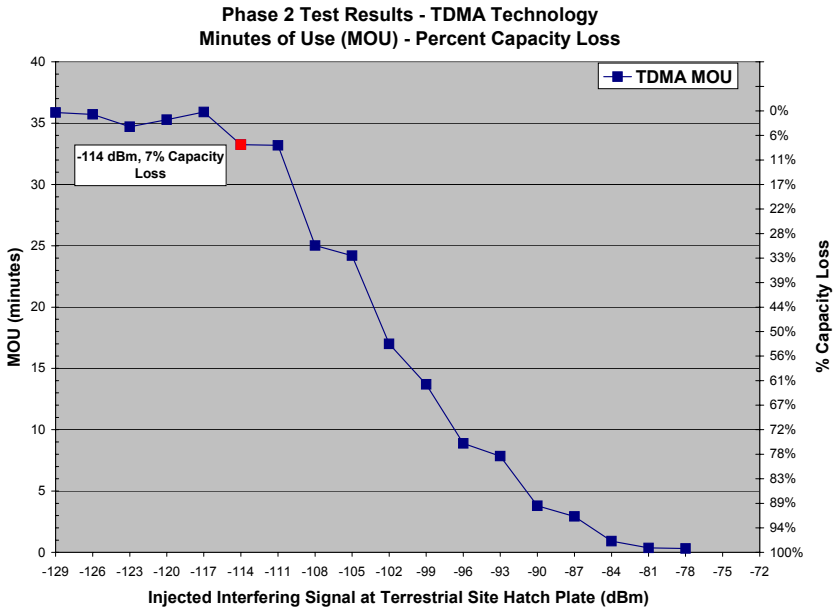

Figure 4.3-G, Phase 2 Test Results: TDMA Minutes of Use,
from V-Comm Report, § 4.3

V-Comm makes the following conclusions regarding AirCell's interference potential to TDMA systems:

> In conclusion, the Phase 2 test results indicate performance degradations and harmful interference to terrestrial cellular service in TDMA technology tests. At levels of -120 dBm to -117 dBm, the harmful interference degrades the performance of terrestrial TDMA cellular service for cell sites and calls operating at their minimum performance levels. At levels of -120 dBm to -117 dBm, the harmful interference is expected to occur at terrestrial cell sites with larger coverage radius than the suburban test site, which are serving terrestrial mobiles at lower signal levels. In addition, this is expected to cause harmful interference to terrestrial in-building cellular calls, which operate at lower signal levels due to the signal path attenuation of the building structure. This effect is particularly significant, as the trend for terrestrial cellular phone use in-buildings is increasing.
>
> At levels of -114 dBm, the harmful interference causes serious obstructions and degradations to TDMA cellular service provided by the suburban test cell site. The test cell site is a typical suburban cell site, which has a coverage radius of 1.5 miles. Terrestrial cell sites with larger coverage areas, or those serving calls in-buildings, can expect greater signal path loss, lower received signal levels, and harmful interference that occurs with interfering signals at

> lower levels than the test cell site. In these cases, harmful interference to TDMA cellular service is expected to occur below the -114 dBm level, and within the -117 to -120 dBm range.
>
> In cases of harmful interference to TDMA digital control channels, the effects are worse. In addition to affecting two timeslots carrying voice traffic, harmful interference to the digital control channel can block all new calls on the cell site sector. For TDMA subscribers in the area, this can result in the inability to make calls within this sector, including all calls made to 911 and other emergency telephone calls.[125]

c. The CDMA Test

Because a CDMA system responds to interference by automatically increasing mobile transmit power in real time, the C/I ratio is not a useful metric for assessing the effects of interference. In the CDMA drive test, therefore, increases in the terrestrial mobile unit's transmit power are the initial measure of interference, representing an increase in system noise floor and thus causing degradation of coverage, capacity, and quality of service. The principal metrics used to assess the effects of interference in the CDMA test are Blocked, Dropped and Overflowed Calls, Minutes of Use (MOU), and Bit Energy per Noise (EbNo). In the baseline test, with no injected AirCell signal, the mobile transmit power was 6.7 dBm, blocked and dropped calls were 0%, overflowed Calls were 0%, Eb/No was 6.8 dB, and MOU was 35.8 minutes (0% capacity loss).[126] As noted above, several variations of the CDMA test were performed, with 1 to 3 AirCell signals injected into the CDMA channel and/or guard band.

---

[125] V-Comm also notes that "[i]n cases of harmful interference to TDMA voice channels, the interference can affect up to 3 calls at a time. TDMA cellular systems utilize 3 timeslots on each radio channel. TDMA system operators assign voice channels and digital control channels for each cell site and sector. TDMA radio channels assigned with only voice channels have three timeslots for voice traffic. TDMA radio channels assigned with digital control channels have one timeslot for the digital control channel, and two for voice traffic." V-Comm Report, § 4.3.

[126] Except as otherwise indicated, the source of all quotations and statistics in this section is V-Comm Report, § 4.4.

In the drive tests, V-Comm found no effect or performance degradation with AirCell signals injected into the CDMA channel at levels of -126 to -123 dBm; mobile transmit power increased only insignificantly over the baseline. When a stronger interfering signal is injected, the mobile transmit power increases significantly:

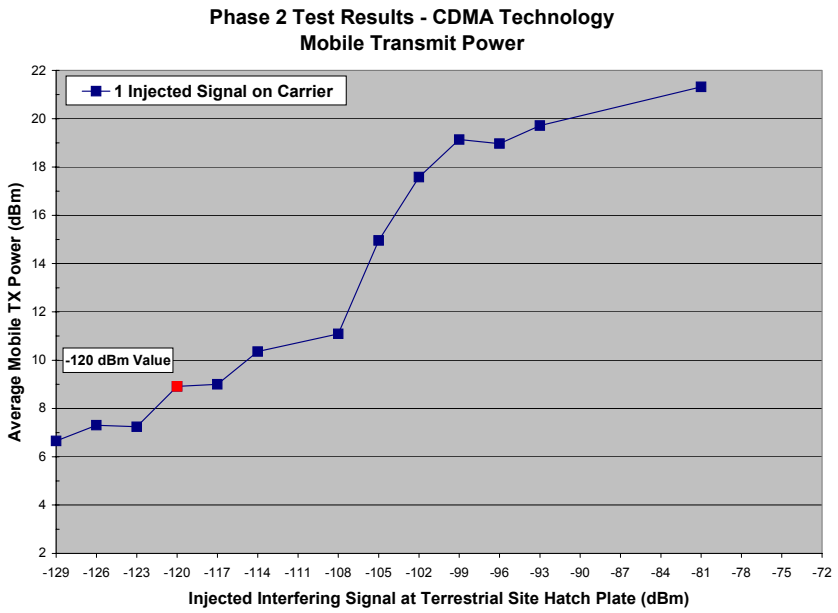

Figure 4.4-A, Phase 2 Test Results: CDMA Mobile Transmit Power, 1 Injected Signal on Carrier, *from* V-Comm Report, § 4.3

It can be seen that at -120 dBm, the mobile transmit power increases by 1.6 dB, and at -114 dBm, the mobile transmit power increases by 3.1 dB. These power increases indicate that the operating noise floor of the CDMA system has increased, which causes degradation of performance by reducing the "system coverage, capacity and quality of terrestrial calls served by the CDMA carrier." V-Comm points out that:

> In CDMA systems, small increases in operating noise floors can have dramatic effects, degrading the performance of the CDMA cellular network and its ability to provide coverage, capacity, and acceptable call quality levels. At the -120 dBm interfering level, the 1.6 dB increase in mobile transmit power is significant and will cause harmful interference to many cell sites within the terrestrial cellular network; causing increased operating cell site noise floors, degradation in call quality, and dropped calls.

Moreover, the effects of an increased noise floor can affect up to 20 calls in a given cell and channel simultaneously, as well as affecting other calls in soft handoff mode. In addition, the interference can affect multiple cells and sectors, as the same CDMA channel is used in all sectors and cells. An increase in mobile transmit power in one sector or cell due to external interference can, in turn, increase the noise floor in the adjacent sectors or cells, thereby causing mobile transmit power to be increased there, as well. V-Comm notes that the result is that "[w]ith the increasing noise floor in the surrounding area, all sectors in the area will experience the effects of the interference, regardless of their antenna azimuth orientation to the airborne AirCell mobile."

In tests with a single AirCell signal injected into the CDMA carrier with a 3 dB system loading condition, there were many indicators that seriously harmful interference occurs. As the graphs below indicate, blocked calls reach 11% with a -111 dBm interfering signal, and system capacity is impaired by 33.4% with an interfering signal at -108 dBm.

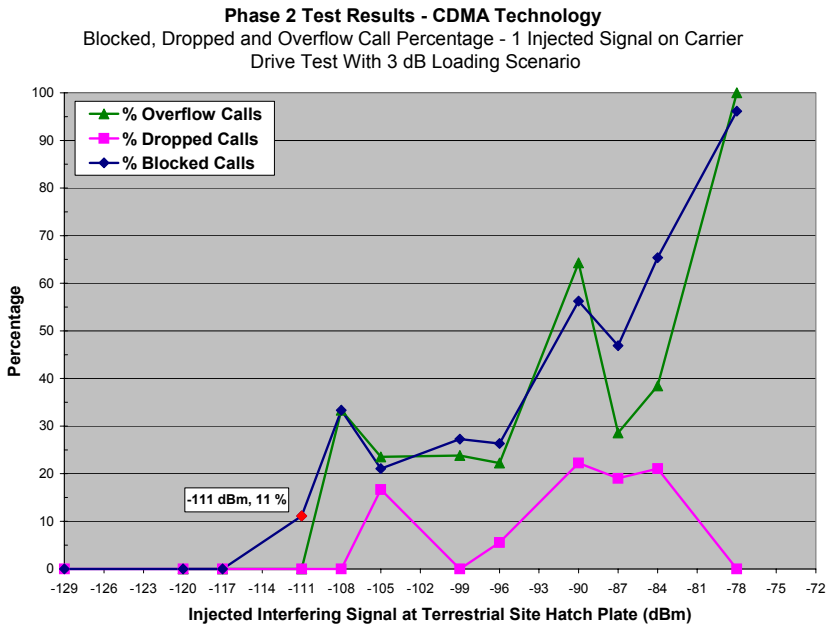

Figure 4.4-B, Phase 2 Test Results: CDMA Blocks, Drops, and Overflow, 1 Injected Signal on Carrier, 3 dB Loading, *from* V-Comm Report, § 4.3

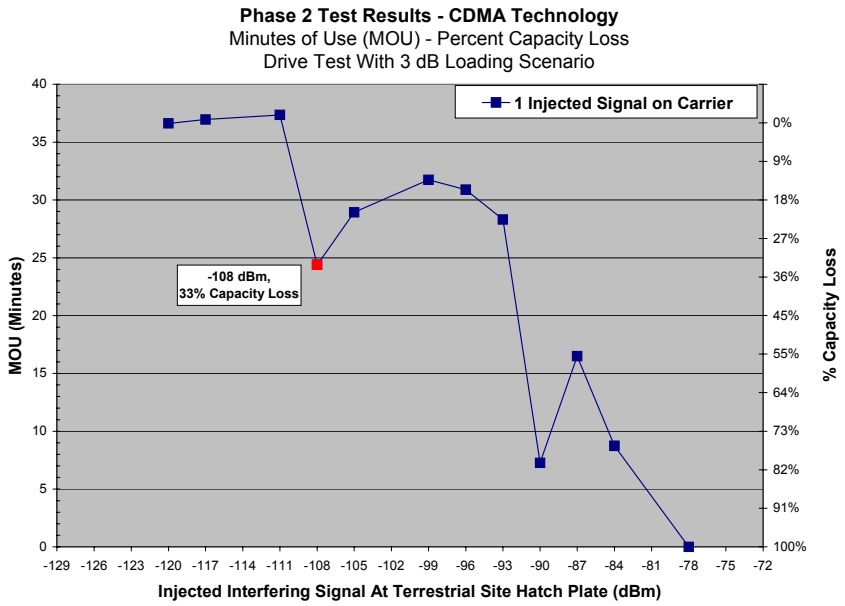

Figure 4.4-C, Phase 2 Test Results: CDMA Minutes of Use, 1 Injected Signal on Carrier, 3 dB Loading, *from* V-Comm Report, § 4.3

These and the other CDMA drive test results[127] confirm that an AirCell signal can cause harmful interference to CDMA system performance under a variety of conditions. V-Comm concludes:

> [T]he Phase 2 test results indicate performance degradations and harmful interference to the terrestrial cellular service in CDMA technology tests. At the -120 dBm level, the harmful interference degrades the performance of terrestrial CDMA cellular service by raising its operating noise floor. For CDMA cell sites, this translates to reduced coverage, capacity, and call quality. At this level, the harmful interference is expected with terrestrial cell sites in suburban, rural, and quiet rural markets with larger coverage radius and mobiles operating at higher transmit power levels, than the suburban test site. In addition, this is expected to cause harmful interference to terrestrial in-building cellular calls, which operate at higher mobile transmit power levels due to the increased signal path attenuation of the building structure. This effect is particularly significant, as the trend for terrestrial cellular phone use in-buildings is increasing.

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127 *See* V-Comm Report, §§ 9.10-9.12.

> At the -111 dBm level, a single injected signal on the carrier causes harmful interference that seriously obstructs and degrades CDMA cellular service provided by the suburban test cell site. The test cell site is a typical suburban cell site, which has a coverage radius of 1.5 miles. Terrestrial cell sites with larger coverage areas, or those serving calls in-buildings, can expect greater signal path loss, higher mobile transmit power levels, and harmful interference that occurs with interfering signals at lower levels than the test cell site. In these cases, harmful interference to CDMA terrestrial cellular service is expected to occur below the -111 dBm level, and within the -114 to -120 dBm range.

d. Summary of the Phase 2 Test Results

V-Comm observed that performance degradation and interference began occurring in the AMPS test at -123 dBm (a 4 dB decrease in C/I) and in the TDMA and CDMA tests at -120 dBm (a 3 dB decrease in TDMA C/I and a 1.6 dB increase in CDMA mobile transmit power). V-Comm noted that the tests were performed at a relatively compact suburban cellsite, and that the effects of interference would be greater on cellsites serving a larger area or serving a high percentage of in-building users, under all three technologies.[128] It summarized the results of the Phase 2 tests as follows:

Injected Interfering Signal Level	AMPS Tests – Effects to System Performance	TDMA Tests – Effects to System Performance	CDMA Tests – Effects to System Performance
Baseline, with no injected interference	Reference Level	Reference Level	Reference Level
-126 dBm	"No effect"	"No effect"	"No effect"
-123 dBm	C/I 4 dB dec.	"No effect"	"No effect"
-120 dBm	C/I 7 dB dec. MOS 0.1 dec.	C/I 3 dB dec. BER 0.2% inc.	Tx Pwr 1.6 dB inc.
-117 dBm	C/I 9 dB dec. MOS 0.2 dec.	C/I 5 dB dec. BER 0.5% inc.	Tx Pwr 1.7 dB inc.
-114 dBm	C/I 12 dB dec. MOS 0.2 dec.	C/I 10 dB dec. BER 1.1% inc.	Tx Pwr 3.1 dB inc.

[128] *See* V-Comm Report, § 4.5.

		MOS 0.3 dec. Blocked Calls 4% Capacity Loss 7%	
-111 dBm	C/I 16 dB dec. MOS 0.4 dec.	C/I 11 dB dec. BER 1.8% inc. MOS 0.4 dec. Blocked Calls 7% Capacity Loss 8%	Tx Pwr 3.5 dB inc. Blocked Calls 11%
-108 dBm	C/I 17 dB dec. MOS 0.7 dec. Dropped Calls 4% Capacity Loss 5%	C/I 12 dB dec. BER 1.7% inc. MOS 0.2 dec. Blocked Calls 28% Dropped Calls 50% Capacity Loss 30%	Tx Pwr 3.8 dB inc. Blocked Calls 33% Overflowed Calls 33% Capacity Loss 33%

Table 4.5-A, Phase 2 Test Results – Summary Results Table
(footnotes omitted), *from* V-Comm Report, § 4.5

C. The V-Comm Case Study Shows AirCell Interference Will Have Widespread Effects on Terrestrial Cellular Operations

At any given time, an AirCell mobile unit will have many terrestrial cellsites in its line of sight, depending on its altitude and the cellular network layout. Moreover, interference from an AirCell unit in motion potentially affects many additional cells as the plane moves along its flight path. In densely populated areas with high levels of air traffic, flight paths are not limited to a narrowly defined corridor; planes fly virtually everywhere. As a result, no cellsite is immune to potential AirCell interference. In the graphic below, an FAA chart of flight tracks in the greater New York area has been overlaid with the location of cellsites to illustrate this.

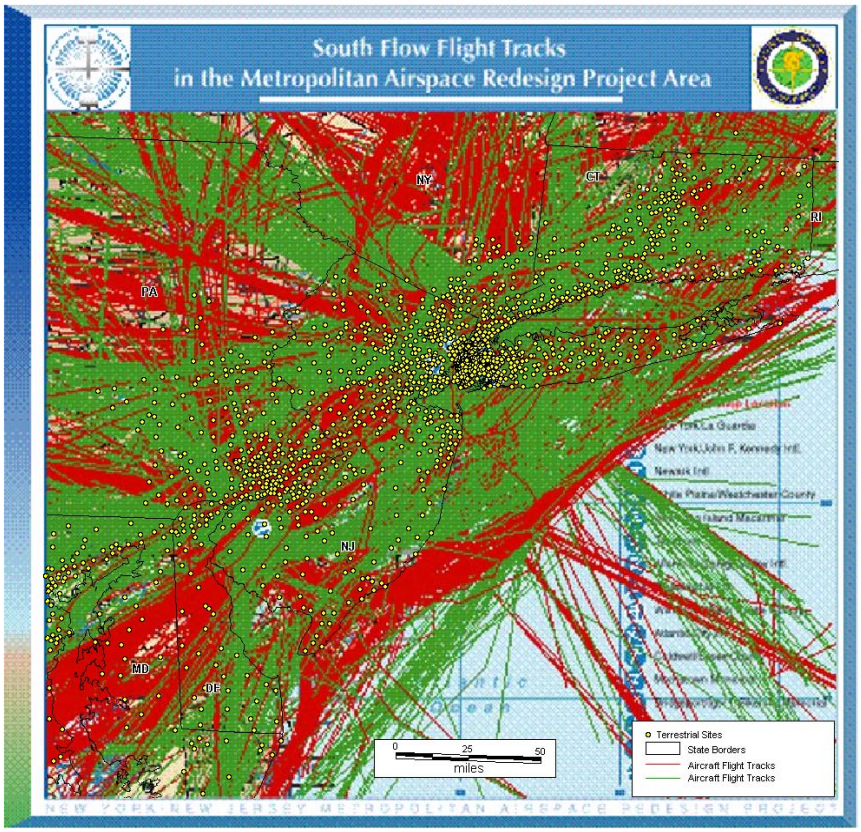

Figure 5.3-B, Regional FAA Aircraft Flight Tracks & Terrestrial Cell Sites, *from* V-Comm Report, § 5.3

After researching the typical parameters of a flight in this region, V-Comm devised a case study that examines a flight between Dulles Airport and Teterboro Airport in the New York metropolitan area. Both of these airports are heavily used by general aviation, and the selected flight path has about 113 commercial flights daily. Accordingly, this flight path is representative of both general aviation and commercial aircraft.[129] The flight path is shown below, superimposed over the terrestrial cell sites in the flight corridor.

[129] *See* V-Comm Report, § 6.2.1.

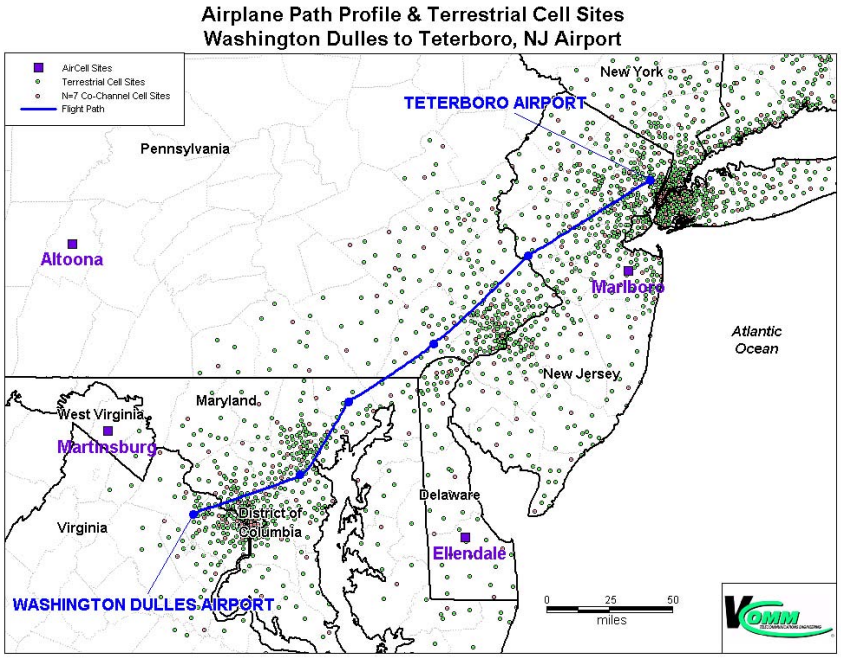

Figure 6.3-A, Airplane Path Profile & Terrestrial Cell Sites,
from V-Comm Report, § 6.3

V-Comm modeled the scope of AirCell interference on the terrestrial cellsites along the flight corridor based on two alternative scenarios: a jet aircraft reaching a cruising altitude of 19,000 feet and a piston engine (propeller) aircraft reaching a cruising altitude of 7,000 feet.[130] Over 2500 terrestrial cellsites are within the line of sight of the flights.[131]

The case study uses the Phase 1 data to determine the signal strength of an AirCell call from the airplane as received at terrestrial cells from various waypoints along its flight path. An Interference Analysis Point based on the Phase 2 data is used to assess the effect of these signals on the terrestrial cells. For purposes of this study, V-Comm selected -114 dBm as its IAP. This represents "the level at which an interfering signal has an undisputed effect on all technologies (AMPS, TDMA, & CDMA), and causes significant harmful interference to terrestrial cellular

130 *See id.,* Figs. 6.2-A, -B (profiles of altitude vs. time, distance).

131 *See* V-Comm Report, § 6.2.1. Figure 6.3-A depicts 2,681 cellsites. *See id.,* § 6.2.2.

service. . . . At this level, regardless of technology chosen, significant harmful interference will occur, thereby degrading terrestrial cellular system performance."[132] V-Comm then plotted, for each of the ten waypoints, a "circle of interference" showing the cells that would receive this level of interference. When the circles are connected, the resulting corridor depicts the cellsites that would receive AirCell signals sufficient to cause harmful interference.

The results of V-Comm's case study for the jet aircraft are reproduced below, showing the cellsites that would receive harmful interference (based on the IAP) from an AirCell call lasting throughout the flight's ascent, cruising at full altitude, and descent. The first shows the cellsites that would be affected by 90 percentile -114 dBm AirCell signal levels if all sites used slant-45 receive antennas, which are more and more frequently deployed. The second shows the ones that would be affected if they all used the more traditional vertically polarized antennas.[133]

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[132] V-Comm Report, § 6.2.3 (footnote omitted). V-Comm notes that a lower figure could have been used for the IAP, in which case more cellsites and calls would have been affected. For the alternative use of a *higher* threshold for the IAP, see Section III.E, below.

[133] Piston aircraft would have a somewhat reduced interference range than the jet aircraft. *Compare* V-Comm Report, § 9.16, Fig. 9.16-B (jet aircraft, horizontally-polarized receive antenna) *with id.,* Fig. 9.16-G (piston aircraft, horizontally-polarized receive antenna).

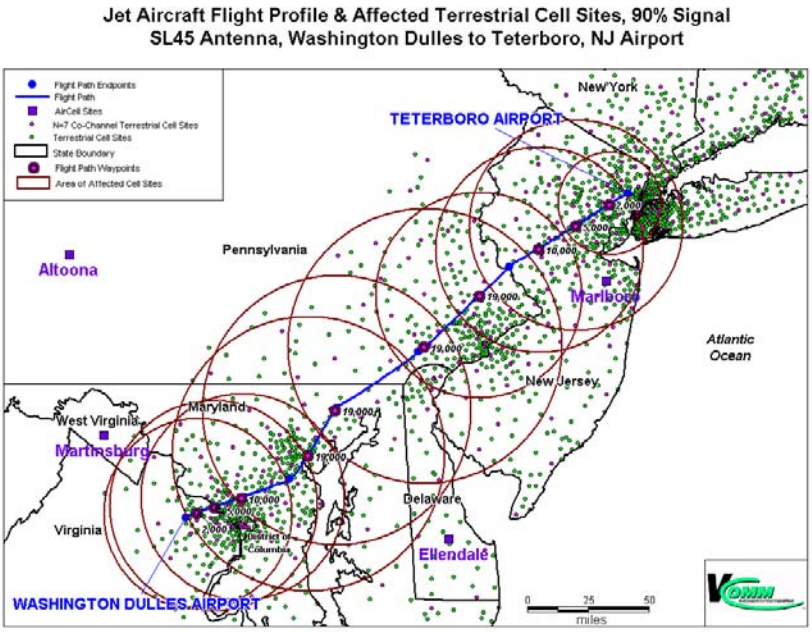

Figure 6.4-A, Jet Aircraft Flight Profile & Affected Terrestrial Cell Sites, SL45 Antenna, 90% Signal *from* V-Comm Report, § 6.4

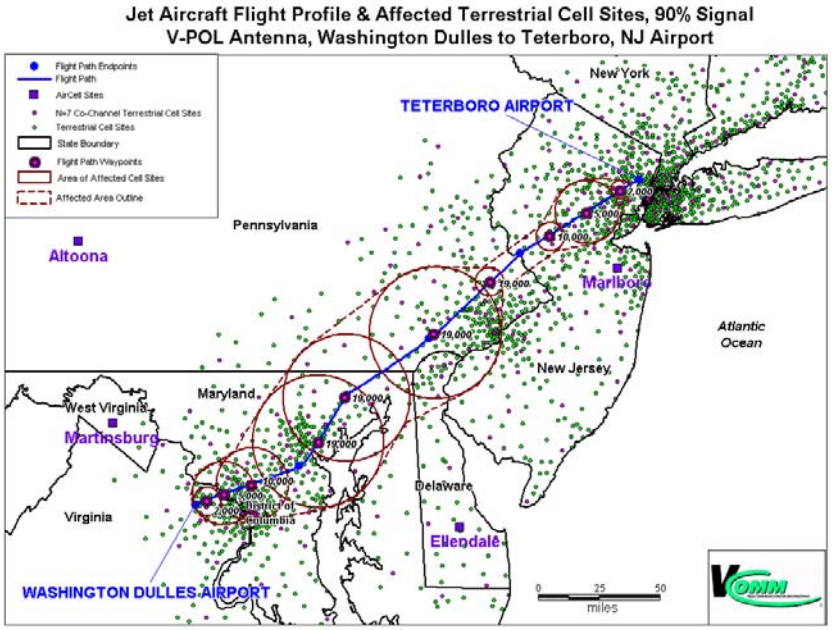

Figure 6.4-B, Jet Aircraft Flight Profile & Affected Terrestrial Cell Sites, V-POL Antenna, 90% Signal, *from* V-Comm Report, § 6.4

As can be seen, the number of cellsites affected depends significantly on the receive antenna used. In addition, the reuse patterns employed in analog and TDMA systems ensure that only a fraction of the cellsites within the interference corridor will actually be affected. The

maps above depict 1/7 of the cellsites with a red circle to illustrate this, on the assumption that an n=7 reuse pattern is used. CDMA cellsites, on the other hand, reuse the same channels in each cell, so all cells in the depicted corridor would be affected by a co-channel AirCell call. In the following table, V-Comm shows how the number of affected cellsites changes based on the technology and antenna type:

Affected Terrestrial Cell Sites
AirCell 90% Signal Level, Jet Aircraft

Terrestrial Antenna Type	AMPS Cell Sites (N=7)	TDMA Cell Sites (N=7)	CDMA Cell Sites (N=1)
H-POL	230	230	1608
SL45	223	223	1564
V-POL	93	93	652
OMNI	53	53	369

Table 6.4-B, Affected Terrestrial Cell Sites: AirCell 90% Signal Level
from V-Comm Report, § 6.4

Based on the number of cellsites affected from the foregoing, V-Comm then computes how many terrestrial calls would potentially receive harmful interference, assuming slant-45 antennas are used:

Technology of Terrestrial System	Affected Terrestrial Cell Sites	Affected Voice Channels or Calls per sector	Total Calls Affected along entire Flight Route	Ratio of AirCell Calls to Affected Terrestrial Calls
AMPS	223	1	223	1:223
TDMA	223	3 - 50	669 - 11,150	1:669 - 1:11,150
CDMA	1564	20	31,280	1:31,280

Table 6.4-C, Affected Terrestrial Cellular Telephone Calls: SL45 Antenna,
AirCell 90% Signal Level, Jet Aircraft (notes omitted), *from* V-Comm Report, § 6.4

It is clear from these tables that a huge number of terrestrial cellular users will encounter harmful interference from a single AirCell call. The actual number will, of course, vary, given that cellular systems use many different antenna configurations and technologies. Regardless of technology, however, AirCell operations will seriously degrade terrestrial cellular service relied on by millions of customers for business, personal, and emergency communications. Right now,

the impact is diminished by the fact that there is very little AirCell usage, and AirCell is limited in the number and type of channels it can use. If AirCell deployment grows substantially, however, there will be a widespread impact. V-Comm points out that flights on the same route used in the test case occur about 113 times every day, and many more use the same airspace. The number of flights served in the area studied is about 8,000 per day, with 99 million passengers served annually. Thus, the number of cellular customers whose calls would be affected by harmful interference from widespread use of the AirCell system each day would be hundreds of times greater than indicated by the figures in the table.[134] V-Comm adds:

> It should be noted that this Case Study outlines a single flight route in one section of the United States. If this methodology were extrapolated throughout the United States, along flight paths through similarly populated areas, the daily number of terrestrial cellular calls affected by AirCell operations would be very significant. When considering that approximately 35% of all 911 & emergency calls are generated by terrestrial wireless phones, the impact to the general public becomes extraordinary.[135]

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134 *See* V-Comm Report, § 6.4.

135 *Id.* (footnote omitted).

D. V-Comm's Conclusions

V-Comm's principal conclusions are as follows:

> Results from the aforementioned tests indicated that "harmful interference" can occur from AirCell airborne units to terrestrial cellular sites. The received airborne interfering signals (from Phase 1 of testing) were measured as high as -72 dBm and as low as -130 dBm with many signals falling in the -90 dBm to -100 dBm range. Phase 2 interference tests indicated a significant increase in adverse terrestrial performance metrics such as dropped calls, blocked calls, low MOS (audio quality) and reduced system capacity. A Case Study was developed to better understand the potential extent of this harmful interference in a highly populated corridor, such as the northeastern United States. Results of the Case Study indicate that as few as 200 and as many as 1500 terrestrial cell sites can be adversely affected by a single typical flight (from Washington, D.C. to the New York metro area). Further, between 200 and 30,000 individual terrestrial subscribers/calls can be affected by this same flight. This flight is the most popular flight route in the northeast and on average is flown over 100 times per business day. Therefore, the repetitiveness of this harmful interference is significant.[136]

V-Comm also concludes that:

> When the impact of terrestrial cellular interference caused by AirCell airborne units is considered in densely populated areas (i.e. Dense Urban, Urban, Suburban), the number of individual calls affected is significant and is anticipated to be as great as 20 per terrestrial CDMA sector, between 3 to 50 per terrestrial TDMA sector, and 1 per terrestrial AMPS sector. The TDMA number is based upon whether or not the AirCell interference is to a voice channel or digital control channel. When the number of affected terrestrial telephone calls per sector are multiplied by the number of affected terrestrial sites, as outlined in the Case Study, the volume of serious obstructions and system degradations is quite large. In fact, as many as 30,000 CDMA, 10,000 TDMA, or 200 AMPS terrestrial calls could be affected by aircraft along the Case Study flight route. If this interference is spread across less densely populated areas, the total number of individual calls affected is expected to be considerably less, however, the interference potential per call would be greater. This is due to larger cell sites, which are more

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[136] V-Comm Report, § 8.

> susceptible to interference at lower levels, since they can operate at lower received terrestrial signal levels and still maintain toll quality calls.[137]

V-Comm notes that its tests did not measure the effects of AirCell interference on a variety of other cellular technologies, such as "3G (3rd generation) voice and data (for all operators), GSM/GPRS (the current 3G migration path for TDMA operators), and E911 location based technologies (required for all operators), CDPD (an earlier generation wireless data technology still in place, and used by many local police departments), and Tower Mounted Low Noise Amplifiers (TMA)," some of which may be more susceptible to harmful interference from AirCell operations than those tested.[138] In addition, V-Comm notes that additional disruptions could be caused by AirCell to analog operations due to co-SAT (supervisory audio tone) collisions, which were avoided during the Phase 2 tests.[139]

V-Comm ends its report as follows:

> Finally, we conclude that AirCell's secondary use of cellular radio spectrum, causes harmful interference to the primary use by terrestrial cellular operators. While this harmful interference does not happen in all cases, when it does occur, it causes serious obstructions as demonstrated by increased system blocking, reduced system capacities, performance degradations as demonstrated by reduced MOS (audio quality), and repeated interruptions as demonstrated in the Case Study for typical flights in a densely populated corridor. Therefore, AirCell's system operation does not meet the conditions of the FCC waiver permitting air-to-ground service as a secondary use of cellular spectrum.[140]

For the reasons stated by V-Comm, as set forth in the excerpts here and as more fully explained in its Report, the AirCell waiver extension request must be denied.

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137 V-Comm Report, § 7.1.

138 V-Comm Report, § 7.5.

139 *See* V-Comm Report, § 7.9.

140 *Id.,* § 8.

E. V-Comm's Approach vs. the Approach followed in the *Remand Order*

V-Comm's tests were conducted before the release of the *Remand Order,* which provided, for the first time, an explanation of how the Commission has previously analyzed AirCell's interference to terrestrial service. Commenters and V-Comm believe that there are serious shortcomings in the approach followed in the *Remand Order.*[141] Some of those shortcomings may be found to constitute legal error when the Court of Appeals reviews that decision. Even if the *Remand Order* survives judicial review, however, the approach followed there is inapplicable here for several reasons.

First, the Commission's analysis of AirCell interference in the *Remand Order* proceeded on the basis of very limited data, as the Court of Appeals has already noted.[142] V-Comm's tests provide a much broader, more comprehensive record for assessing AirCell's interference potential. The Commission must decide how to respond to the AirCell Petition based on this expanded record, not on the limited facts that were available earlier.[143] Moreover, the facts that are now in the record allow the Commission to make a record-based determination of important decisional factors that the *Remand Order* determined on the basis of generic "textbook" information. For example, we now have an up-to-date "real world" record of measured noise floor levels in operating cellular systems in a wide variety of market environments, and a record of the signal strengths at which mobile transmissions are actually received in modern cellular systems. Such data, as well as data concerning noise levels and received signal strengths from the 1997 tests,

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[141] V-Comm's analysis of the *Remand Order* from a technical perspective is set forth in the V-Comm Remand Analysis in Exhibit III. The following discussion is based in large part on the V-Comm Remand Analysis.

[142] *See AWS,* 270 F.3d at 968

[143] *See, e.g, Universal Camera Corp. v. NLRB,* 340 U.S. 474, 487-88 (1951); *BFI Waste Systems v. FAA,* 293 F.3d 527, 535 (D.C. Cir. 2002).

allows the Commission to make informed, fact-based determinations concerning the minimum acceptable received signal levels in today's cellular systems. The use of assumptions about cellular received signal levels derived from textbooks is not necessary or appropriate, now that there is a comprehensive record.

Second, it is unclear how the Commission arrived at its determination in the *Remand Order* of when interference rises to the level of being "harmful." The FCC's decision there to deem interference harmful when it reaches a particular level was based in part on assumptions about the minimum received signal level that are not consistent with the data now before the agency. Moreover, the dividing line between interference effects considered acceptable and harmful did not have an evidentiary basis. V-Comm has now provided a record of how terrestrial cellular signals in a typical environment will be affected by AirCell transmissions that permits the Commission to make a factual determination more finely attuned to the definition of harmful interference.

In short, the rationale of the *Remand Order* was based on consideration of a much more limited record than is now before the Commission. Whether that decision was sustainable as a matter of law does not determine how the Commission assesses AirCell's interference potential on a going-forward basis. That must be based on the record now before the Commission. And equally important, the rationale of the *Remand Order* has no application to AirCell's interference potential *vis-à-vis* digital cellular operations, given the Commission's express finding that the preexisting record did not support AirCell's use of digital channels.[144]

Finally, the waiver extension could not be granted even if the Commission chose (despite the new record) to apply the -110 dBm threshold used in the *Remand Order* for determining

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[144] *See Bureau Order,* 14 F.C.C.R. at 817.

harmful interference by AirCell to cellular operations. The data compiled by V-Comm demonstrates conclusively that AirCell signals will be received by typical terrestrial cellular systems at levels exceeding this threshold under some circumstances. In fact, V-Comm concluded that if the -110 dBm threshold were used to assess the harmful interference in its Dulles-Teterboro case study, the threshold would be exceeded at 43 cellsites based on *average* AirCell signal levels (*i.e.,* AirCell's signal would, on average, be at or above the threshold) and 185 cellsites based on 90 percentile AirCell signal levels (*i.e.,* AirCell's signal would be at or above the threshold 10% of the time). The following map illustrates the extensive corridor of cellsites that would receive harmful interference, based on 90th percentile signals at or above the -110 dBm threshold employed in the *Remand Order*:

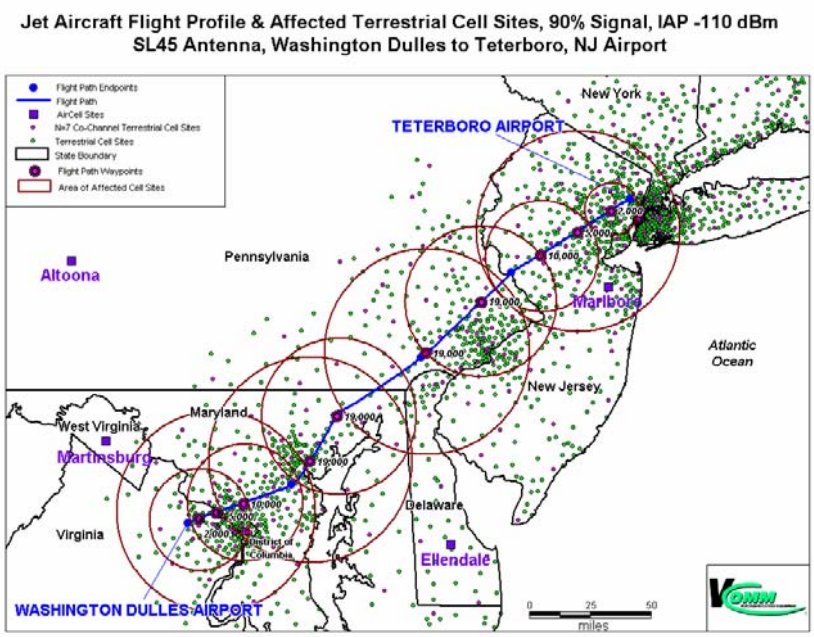

Figure 7-C, Flight Profile & Affected Terrestrial Sites, Slant-45 Polarized Terrestrial Antenna, 90% Signal, IAP -110 dBm, *from* V-Comm Remand Analysis, § 7.3

CONCLUSION

For the foregoing reasons, the Petition filed by AirCell and its Partners for extension of their waiver of the airborne cellular rule must be denied in its entirety.

Respectfully submitted,

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Certificate of Service

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