Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands	)	WT Docket No. 04-356
	)	
Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands	)	WT Docket No. 00-353
	)	

JOINT COMMENTS OF SPRINT CORPORATION AND VERIZON WIRELESS

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Attachment A: Sean Haynberg, Director of RF Technologies, V-COMM, *H-Block Impact on Incumbent PCS Operations* (December 2004).

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JOINT COMMENTS OF SPRINT CORPORATION AND VERIZON WIRELESS

Sprint Corporation ("Sprint") and Verizon Wireless (collectively, the "CDMA Carriers") jointly submit these comments in response to the Federal Communications Commission's ("FCC" or "Commission") *H Block NPRM*, which seeks to develop service rules for Advanced Wireless Services ("AWS") operating in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz bands.[1]

The CDMA Carriers believe that, without adequate technical rules, the use of the 1915-1920 MHz band ("H Block") could result in significant harmful interference to existing wireless services. Appended as Attachment A is a technical analysis prepared by V-COMM that extensively analyzes the H Block interference issues.[2] This analysis demonstrates that the use of

[1] *Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands*, Notice of Proposed Rulemaking, 19 FCC Rcd 19263 (2004) ("*H Block NPRM*").

[2] Sean Haynberg, Director of RF Technologies, V-COMM, *H-Block Impact on Incumbent PCS Operations* (December 2004) ("V-COMM Report"), appended as Attachment A. Mr. Haynberg has over 15 years of experience in wireless engineering, including wireless system design, implementation, testing and optimization for wireless systems utilizing CDMA, TDMA, GSM, AMPS and NAMPS wireless technologies. Biographies of Mr. Haynberg and other V-COMM principals are appended to the end of the V-COMM Report.

the H Block for terrestrial mobile transmissions without adequate power and out-of-band emission limits would interfere with existing mobile devices that receive in the 1930-1990 MHz Personal Communications Service ("PCS") band. To prevent such harmful interference from occurring, the CDMA Carriers propose that the Commission take the following actions:

- Adopt an output power limit of 5 dBm for terrestrial mobile devices operating in the 1918.125-1920 MHz band;
- Adopt an output power limit of 8 dBm for terrestrial mobile devices operating in the 1916.875-1918.125 MHz band;
- In the alternative, designate the 1916.875-1920 MHz band for uses that would not cause harmful interference, such as Fixed or Air-to-Ground use;
- Complete further testing to determine an appropriate power limit for the 1915-1916.875 MHz band; and
- Adopt an out-of-band emissions limit for operations in the H Block spectrum that limits emissions into the 1930-1990 MHz PCS receive band to –76 dBm/MHz.

I. INTRODUCTION

As PCS licensees and wireless carriers that provide service to more than 60 million subscribers – all of which could be subject to new, ubiquitous and substantially harmful interference from a PCS-like mobile service operating in the H Block – the CDMA Carriers have significant legally protected rights and expectations at issue in this proceeding. While we generally favor spectrum assignments that promote advanced, flexibly licensed services, the Commission must ensure that in making such assignments, it does not cause interference to licensed services in adjacent bands. With respect to the H Block in particular, the Commission must ensure that the technical requirements applied to it are sufficient to prevent interference to operations in the nearby PCS spectrum blocks.

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After receiving informal notice in July 2004 of the Commission's intent to redesignate the H Block for uses that would include PCS-like services, CTIA-The Wireless Association ™ ("CTIA") and its members, including Sprint and Verizon Wireless, held meetings with FCC staff from the Office of Engineering and Technology ("OET") and the Wireless Telecommunications Bureau ("WTB") and submitted various filings into the record outlining the interference potential from certain uses of the H block spectrum. Subsequent to those meetings, CTIA and several of its member companies requested that the Commission delay permanent action on the allocation of the H Block until comprehensive interference testing could be completed.[3] To that end, CTIA began developing a test plan to examine the interference potential, the parameters of which were discussed at meetings with OET staff.[4] For its part, Sprint submitted results of H Block interference testing performed by Nokia Inc. ("Nokia") – a major manufacturer of PCS handsets, with expertise in the area of handset design and performance. This testing clearly demonstrated the susceptibility of existing and new PCS handset models to overload interference caused by operations in the H Block spectrum (the "Nokia Test Report").[5]

The wireless industry outlined three distinct types of interference problems posed by mobile operations in the H Block: (1) out-of-band emission ("OOBE") interference; (2) overload interference; and (3) intermodulation ("IM") interference.[6] Specifically, as set out in the *AWS*

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[3] *See*, *e.g* , *ex parte* Comments of CTIA, ET Docket No. 00-258 (filed on July 30, 2004, and August 5, 13 and 18, 2004); *ex parte* Comments of Sprint, ET Docket No. 00-258 (filed on Sept. 1 and 2, 2004); *ex parte* Comments of Verizon Wireless, ET Docket No. 00-258 (filed on Sept. 2, 2004).

[4] *See ex parte* Comments of CTIA, ET Docket No. 00-258 (filed on August 18, 2004).

[5] *See* "H Block Overload Test Results, Single Tone Desensitization (Overload) and Duplexer Testing Over Temperature," attached to *ex parte* Comments of Sprint, ET Docket No. 00-258 (filed on Sept. 1, 2004) ("*Sprint H Block Presentation I*").

[6] The potential for OOBE and overload interference from H Block operations has been well established in the record. The potential problems associated with intermodulation were also raised, but there was insufficient time to develop a more complete record on that subject prior to the Commission's *H Block Order*. *See ex parte* Comments of Verizon Wireless, ET Docket No. 00-258 (filed on Sept. 2, 2004).

Third NPRM[7] which precipitated the *H Block Order*[8], PCS mobiles are designed and manufactured to operate with 20 MHz of frequency separation between the mobile receive band (1930-1990 MHz) and the mobile transmit band (1850-1910 MHz). As a result, the filtering technology incorporated into many millions of new and legacy handsets is incapable of filtering out the fundamental signals from a mobile AWS device operating in the 1915-1920 MHz band.

Although the earlier record in this proceeding had focused on OOBE interference,[9] further study of H Block interference by the wireless industry as well as the handset testing performed by Nokia revealed that overload interference posed an even more serious problem for "direct conversion" handsets incorporating SAW duplexer filters.[10] As Sprint explained in its *ex parte* presentations, SAW technology represents the dominant filter technology deployed in PCS

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[7] *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, Third Report and Order, Third Notice of Proposed Rulemaking and Second Memorandum Opinion and Order, 18 FCC Rcd 2223, 2248-49 at ¶ 50 (2003) ("*AWS Third NPRM*").

[8] *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, Sixth Report and Order, Third Memorandum Opinion and Order, and Fifth Memorandum Opinion and Order, ET Docket Nos. 00-258 and 95-18, FCC 04-219 (rel. Sept. 22, 2004) ("*H Block Order*").

[9] PCS industry parties responding to the *AWS Third NPRM* opposed the use of the H Block for PCS-like uses on the basis that filtering technology did not provide adequate OOBE protection to PCS operations only 10-15 MHz away, but it does not appear that either the PCS industry or the Commission considered the issues of overload or IM interference. *See*, *e.g.*, Comments of the CTIA-The Wireless Association ™ ("CTIA"), ET Docket No. 00-258 (filed April 14, 2003) at 3; Comments of Verizon, ET Docket No. 00-258 (filed April 14, 2003) at 4-6; Comments of Motorola, Inc. ("Motorola"), ET Docket No. 00-258 (filed April 14, 2003) at 4; Reply Comments of AT&T Wireless Services, Inc. ("AT&T Wireless"), ET Docket No. 00-258 (filed April 28, 2003) at 6; *Ex parte* comments of Motorola, ET Docket No. 00-258 (filed Dec. 18, 2002). CTIA, however, did warn that PCS mobile receivers would not be able to reject signals from ATC mobiles operating at 1990 MHz. *See ex parte* comments of CTIA, ET Docket No. 00-258 (filed Jan. 27, 2003).

[10] The Nokia Test Report included test data covering three handsets incorporating superheterodyne technology, all of which appeared to have considerably more rejection of H Block signal levels than direct conversion technology.

handsets today.[11] Finally, the Nokia Test Report also revealed that duplexer filter performance degrades significantly as the temperature of the duplexer increases. Thus, the longer a handset is engaged in a call, the hotter the duplexer inside the handset will become, and the more susceptible to interference that handset will become.

Notwithstanding the technical concerns established in the record by the wireless industry, the Commission adopted the *H Block Order*, which, among other things, redesignated the H Block for AWS use, on the assumption that technical requirements for H Block operations could be established that would substantially prevent harmful interference to PCS operations. It appears that the Commission can ameliorate the interference potential to incumbent PCS operations by establishing strict technical requirements for use of the H Block spectrum, as proposed herein. However, the output power limitations required to protect PCS operations could limit the suitability of the H Block spectrum, or certain portions of it, for terrestrial mobile services. Thus, the Commission may find it more desirable to limit the band to other uses that do not raise similar interference concerns. For example, the use of the spectrum for Fixed or Air-to-Ground ("ATG") services would avoid the problems associated with operating mobile devices in close proximity to one another, and are consistent with the band's existing service allocations.

To provide a basis for establishing such requirements, CTIA contracted two independent entities with extensive expertise and experience in radiofrequency engineering and device testing

[11] *See*, *e.g.*, "H Block Implications of Allocating the H Block for Mobile Services," attached to *ex parte* Comments of Sprint, ET Docket No. 00-258 (filed on Sept. 2, 2004) ("*Sprint H Block Presentation II*") at 18-19 and 41. Accordingly, FBAR filter performance is irrelevant to the overload problem. While PCS handsets utilizing FBAR filters may be more resistant to H Block overload than direct conversion phones using SAW filters, they comprise a minority share of the legacy PCS handset market and do not provide a basis for developing output power rules for the H Block.

– PCTest Engineering Laboratory, Inc. ("PCTest")[12] and the Wireless Information Network Laboratory ("WINLAB") of Rutgers University[13] – to perform H Block OOBE, overload and IM interference testing in accordance with the test plan that CTIA had been developing specifically for this purpose. The PCTest and WINLAB test reports are being submitted with CTIA's comments in this proceeding.

The PCTest and WINLAB tests cover eleven handsets in total (composed of six CDMA handsets, four GSM handsets, and one UMTS handset), representing models that are both widely in commercial distribution and use today, as well as new models just entering commercial distribution (and thus likely to be in use for some time). Sprint, for example, provided four separate "direct conversion" handset models from three manufacturers.[14] All four of the units provided were production units taken at random from existing inventory of handsets Sprint randomly tests for internal certification purposes, and are the equivalent of off-the-shelf products. Of these four handset models, three of the handset models are currently in use by more than 2.5 million Sprint subscribers, while the fourth (Sample A in the PCTest Report) currently is one of Sprint's top-selling models, which only recently entered commercial distribution.

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[12] PCTest is located in Columbia, MD, and was founded by former FCC Laboratory engineers to assist industry in regulatory technical matters. PC Test is Telecommunications Certification Body authorized to approve various types of devices subject to certification under the FCC's Rules, and holds a number of accreditations, including A2LA, ANSI, NVLAP and NMI. *See* http://www.pctestlab.com.

[13] WINLAB is an industry/university cooperative research center focused on wireless technology, founded at Rutgers University in New Jersey.

[14] In addition to the four handsets provided by Sprint; Verizon provided a total of three handsets for testing; Cingular Wireless LLC ("Cingular"), AT&T Wireless and T-Mobile USA, Inc. ("T-Mobile") collectively provided a total of seven handsets for testing, consisting of five GSM handsets and two UMTS handsets. One of these GSM handsets and one of the CDMA handsets turned out to have faulty connectors, which caused erroneous test results that were deleted from the test reports. In addition, the results for one of the UMTS handsets, which utilized a Bulk Acoustic Wave filter and did not show any adverse results at an ambient temperature of 19° are not included. None of the handset models tested by PCTest or WINLAB were identical to the handset models tested by Nokia and reported in the Nokia Test Report.

Verizon Wireless similarly chose handset models that are in wide use by its customers and were recently tested by its handset certification laboratory and determined to be in full compliance with the industry's strict technical standards. The PCTest and WINLAB test data is consistent with the data contained in the Nokia Test Report, and strongly suggests that direct conversion handsets utilizing SAW filters will be susceptible to IM and overload interference from PCS-like operations in the H Block spectrum.

II. SUMMARY

As Chairman Powell and most of the Commissioners generally acknowledged in adopting the *H Block Order*, it is imperative that the Commission protect existing wireless consumers from interference when establishing rules for H Block operations.[15] The potential for interference to PCS operations was established by the Nokia Test Report. The subsequent testing by PCTest and WINLAB corroborates the Nokia findings, and quantifies IM interference as a particularly serious problem for CDMA handsets.[16] IM interference could potentially impact millions of CDMA users on B Block spectrum, at much greater distances than overload. That is on top of the millions of PCS consumers using both wide-band and narrowband

[15] *See H Block Order*, Statement of Chairman Michael K Powell ("There have been interference concerns raised in the record about proceeding with the designation of the 1915-1920 MHz band for advanced wireless services. [] I believe that . . . the initiation of a service rules proceeding will afford the Commission latitude to address comprehensively the existing and future test results . . . ."); Statement of Commissioner Kathleen Q. Abernathy ("I also recognize that redesignation of the H block spectrum for advanced wireless communications uses holds the potential to cause harmful interference with existing broadband PCS services unless we adopt appropriate technical limitations on operations within the H block."); Statement of Commissioner Michael J. Copps ("Importantly, the Commission must ensure that the use of this band does not cause unacceptable interference to consumers who currently use proximate bands."); Statement of Cmmissioner Jonathan S. Adelstein ("In promoting new services, we always need to make sure that we are adequately protecting any existing service. In this case, we must ensure that our rules shield the significant base of existing PCS customers from harmful interference.").

[16] Nokia did not test handsets at a receive level of –105 dBm, but the PCTest and WINLAB data for handsets tested at a receive level of –100 dBm is consistent with Nokia Test Report results.

technologies that could be impacted by OOBE and overload interference throughout the PCS A, B, C, D, E and F blocks.

Given the seriousness of these interference threats to its subscribers, Verizon Wireless commissioned V-COMM – an engineering consulting firm with decades of experience analyzing, developing and implementing RF-based networks – to provide expert interpretation and analysis of the test data compiled by PCTest and WINLAB. As explained in the attached V-COMM Report, the data compiled in the test reports prepared by PCTest and WINLAB demonstrates the following:

1. H Block-originated IM interference presents the most severe interference problem for PCS operations – in particular, on PCS B Block channels. It causes degradation to the PCS call when the power level of the H Block mobile measured at the victim PCS receiver is –36 dBm or greater;

2. H Block-originated overload interference causes degradation to PCS calls on all PCS Blocks (A through F) when the power level of the H Block mobile measured at the victim PCS receiver is –28 dBm or greater; and

3. H Block-originated OOBE interference causes degradation to the PCS calls on all PCS Blocks (A through F) when the in-band noise level of the H Block mobile OOBE measured at the victim PCS receiver is –117 dBm/MHz or greater (and PCS receive level is at –105 dBm).

In establishing technical rules to prevent interference to existing services, the Commission must ensure that all forms of interference are adequately addressed. This includes IM interference, which represents the worst case interference threat to CDMA operations by virtue of its ability to degrade B Block calls at large distances relative to overload interference.[17] The test data indicates that power limits of 8 dBm for the 1916.875-1918.125 MHz band

[17] IM interference also impacts PCS F Block channels, but at power levels equivalent to those at which overload interference creates an interfering impact. Thus, ameliorating the overload interference problem also would ameliorate the IM interference problem for the F Block. However, because IM interference to the B Block occurs at lower power levels than overload interference, ameliorating the overload interference problem would not fully ameliorate the IM interference problem with respect to the B Block.

("Middle Segment of the H Block") and 5 dBm for the 1918.125-1920 MHz band ("Upper Segment of the H Block") are necessary to protect PCS handsets from H Block-originated IM interference at a separation distance of one meter. To the extent that these limits hamper the utility of the 1916.875-1920 MHz band for a PCS-like service, this portion of the H Block may be better suited to other uses, such as Fixed or Air-to-Ground.

In addition, the Commission's assessment of the overload interference problem is insufficient in many respects. The Commission's assumption of –3 dB antenna gain for PCS handsets, for example, does not reflect real-world practice. Further, it is clear that the conditions precedent to overload interference – principally, the PCS handset operating at high receive sensitivity and an H Block mobile device operating at high enough power to cause interference – are not limited to operations at the edge of service areas, but also would occur routinely in everyday use, such as in numerous indoor settings, in automobiles, planes, trains, etc. The Commission's contention that PCS handsets could tolerate an interfering H Block signal level of –21 dBm (upon which it based its proposed output power limit for H Block mobile devices of 23 dBm) does not comport with the test data. In particular, the test data from PCTest and WINLAB demonstrates that PCS operations suffer degradation to PCS calls when receiving H Block-originated "overload" signal power at a level of –28 dBm, which is 7 dB less than the Commission had concluded. Finally, the V-COMM Report confirms the well-documented position of the wireless industry that the Commission should require H Block mobile devices to comply with the –76 dBm OOBE limit set forth in PCS industry standard, TIA 98-F.

III. THE COMMISSION SHOULD BASE THE H BLOCK POWER LIMTS UPON THE IM INTERFERENCE DATA OBTAINED THROUGH TESTING

While IM interference is a mode of interference that is commonplace and well understood by the industry and the Commission, neither had sufficient time to explore the full impact of H Block-originated IM interference to PCS handsets prior to the adoption of the *H Block Order* and *H Block NPRM*. In essence, when the receiver becomes non-linear due to the addition of the H Block fundamental signal power, the new H Block frequencies combine with the victim handset's transmitting frequencies to produce new signals that can fall outside the H Block band but inside the victim handset's receive band, resulting in harmful interference.[18] IM interference can result in call degradation, dropped calls and/or inability to receive calls, and produces these effects at greater distances relative to overload interference. Because the IM and overload interference problems are rooted in the design and inherent limitations of the duplexer technology incorporated into the PCS handsets, there is no "fix" that can be implemented within the H Block mobile device, other than reducing the output power of the H Block mobile device transmissions.[19]

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[18] IMD interference has been defined by the National Telecommunications and Information Administration's Institute for Telecommunication Sciences as "[t]he production, in a nonlinear element of a system, of frequencies corresponding to the sum and difference frequencies of the fundamentals and harmonics thereof that are transmitted through the element." See http://www.its.bldrdoc.gov/fs-1037/dir-019/_2812.htm.

[19] As outlined in Sprint's September 2 presentation to the Commission, the receive filters of SAW duplexer filters (and FBAR filters) inside PCS handsets do not block out H Block transmissions because the slope of the receive filter's skirt overlaps the H Block. *See Sprint H Block Presentation II* at 17 and 18. As a result, "The duplexers in millions of PCS handsets deployed today [are] 'listening' to the H Block transmissions." *Sprint H Block Presentation I* at 4. Moreover, as depicted in the Nokia Test Report, this overlap increases significantly as the temperature of the duplexer increases. *See* Nokia Test Report at 9-11. As a result of this overlap, the H Block signals are received at the victim handset and are directed into the receiver circuitry, overwhelming the receiver and causing it to become non-linear. This receiver desensitization results in a sharp (and, generally, run-away) increase in Frame Error Rates ("FER") in signal processing.

A. IM Interference Poses A Significant Interference Threat To PCS B Block Operations

As explained in the V-COMM Report, the PCTest and WINLAB test data shows that IM interference is a more problematic form of interference than overload interference, at least with respect to PCS B Block operations. Specifically, the test results found H Block transmissions in the Upper Segment of the H Block caused an IM-induced one percent increase in frame error rate ("FER") – by which point the call has become impacted by the H Block signal – in most of the CDMA handset test samples when the received H Block signal level was approximately –36 dBm.[20] In contrast, the Commission has contended that PCS handsets could tolerate an H Block signal at a received level of –21 dBm.[21] As V-COMM further explains, the receive level of –105 dBm represents a 5 dB fade margin that could be expected to occur at least 34 percent of the time with respect to a baseline receive level of –100 dBm due to signal fading, but even at the –100 dBm receive level, the IM-induced one percent increase in FER occurred in most of the CDMA handset test samples when the received H Block signal level was approximately –29 dBm.[22] Further, these figures decrease by only a few dB when the H Block transmission originates in the Middle Segment of the H Block.[23]

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[20] This CDMA samples were operating at a receive level of –105 dBm and an ambient operating temperature of 19°. *See* V-COMM Report at 16-17. In addition, as explained in Section III below, these and all other technical interpretations contained herein and in the V-COMM Report assume the following losses: (i) relevant free space; and (ii) 3 dB of loss for body absorption and/or miscellaneous factors.

[21] *See H Block Order* at ¶ 27.

[22] *See* V-COMM Report at 16, Table 8. It should be noted that focusing on the one percent increase in FER as the call degradation level reflects PCS industry practices with respect to network reliability, which typically require that the network not exceed 2 percent FER in total. Under *best* case conditions (*i.e.*, at a receive level of –100 dBm and an ambient operating temperature of only 19°), the CDMA test samples would experience IM-induced FER of two percent, and thus begin to exceed the typical network reliability standard, at approximately –29 dBm.

[23] It should also be noted that neither PCTest nor WINLAB tested for IM interference below the center frequency of 1917.5 MHz, but the minimal drop in IM interference susceptibility shown between H Block transmissions centered upon 1918.75 MHz and 1917.5 MHz suggests both that IM interference could be a

B. An H Block Power Limit of 5 dBm Is Required to Protect PCS Operations from IM Interference

In light of the new test data on IM interference, it is clear that the 23 dBm power limit proposed by the Commission will not be sufficient to protect PCS operations from H Block-originated IM interference. Specifically, as the V-COMM Report details, using the 23 dBm power limit proposed by the FCC (and 3 dB of loss for body absorption / miscellaneous factors) would require 56 dB of free space loss to ensure that the H Block mobile device's power is received by the PCS handset at a signal strength of under –36 dBm (the level at which a one percent increase in FER occurs). This means that the H Block mobile device must not come within 26 feet (or 8 meters) of the PCS handset (operating at a receive level of –105 dBm).[24] This does not even represent the worst case, since the worse-case handset test sample demonstrated IM interference at a received H Block mobile device power level of –40 dBm, which occurs at 41 feet (or 12.5 meters) of an H Block mobile device operating at 23 dBm.[25] Subscribers typically operate their handsets well within 26 feet of one another and, thus, interference would be commonplace with an H Block output power limit set at 23 dBm. In fact, with the proliferation of mobile devices, it is commonplace for subscribers to be within a few feet of one another, and existing PCS devices are designed to ensure effective non-interfering operations within one meter.

As detailed in the V-COMM Report, based upon the PCTest and WINLAB test data, to provide protection for PCS operations at one meter from H Block-originated interference would

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problem throughout the H Block and that output power limits similar to those proposed herein for the 1916.875-1918.125 MHz and 1918.125-1920 MHz portions of the H Block could well be required throughout the H Block.

[24] *See* V-COMM Report at 16.

[25] *Id*.

require an output power limit of 5 dBm for H Block mobile devices operating in the Upper Segment of the H Block, which is considerably *lower* than the 23 dBm limit proposed by the Commission.[26] Further, because the IM problem also is caused by transmissions emanating from the Middle Segment of the H Block, a power limit of 8 dBm applied to this spectrum would be required to protect PCS operations at a spacing distance of one meter.[27]

C. Ignoring The IM Interference Threat Would Disproportionately Harm CDMA and B Block Licensees

Though limited to PCS B (and F) Block spectrum, IM interference could potentially affect millions of CDMA subscribers. Depending upon how the H Block is channelized, H Block mobiles could cause IM interference to as many as five B Block CDMA channels. CDMA carriers serve millions of subscribers within the Metropolitan Trading Areas of their B Block licenses, but channelization schemes deployed within these areas vary depending upon cell capacity, usage and other factors. Because IM interference impacts PCS B Block operations at much greater distances than overload interference, however, whatever percentage of subscribers would be on one of these affected B Block channels at any given time would also be at much greater risk of encountering IM interference than overload interference. As the

[26] Although the technical limits proposed herein and the V-COMM Report are based upon a separation distance between the H Block mobile device and the PCS handset of one meter, PCS handsets today operate extremely well at much closer proximities. Typical examples include numerous everyday situations in which people sit close together, such as trains, buses, cars, grounded planes, concert halls, stadiums, movies, clubs, and where people stand together, such as in ticket lines. Indeed, the test data shows that PCS CDMA handsets can operate with a separation distance between each other of as little as nine inches. *See* V-COMM Report at 26, n.44. Further, the instances of handset usage at distances less than one meter from one another can only increase, as the proliferation of wireless PCS and H Block mobile devices increases.

[27] It should also be noted that neither PCTest nor WINLAB tested for IMD interference below the center frequency of 1917.5 MHz, and the minimal drop in IMD interference susceptibility shown between H Block transmissions centered upon 1918.75 and 1917.5 suggests both that IMD interference could be a problem throughout the H Block and that the very low output power limits proposed herein for the upper half of the lower H Block channel could well be required throughout the H Block.

V-COMM Report explains, for example, if the Commission adopted its proposed 23 dBm output power limit for the H Block, the worst-case handset tested would experience severe interference at a distance from the H Block device of 41 feet, while the majority of handsets tested would experience severe interference at a distance of 26 feet.[28] At those distances, interference become the norm rather than the exception.

Even if a given B Block area is not utilizing a CDMA channel otherwise subject to IM interference, ignoring the IM interference danger would place future users at risk as these channels are deployed, along with planned EVDO deployments, which will usher in the types of broadband services that the Commission has sought to encourage. Further, by ignoring the IM interference problem, the Commission would effectively favor one technology over another. By fully protecting some licensees from harmful interference and not others, the Commission effectively would be holding similarly situated licensees to different interference standards. Specifically, because the IM problem only arises with respect to wide-band technologies, it does not affect GSM carriers. If the Commission, for example, adopts an H Block output power limit of –13 dBm to protect legacy and new PCS handsets only from overload interference, that limit would reduce but not eliminate the IM interference problem because IM causes interference at lower power levels than overload does. As a result, while GSM handsets would be protected from H Block overload interference, CDMA handsets would be protected from overload interference, but would nonetheless have to be reconfigured with new filtering technology (assuming such technology could be developed) to account for the remaining IM interference threat. In addition, ignoring IM interference would disproportionately affect B Block licensees, who would be held to a different standard of interference than similarly situated PCS A, C, D

[28] *See* V-COMM Report at 16.

and E Block licensees. As the most spectrally-efficient technology in use today, the Commission should focus on interference measures that enhance rather than stifle CDMA operation.

D. The Commission Should Consider Limiting the 1916.875-1920 MHz Band To Other Non-interfering Uses

While adoption of the relatively low power limits proposed herein for terrestrial mobile operations in the H Block is necessary to protect PCS operations from harmful interference, it likely would hamper the utility of this spectrum for PCS-like services. However, the Commission has other options available for making use of the H Block in a manner that would not pose interference problems for PCS operations and would conform to the existing allocations for the band. Specifically, while PCTest and WINLAB test data shows that the 1916.875-1918.125 MHz portion of the H Block is not well-suited for *high-powered* AWS applications as the Commission earlier assumed, it may be suited for *low-powered* AWS applications. Such application might include, for example, wireless systems with smaller cell sizes. Other options include limiting the 1916.875-1918.125 MHz band to fixed operations, which are easily coordinated around and would not need to be limited to the low power levels that would be required for a mobile use in that band.[29]

The Commission also could consider designating the 1917.5-1920 MHz band for ATG use, as contemplated in the *H Block NPRM*.[30] The Commission currently is looking at revamping the ATG spectrum and service rules to make possible the provision of broadband services on-board commercial aircraft in WT Docket No. 03-103. Designation of the 1916.875-1918.125 MHz portion of the H Block for ATG use would enhance competition in the ATG sector by providing enough spectrum to ensure multiple service providers. Further, as the

[29] *See*, *e.g.*, V-COMM Report at 25.

[30] *H Block NPRM* at ¶ 108.

Commission observed in the *H Block NPRM*, an ATG service likely would not pose a risk of overload interference, since it is unlikely that PCS handsets would be operated in close enough proximity to the airplane's transmitter to trigger such results.[31]

IV. THE COMMISSION'S ANALYSIS OF THE OVERLOAD INTERFERENCE PROBLEM IS FLAWED

The *H Block NPRM* suggests that applying a 23 dBm output power limit to H Block devices should provide sufficient interference protection to PCS handsets operating at a distance of one meter.[32] The *H Block NPRM* cites the one-paragraph overload analysis contained in the *H Block Order* as support for this assertion.[33] The Commission determined that the 23 dBm figure would not interfere with PCS by subtracting from that figure: (i) 38 dB to account for free space loss at one meter; (ii) 3 dB for assumed body absorption (head loss); and (iii) 3 dB for assumed antenna gain.[34] According to the Commission, at the resultant power level of –21 dBm, six of the seven handsets tested for the Nokia Test Report would "experience no impact" and indicated that the seventh handset would be protected at a distance of 1.5 meters.[35] The Commission further downplayed the interference potential of applying a 23 dBm power limit on grounds that PCS phones do not generally operate at full power and that "other propagation factors" would mitigate the actual received power.[36] As explained below, the Commission's analysis of the overload problem is flawed in key respects.

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[31] *Id*. This assumes that the ATG system will not be operated on the ground.

[32] *See NPRM* at ¶ 107.

[33] *Id.* (*citing H Block Order* at ¶ 27).

[34] *See H Block Order* at ¶ 27.

[35] *Id*. (the Commission contended that six of the seven handsets could tolerate and AWS signal as a level of –21 dBm or less "without experiencing any degradation.").

[36] *Id*.

A. There Is No Sound Basis To Assume A 3 dB Loss In H Block Signal Strength Due To Antenna Gain.

As a starting point, the Commission's assumption of -3 dB for antenna gain does not reflect real-world practice.[37] Antenna gain varies greatly among handset models, but in real-world practice, antenna gain is assumed to be 0 dBi. PCS industry standards, for example, call for assuming an antenna gain of 0 dBi in test procedures.[38] Moreover, as the V-COMM Report explains, the average antenna gain of the handsets tested by PCTest and WINLAB, for example, was +1.2 dBi, which is 4.2 dB greater – and thus 4.2 dB *more* susceptible to H Block interference – than the Commission's assumption of –3 dB antenna gain.[39] Accordingly, the FCC's assumption of a constant 3 dB loss in the link budget between H Block devices and PCS handsets appears to be fundamentally wrong and should not be used to calculate the appropriate output power limits for H Block mobile devices. In keeping with the PCS industry practice and recognizing that antenna gain on PCS handsets vary widely both above and below 0 dBi, the CTIA test plan and all power budget analyses contained herein assume an antenna gain of the PCS handset of 0 dBi, which is 2.7 dB lower than the worst-case antenna gain of the handsets tested by PCTest and WINLAB.[40]

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[37] Although the V-COMM analyses assumes 3 dB of loss to cover body absorption and/or other miscellaneous losses, this assumption is also overly conservative. Head losses could only be applicable in those situations where (i) the PCS handset user is holding the handset up to its ear (as opposed to using an ear bud or headset, use of which, for example, is mandated by law in several jurisdictions when driving) and (ii) the interfering H Block device's line-of-sight to the PCS handset is obstructed by the PCS user's head. As the V-COMM Report explains, however, this line of sight is unobstructed between 57 and 65 percent of the time. *See* V-COMM Report at 9.

[38] *Id.* at 8.

[39] *Id*.

[40] *Id*.

B. H Block Device Transmit Power And PCS Handset Receive Sensitivity Are Maximized In Numerous Situations Other Than At The Edge Of The Cell.

The Commission has characterized the overload interference problem as being limited to the worst-case situation where the H Block mobile device is transmitting "at maximum power (near the edge of its service area) at the upper edge of the band (near 1920 MHz) and the [PCS] mobile receiver is trying to receive a weak signal (near the edge of its service area) at the lower edge of the band (near 1930 MHz) and only free space loss is considered."[41] The Commission's characterization of this problem is flawed in several respects. First, the H Block device need only be transmitting at a power level sufficient to cause IM, overload or OOBE interference to the PCS device. That power level may or may not be the "maximum" power level of the H Block device. For example, test data shows that an H Block mobile device authorized to operate at the Commission's proposed 23 dBm power limit would cause IM interference to a PCS handset on a relevant B Block channel at one meter using at an output power of just over 5 dBm.

Further, test data shows clearly that neither the H Block device nor the PCS device need be near their band edges, since H Block transmissions *centered* at 1917.5 MHz cause severe IM overload interference to PCS handsets receiving in the middle of the PCS B Block (which is well above 1930 MHz). Moreover, it is clear that neither the H Block handset nor the PCS handset must be at the edge of their service areas to be transmitting at sufficient power to cause overload interference or operating at their highest receive sensitivity. As V-COMM explains, for example, PCS handsets must increase transmit power and increase receive sensitivity to transmit and receive signals through walls, cars, etc., just as they do when operating at the edge of the cell

[41] *H Block Order* at ¶ 22. *See also id.* at ¶ 23.

site.[42] PCS subscribers use their phones inside building lobbies, offices, homes, trains, planes, automobiles, arenas, movie theaters, hotel rooms, etc. – all locations of which can be expected to require that the PCS handset function just as if it were in an open area outdoors at the edge of the cell site.

The Commission similarly mischaracterizes the condition of the H Block handset operating at full power and the PCS handset operating at it highest receive sensitivity as akin to the so-called "near/far" effect.[43] The near/far effect occurs when a mobile interacting with a far away base station (and thus operating towards the edge of its service area) is interfered with by a another nearby base station.[44] PCS carriers mitigate by either co-siting or near-siting their respective base stations.[45] The mobile-to-mobile interference scenario presented by the H Block interference, however, should not be confused with the base station-to-mobile interference scenario associated with the near/far effect, because there are millions of mobiles compared with only a fraction of serving base station base stations (which have been already been coordinated to avoid the near/far effect). Handsets routinely operate in very near proximity to other handsets. Further, as explained above, the overload interference caused by H Block operations is not limited to situations in which the PCS handset is operating at the edge of coverage or otherwise

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[42] *See* V-COMM Report at 30-31.

[43] *H Block Order* at n.46. *See also* e*x parte* comments of Nextel Communications, Inc., ET Docket No. 00-258 (filed Sept. 2, 2004).

[44] TIA describes the near/far effect as being produced "when a mobile station is located far from its serving base station, but near an interfering base station. Under these circumstances, the strength of the desired signal is low while the strength of the interfering signal is high. The interfering signal may be out-of-block emissions from the interfering base station (for co-market interference), or co-block (or even co-channel) emissions from the interfering base station (for adjacent market interference). Generally, sensitivity degradation [] is the controlling factor in interference cases, but the near/far effect may be important in some circumstances, such as co-channel interference near market boundaries, and during deep fades or other periods of low desired signal levels." TIA/EIA TSB-84A at Section 9.4.

[45] *See* TIA/EIA TSB-84A.

far from its associated base station, but also occurs when the PCS handset is operated in buildings, vehicles or other locations having obstruction losses.

Moreover, all assumptions and tests to date have only considered a *single* H Block mobile device as the interfering source, but each time the number of H Block mobile devices doubles, so does the interference. The PCS handset operating environment today suggests that there will be multiple handsets operating in near proximity to victim handsets. Accordingly, the Commission incorrectly minimizes the potential for H Block-to-PCS interference by asserting that operation at the edge of cell is a necessary but improbable condition to overload interference. Moreover, the Commission's analysis is irrelevant to the user who happens to be operating at the edge of the service area and whose call is interfered with by virtue of his location.

C. Under Realistic Assumptions, Overload Interference Occurs At A Received H Block Device Signal Power Level Of –28 dBm.

Stripped of the unrealistic assumption of –3 dB for antenna gain, the 23 dBm power limit proposed by the Commission would allow –18 dBm into the PCS handset at spacing distance between H Block and PCS devices of one meter, causing every direct conversion handset tested by Nokia that used a SAW filter to experience increases in FER well in excess of one percent.[46] As the V-COMM Report explains, the test data compiled by PCTest and WINLAB indicates that PCS operations experience overload interference resulting in unacceptable increases in FER when the received H Block mobile device signal power is at a level of –28 dBm.[47] Moreover, it can be expected based upon the test results that H Block-originated overload interference would

[46] Test Phones 1-3 in the Nokia Test Report were direct conversion handsets using SAW filters, while the remaining direct conversion handset – Test Phone 4 – used an FBAR filter.

[47] *See* V-COMM Report at 12.

impact *all* PCS spectrum (Blocks A-F) – not just the A Block, as the Commission surmised.[48] In any event, the Commission's proposed "acceptable" received H Block signal level of –21 dBm (which includes 6 dB of losses for antenna gain and body absorption) is well above the –36 dBm level required to protect PCS operations from IM interference.

V. THE COMMISSION SHOULD ESTABLISH AN OOBE LIMIT FOR H BLOCK DEVICES OF –76 DBM/MHZ

There does not seem to be any disagreement in the record that H Block devices must be subject to OOBE limits well below the –13 dBm/MHz limit for PCS devices currently set forth in Part 24 of the Commission's Rules. The wireless industry has consistently maintained that if the H Block is ultimately used for terrestrial mobile services, those services must be subject to the –76 dBm/MHz OOBE limit set forth in PCS industry standard, TIA 98-F, to avoid adverse impacts to wireless consumers.[49] CDMA handsets meet the –76 dBm/MHz limit and are designed with the expectation that the –76 dBm/MHz limit will not be exceeded. The test data supplied by PCTest and WINLAB supports that view, and the CDMA Carriers reiterate that such a limit is necessary to protect PCS operations.

Neither the –60 dBm/MHz OOBE limit nor the –66 dBm/MHz limit suggested by the Commission is sufficient to protect existing PCS operations. As explained in the V-COMM report, neither of these limits is reflective of the receiver sensitivity of today's PCS handsets.[50] Specifically, the test data shows that in-band (AWGN) noise causes interference to CDMA calls at a level of –117 dBm/MHz, which would require an OOBE limit of –76 dBm/MHz to protect

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[48] *Id*.

[49] The –76 dBm/MHz limit should be measured using an average RMS function.

[50] *See* V-COMM Report at 25-26.

mobiles one meter away.[51] Moreover, as V-COMM explains, the PCTest and WINLAB test data suggests that GSM handsets in widespread use today would in fact meet the –76 dBm/MHz limit.[52] Specifically, the V-COMM Report found that, "Existing PCS handsets that operate at the +23 dBm transmit power level comply with [the –76 dBm/MHz] limit by a large margin; or by about 20 dB on average, or by 16 dB in the worst case."[53] Further, the record in this proceeding indicates that filtering technology exists that would enable H Block mobile devices to meet this limit.[54] Accordingly, the Commission's assertion that a –60 dBm/MHz limit would leave PCS no worse off than it is today does not ring true.[55] In any event, GSM is a high-power (+30 dBm), narrowband, time-gated technology that should not serve as the basis for developing an OOBE limit to protect wideband, code-based operations adhering to the CDMA standard.

[51] *Id*. at 26. This figure is computed as –76 dBm/MHz, minus 38 dB of free space loss for 1 meter, minus 3 dB of loss for head, body and/or other miscellaneous factors body loss, which equals a –117 dBm/MHz power level at the victim receiver.

[52] GSM handsets tested in CTIA tests were all below –71 dBm/MHz level, and the average was 77.7 dBm/MHz, or 1.7 dB below the proposed -76 dBm/MHz level. *See* V-COMM Report at 20-21.

[53] *See id*. at 26.

[54] *See ex parte* comments of Agilent, ET Docket No. 00-258 (filed Aug. 19, 2002).

[55] The –60 dBm/MHz figure is also objectionable because it was proffered as providing protection at only two meters, which does not reflect everyday use of PCS handsets today.

VI. CONCLUSION

For the reasons set forth above, Sprint and Verizon Wireless request that the Commission take the following actions:

- Adopt an output power limit of 5 dBm for terrestrial mobile devices operating in the 1918.125-1920 MHz band;
- Adopt an output power limit of 8 dBm for terrestrial mobile devices operating in the 1916.875-1918.125 MHz band;
- In the alternative, designate the 1916.875-1920 MHz band for other non-interfering uses, such as Fixed or Air-to-Ground;
- Complete further testing to determine an appropriate power limit for the 1915-1916.875 MHz band; and
- Adopt an out-of-band emissions limit for operations in the H Block spectrum that limits emissions into the 1930-1990 MHz PCS receive band to –76 dBm/MHz.

Respectfully submitted,

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ATTACHMENT A

H-Block Impact on Incumbent PCS Operations

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