

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

In the Matter of)	
)	
Amendment of Part 15 of the)	
Commission's Rules Regarding Spread)	ET Docket No. 99-231
Spectrum Devices)	
)	DA 00-2317
Wi-LAN, Inc.)	
Application for Certification of an)	
Intentional Radiator Under Part 15 of The)	
Commission's Rules)	

Reply Comments of Agere Systems

Agere Systems (“Agere”) is a leading manufacturer of Wireless Local Area Network (“WLAN”) devices and equipment compliant to the IEEE 802.11b standard that operates at transmission rates of up to 11 Mbps in the 2.4 GHz band as unlicensed Part 15 devices. Agere is also a promoter member of the Bluetooth SIG, Inc. and a manufacturer of FHSS products compliant to the Bluetooth specification.

Agere actively participates in the IEEE 802.11 Local Area Network Standards Committee’s Task Group G, which is developing extensions for systems that would operate under the category of Digital Transmission Systems (“DTSs”), for which the Commission is considering enabling changes to its rules in this proceeding. Agere is also actively developing DTS products.

As such, Agere is an interested party in this proceeding and appreciates the opportunity to present these timely filed reply comments for the Commission’s consideration.

Introduction and Executive Summary

1. On May 10, 2001, the Commission adopted a *Further Notice of Proposed Rule Making and Order* (the “*Further Notice*”)¹ in the above-captioned proceeding to improve spectrum sharing by unlicensed devices operating in the 2.4 GHz band (2400 - 2483.5 MHz), provide for introduction of new digital transmission technologies, and eliminate unnecessary regulations for spread spectrum systems.

2. According to the FCC’s Electronic Comment Filing System (“ECFS”), a total of 22 comments (including those of Agere) were timely filed, with additional sets of comments filed as “Ex Parte or Late filed.”

3. Agere, in these reply comments, responds to specific points raised by some of the other Commenters that we believe merit further discussion and consideration by the Commission.

Adaptive Frequency Hopping in the 2.4 GHz Band

4. A majority of the Commenters, including Agere, support the Commission’s proposed rules change to permit a reduced hopset of no fewer than 15 hopping frequencies and a power limit of 125 mW.

5. However, some Commenters expressed that while the use of adaptive hopping (“AH”) techniques should be permitted, they should not be mandatory, and that the proposed reduction in power would be sufficient to provide adequate interference protection to other occupants of the band. Agere respectfully disagrees with this viewpoint.

¹ *Further Notice of Proposed Rule Making and Order, FCC 01-158, May 10, 2001.*

6. While a reduction in power might reduce the interference potential, we respectfully submit that the Commission's public interest objective should be to maximize the coexistence potential between FHSS systems (such as, for example, Bluetooth), DSSS systems (such as, for example, 802.11b), and the new class of DTSs that the Commission proposes to authorize. The Commission should strive to maximize the coexistence potential so that the 2.4 GHz band can support the ever-increasing number of users in the frequency band.

7. Furthermore, while the Commission's current rules permit a maximum transmit power of 1 Watt, in reality the vast majority of FHSS and DSSS devices in use employ transmit powers well below that limit. For example, the maximum transmit power for a Bluetooth "Class 1" device, per the Bluetooth qualification requirements, is +20 dBm, or 100 mW, which is 10 dB below the Commission's current transmit power limits. Additionally, most Bluetooth devices operate as "Class 2" or "Class 3" devices, which are limited by the Bluetooth qualification requirements to transmitter output powers of +4 dBm and 0 dBm, respectively, which equates to 26-30 dB below the current Part 15.247 power limit of 1 Watt. As such, if the power limits were allowed to exceed 125 mW, other occupants of the 2.4 GHz band may suffer from unacceptable levels of interference.

8. We submit that permitting a reduction in the number of hopping channels without also simultaneously requiring the use of AH techniques falls short of maximizing the coexistence potential between various occupants of the band, which is necessary to promote efficient use of the spectrum by all types of ever-increasing numbers of Part 15 devices.

9. For this reason, Agere encourages the Commission to consider the use of AH techniques, along with the proposed power limit of 125 mW, in exchange for the flexibility of employing hopsets as small as 15 hops for FHSS systems with 20 dB bandwidths of 1 MHz or less.

10. One Commenter² supports reducing the hopset requirement to 15 hops and the 125 mW power limit, but equates the use of AH techniques with Quality of Service (“QoS”) mechanisms, stating that the use of AH techniques is “overly protective,” “not necessary to mitigate interference,” and “counterproductive.”

11. Agere wishes to clarify that QoS mechanisms and AH techniques are not equivalent. QoS mechanisms typically operate only within, and benefit, the system that implements them. While the use of AH techniques result in reduced interference to AH-FHSS systems from other occupants of the band, in contrast to QoS mechanisms, it will also result in reduced interference to other occupants of the band.

12. Another Commenter³ supports reducing the minimum required hopset to 15 hops, but suggests that the 15 hopping frequencies be spread uniformly over a minimum of 90% of the band and further states that the use of AH techniques cannot be made mandatory because transmit only devices could not comply.

13. Agere objects to the suggestion of uniformly spreading the 15 hopping frequencies over a minimum of 90% of the band because that would defeat the intent of reducing the minimum required hopset. The Joint Petitioners⁴ asked the Commission for the ability to use reduced hopsets in order to allow AH techniques to be practically applied, selectively and adaptively using unoccupied portions of the band to avoid interference to and from “wideband, frequency static” systems.

14. With respect to transmit only devices, Agere submits that, under the proposal we submitted, they could continue to operate within the “75 hop” requirement. Furthermore, because the duty cycles of transmit only devices are typically quite low, the interference potential presented by this approach is minimal.

² See *Comments of Adtran, Inc.*

³ See *Comments of Ademco Group*

⁴ See *Joint Petition for Clarification or, in the Alternative, Partial Reconsideration*, (the “Joint Petition”) filed October 20, 2000 by 3Com, Apple Computer, Cisco Systems, Dell Computer, IBM, Intel Corp., Intersil, Lucent Technologies (Agere Systems was formerly the Microelectronics Group of Lucent Technologies), Microsoft, Nokia Inc., Silicon Wave, Toshiba American Information Systems, and Texas Instruments (the “Joint Petitioners”)

15. In summary, Agere believes that the use of intelligent AH techniques should be required, along with the 125 mW power limit proposed, in exchange for the flexibility and advantages of the ability to employ reduced hopssets in “narrowband” FHSS systems.

16. Agere believes that the line of argument detailed in one Commenter’s filing, indicating that “The Commission’s Frequency Hopping Proposal Could Lead To Systems That Spread Less And, Therefore, Increase The Potential For Interference,”⁵ is unsupported and contradicted by the preliminary determination of the Commission.⁶

17. In support of its challenge to the Joint Petition and the Commission’s resulting proposal, the Commenter states that it “... disagrees with both the Petitioners’ premise that the current regulations worsen interference by compelling multiple systems to operate predominantly in the same spectrum and the notion that the current rules negate the opportunity for frequency hopping systems to use AH techniques.”

18. Agere, as one of the Joint Petitioners, believes that the Joint Petitioners adequately described valid and technically correct reasons demonstrating that the Commission’s current rules unintentionally result in unnecessary and avoidable interference. Correspondingly, the Joint Petitioners explained why the Commission should modify its rules in order to appropriately mitigate such unnecessary and avoidable interference.

⁵ See *Comments of Proxim, Inc.*, page 3 at section I.

⁶ See *Further Notice of Proposed Rule Making and Order*, FCC 01-158, May 10, 2001, at para. 12-13

19. The Commenter's contention that, "The proposed rule change ... will lead to systems with less spreading and, therefore, increased interference potential to other receivers.", misinterprets the available body of knowledge. A primary source of unnecessary, avoidable interference between systems in the 2.4 GHz band is caused by the requirement that narrowband FHSS systems employ at least 75 hopping frequencies, which makes it impossible for FHSS systems such as Bluetooth and frequency static DSSS systems such as IEEE 802.11b systems to avoid occupying the same frequencies at the same time.

20. The combined use of reduced hopsets and AH techniques will, as described by the Joint Petitioners, eliminate, or at least greatly reduce, instances of unnecessary interference, promoting coexistence and allowing increased efficiency in the use of the 2.4 GHz band.

21. The Commenter states that the proposed minimum hopset of 15 hopping channels "now appears completely arbitrary" and appears to argue in favor of requiring all FHSS systems to occupy a significantly larger portion of the band at a minimum.⁷

22. While it is true that the Joint Petitioners selected this number, in part, for consistency with the Commission's new rules for the number of hopping frequencies required as a minimum for the Wideband FHSS systems, such as "HomeRF," the choice was not made solely on that basis.

23. When the current density of occupancy of the 2.4 GHz band is taken into account, along with the dramatically increasing numbers of occupants (FHSS, DSSS, and DTS) in the band, one can determine that continued coexistence amongst FHSS systems and other occupants of the band can only be achieved by a regime that allows, and even requires, narrowband FHSS systems to intelligently adapt their hopsets to find the remaining, relatively narrow, unoccupied "holes" in the band.

⁷ See *Comments of Proxim, Inc.*, page 3 and 4 at section II.

24. In Section II of its comments, the Commenter seems to misunderstand the intent of the Joint Petitioners, envisioning instead a continued requirement that the proposed minimum hopset of 15 hopping channels span at least 75 MHz, even for “narrowband” FHSS systems.⁸

25. To clarify, the intent of the Joint Petition was that narrowband FHSS systems employing intelligent AH techniques and operating at or below the 125 mW transmitter power limit would not be required to span 75 MHz. Rather, such narrowband FHSS systems would be permitted to employ as few as 15 hopping frequencies independently, intelligently, and adaptively selected to avoid interference to and from other occupants of the band.

26. As was stated in the Joint Petition, it was the Joint Petitioners’ intent to seek rule modifications enabling narrowband FHSS systems (such as Bluetooth) to effectively employ AH techniques to mitigate unnecessary and avoidable interference between such systems and other occupants of the band.

27. We would respectfully refer the Commission’s attention to the proposed rules language suggested in the Joint Petition, which we believe addresses the Joint Petitioners’ request for reduced hopsets for narrowband systems employing AH techniques, while simultaneously preserving the provisions for Wideband FHSS systems enacted by the Commission in its First Report and Order.

28. We make two additional observations with regard to the Commenter’s comments on the Commission’s proposed new rules for adaptive FHSS systems in the 2.4 GHz band.

29. We also believe that the Commenter’s assertion that FHSS systems using AH techniques should be required to occupy 50-60% of the 2.4 GHz band⁹ is excessive and would reduce the coexistence benefits of the AH techniques.

⁸ See *Comments of Proxim, Inc.*, page 3 and 4 at section II.

⁹ See *Comments of Proxim, Inc.*, page 5, in the first (partial) paragraph at the top of the page

30. The vast majority of Commenters supported the 15 hop minimum proposed by the Joint Petitioners and embodied in the Commission's proposed language for new rules.

31. Agere continues to support the 15 hop minimum as providing a reasonable amount of spreading, yet not requiring the occupancy of so much bandwidth that adaptive FHSS systems cannot possibly find a hopset which does not overlap other, wideband, frequency static occupants of the band, such as DSSS systems and DTS systems.

32. Secondly, the Commenter opposes the 125 mW transmitter power limit, objecting to the 125 mW power limit because they contend that voice applications would benefit from a 1 Watt, rather than a 125 mW, power limit. However, the Commission, in its *First Report and Order* in this proceeding, already considered this issue and decided that a 125 mW limit was sufficient and appropriate for WBFH systems (such as "HomeRF," which supports voice applications). The Commission determined that 1 Watt was not necessary to support such applications and that a limit of 125 mW was appropriate in the interest of mitigating interference from such systems. In addition, the Commenter's current line of products supports voice applications without the necessity of 1 Watt of transmit power. In view of the foregoing, we respectfully believe that the Commission should favorably view the conclusion reached by the vast majority of the Commenters and that the Commission should limit the transmitter power level to 125 mW for narrowband FHSS systems employing reduced hopsets and AH techniques.

33. Finally, Agere reiterates its recommendation and rationale for the elimination of the "30 second re-determination of hopsets" requirement proposed in the *Further Notice*.¹⁰ We note other Commenters,¹¹ also oppose this requirement on the same basic grounds as Agere.

¹⁰ See *Comments of Agere Systems*, at 16

¹¹ See *Joint Comments of 3Com Corporation, et al*, at footnote 11; see also *Comments of Intersil Corporation*, in the last sentence of the paragraph ending at the top of page 4

34. FHSS systems using effective AH techniques should evaluate the interference environment in which they operate on a continuous basis, adapting to a changing environment in a manner that avoids interference to and from other occupants of the band, particularly frequency static wideband systems such as 802.11b and DTS systems.

35. As stated in Agere's original comments in this proceeding, verification of compliance to a requirement to use AH techniques in exchange for the ability to use a reduce hopset can consist of a relatively simple test. First, the FHSS system would be placed into a mode where it is observed to be engaged in normal communications and to be hopping with a particular hopset. Next a static interference source, for example a CW carrier or a DSSS signal (such as an IEEE 802.11b compliant signal) would be introduced into a portion of the band encompassed by the FHSS system's hopset, and the FHSS system should be observed to adapt its hopset to avoid the other system. This process can be repeated, changing the frequency of the static interference source and observing that the FHSS system again adapts its hopset to avoid the other system.

Digital Transmission Systems ("DTSS")

36. Agere notes that virtually all of the Commenters support some form of modifications to the Commission's rules authorizing the deployment of DTSSs.

37. However, there appears to be no clear consensus on the favored mechanism, modification of Part 15.247 of the Commission's rules, modification of the U-NII rules, or some combination thereof, nor on the rules on the power limits.

Mechanism for New Rules

38. Five Commenters proposed to maintain a total power limit for DTS of 1 Watt¹². One of them explicitly state proposes to adopt a total power limit of 1 Watt, or $17 \text{ dBm} + 10\log B$, where B is the bandwidth in MHz and a PSD of 17 dBm/MHz to "ensure that higher power levels are available for point-to-point operations" in the case that the FCC would eliminate the DSSS rules. Agere assumes that all of those Commenters made the proposal for the high total power limit in order to ensure that businesses that plan to approve current DSSS devices intended point-to-point links under to the current rules would still be approved under the new rules in the immediate future. To respond to the concern of those requiring extension of approval for systems that are under development using the current rules, Agere proposed to maintain the current DSSS rules. To respond to those that would like to be able to deploy point-to-point links under the new rules, Agere proposed to permit higher gain antennas for DTSs.

39. Five Commenters proposed maintaining the processing gain requirement¹³. Eight Commenters supported the elimination of the processing gain requirement¹⁴. In addition, one Commenter¹⁵ expressed concern about the new rules leading to systems with less spreading and thus to more interference. To respond to the concerns of those that want to keep the processing gain requirement, Agere proposed to maintain the original rules for DSSS. To respond to those that want to eliminate the processing gain rules as well to those that are concerned that the new rules would not limit the interference potential, Agere proposes to adopt DTS rules with stricter limits on the power spectral density.

¹² See Comments of Intersil Corporation, the OFDM Forum, Texas Instruments, Wi-LAN and WCIA, supporting a 1 W power limit.

¹³ See Comments of Agere Systems, the Ademco Group, the ARRL, Axonn, and Intersil.

¹⁴ See Comments of Adtran, CISCO Systems, the Joint Commenters, the OFDM Forum, Silicon Wave, Western Multiplex, Wi-LAN, and the Wireless Communication Industries Association.

¹⁵ See Comment of Proxim, Inc., page 3, 2nd paragraph in section I.

40. Agere respectfully suggests that the proposal outlined in its comments,¹⁶ wherein Part 15.247 of the Commission's rules would be maintained in place for DSSS and FHSS systems (with the necessary modifications to the FHSS rules to provide for effective use of AH in the 2.4 GHz band) and combined with an expansion of the U-NII rules to provide for DTSs in the 2.4 GHz band, represents an effective regulatory mechanism to provide for the needs of all users of the band with a minimum of disruption and confusion.

Power Limits

41. We also observe that there appears to be a divergence of opinion amongst the Commenters with respect to what transmit power limit should be applied to DTSs in the 2.4 GHz band, with five Commenters favoring the retention of a 1 Watt transmit power limit for DTSs¹⁷ and three Commenters advocating lower transmitter power¹⁸ varying between 100 and 250 mW. Agere has proposed to limit the total power limit for DTSs to 125 mW together with an increase in the permitted antenna gain. The lower total power limit is a contribution to the conservation of power radiation in the band, thus permitting better re-use of the frequency for neighboring cells and limiting the interference potential. The increase in antenna gain is a response to those that are concerned about the capabilities of point-to-point links.

¹⁶ See *Comments of Agere Systems*, at 25-27 and 30-32, along with suggested rules change language in Appendix B

¹⁷ See *Comments of Intersil Corporation, the OFDM Forum, Texas Instruments, Wi-LAN and WCIA support a 1 W power limit*.

¹⁸ See *Comments from Adtran (100 mW), Agere (125 mW) and Intersil (250 mW)*,

42. One Commenter¹⁹ was concerned about the new rules leading to systems with less spreading and thus to more interference and seven Commenters proposed to require power spectral density limits of between 11 and 22 dBm/MHz²⁰ rather than the limit of 8 dBm/3 kHz (equivalent to 33 dBm/MHz) as proposed by the FCC. Agere contends that their proposed limit for power spectral density of 10 dBm/MHz and a total power limit of 125 mW suits the mobile applications, while an increased antenna gain limit from 6 dBi to 15 dBi would benefit the point-to-point applications.

43. Agere reiterates the assertions in our comments²¹ that, given the wide flexibility in waveforms which may be employed in DTSSs, a lower transmit power limit and power spectral density limit, combined with allowances for higher antenna gains, are warranted in the interest of limiting the interference potential of DTSSs and promoting coexistence and efficient spectral use in the 2.4 GHz band.

44. We also respectfully refer the Commission's attention to the usage cases and link analyses presented in Appendix A of Agere's comments²², which demonstrate that equivalent, and in some cases superior, link performance can be obtained and interference potential to other systems can actually be reduced in point to point and point to multipoint applications with transmitter powers which are below the current 1 Watt, 8 dBm/3 kHz DSSS transmitter power and PSD limits of Part 15.247 of the Commission's rules, provided that the benefits of higher directional antenna gains are allowed in the point to point and point to multipoint usage cases and are exploited appropriately through good system design.

¹⁹ See *Comment of Proxim, Inc.*, page 3, 2nd paragraph in section I

²⁰ See *Comments of Agere Systems (11 dBm/MHz), Apple Computer (10 dBm/MHz), IEEE 802 (20 dBm/MHz if approved to transmit the full 1 W total power limit. Devices for the nomadic applications, however, are deployed with total power of less than 100 mW or 10 dBm/MHz power spectral density), Intersil Corporation (11 dBm/MHz), OFDM Forum (17-20 dBm/MHz), Texas Instruments (17-20 dBm/MHz), and the Wireless Communications Industries Association (22 dBm/MHz)*

²¹ See *Comments of Agere Systems*, at 19-24

²² See *Comments of Agere Systems*, Appendix A

45. In the interest of reducing potential interference and maximizing the efficient use of the spectrum in the 2.4 GHz band by DTSs, Agere therefore again respectfully urges the Commission to adopt the 125 mW transmit power limit and 10 dBm/MHz PSD limits for 2.4 GHz DTSs, along with provisions in its rules allowing higher directional antenna gains for point to point and point to multipoint systems before reductions in transmitter output power would be required, as proposed in our comments.

Respectfully submitted,

Agere Systems

By: /s/
Mark A. Kurisko
Corporate Counsel
Agere Systems
1247 South Cedar Crest Blvd.
Building 1259, Room 59-111P
Allentown, PA 18103

(610) 712-3754 voice
(610) 712-3760 FAX

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This is to certify that on the 25th of September, 2001, service copies of the attached document entitled "Reply Comments of Agere Systems" were delivered to the US Postal Service for delivery to the following interested parties:

Ademco Manufacturing Company
Division of Honeywell
160 Eileen Way
Syosset NY 11791
ATTN: Mr. Daniel J. O'Sullivan

Adtran, Inc.
c/o Mintz, Levin, Coh, Ferris, Glovsky
& Popeo, P.C.
701 Pennsylvania Ave, NW
Suite 900
Washington DC 20004
ATTN: Mr. Russel H. Fox

Apple Computer, Inc.
c/o Harris, Wiltshire & Grannis, LLP
1200 Eighteenth Steet, N.W.
Suite 1200
Washington DC 20036
ATTN: Mr. Scott Blake Harris

The American Radio Relay League
c/o Booth, Freret, Imlay & Tepper, P.C.
5101 Wisconsin Avenue, N.W.
Suite 307
Washington DC 20016
ATTN: Mr. Christopher D. Imlay

Axon, LLC
c/o Schwaninger & Associates, P.C.
1331 H Street, N.W.
Suite 500
Washington DC 20005
ATTN: Mr. Garret R. Hargrave

Bluetooth SIG, Inc.
c/o Mr. Tom Siep, General Manager
1802 Pleasant Valley Drive, #100
M/S 365
Garland TX 75040
ATTN: Mr. Tom Siep

Bret Boren
1000 Breeze Way
Southlake TX 76092

Cisco Systems Inc.
320 Springside Drive
Akron OH 44333
ATTN: Mr. David A. Case, NCE

IEEE Project 802
c/o Agere Systems
Zadelstede 1-10
Nieuwegein 3431 JZ
The Netherlands
ATTN: Mr. Vic Hayes

Intel Corporation
Intel Government Affairs
1643 I Street, NW
Suite 300
Washington DC 20006
ATTN: Mr. Peter Pitsch

Clearwire Technologies, Inc.
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

3Com Corporation
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

Intersil Corporation
2401 Palm Bay Road
Palm Bay FL 32903
ATTN: Mr. Larry Ciaccia

InterWAVE Communications Inc.
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

LinCom Wireless, Inc.
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

Symbol Technologies, Inc.
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

Vocollect, Inc.
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

The OFDM Forum
c/o Mr. Peter Nurse
2891 Sunridge Way NE
Calgary AB T1Y 7K7
Canada
ATTN: Mr. Peter Nurse

Proxim, Inc.
c/o Goldberg, Godles, Wiener & Wright
1229 Nineteenth Sreet, N.W.
Washington DC 20036
ATTN: Mr. Henry Goldberg

Sirius Satellite Radio Inc.
c/o Latham & Watkins
555 11th Street, N.W.
Suite 1000
Washington DC 20004
ATTN: Mr. Davide Leive

Silicon Wave, Inc.
c/o Harris, Wiltshire & Grannis, LLP
1200 Eighteenth Street, N.W.
Suite 1200
Washington DC 20036
ATTN: Mr. Scott Blake Harris

Texas Instruments
Government Relations
1455 Pennsylvania Avenue NW
Suite 375
Washington DC 20004
ATTN: Mr. John Boidock

WIDCOMM Inc.
9645 Scranton Rd.
Suite 205
San Diego CA 92121
ATTN: Mr. Heip Pham

Western Multiplex Corp.
1196 Borregas Avenue
Sunnyvale CA 94568
ATTN: Mr. Donald J. Arndt

WECA
c/o Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street
11th Floor
Arlington VA 22209
ATTN: Mr. Mitchell Lazarus

Wi-LAN, Inc.
2891 Sunridge Way NE
Calgary AB T1Y 7K7
Canada
ATTN: Mr. Ramesh Uppal

Wireless Communications Association
International, Inc.
c/o Wilkinson Barker Knauer, LLP
2300 N Street, NW
Suite 700
Washington DC 20037 1128
ATTN: Mr. Paul J. Sinderbrand

By: /s/
Mark A. Kurisko
Corporate Counsel
Agere Systems
1247 South Cedar Crest Blvd.
Building 1259, Room 59-111P
Allentown, PA 18103

(610) 712-3754 voice
(610) 712-3760 FAX