

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: David Chauncey et al.
U.S. Patent No.: 8,345,780 Attorney Docket No.: 50095-0106IP1
Issue Date: January 1, 2013
Appl. Serial No.: 12/132,757
Filing Date: June 4, 2008
Title: WIRELESS COMMUNICATION SYSTEM COMPENSATING
FOR INTERFERENCE AND RELATED METHODS

DECLARATION OF DR. ZHI DING

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I, Zhi Ding, Ph.D., declare that:

I. Introduction

1. My name is Zhi Ding, and I have been retained by counsel for Petitioner Apple Inc. (“Apple” or “Petitioner”) as an expert witness to provide assistance regarding U.S. Patent 8,345,780 (“the ’780 Patent”). Specifically, I have been asked to consider the validity of claims 1-4 and 7-14 of the ’780 Patent (the “Challenged Claims”) in view of prior art, anticipation and obviousness considerations, and understanding of a person of ordinary skill in the art at the time of the invention, i.e., as of the effective filing date of the patent application as it relates to the ’780 Patent (“POSITA”). I have personal knowledge of the facts and opinions set forth in this declaration and believe them to be true. If called upon to do so, I would testify competently thereto.

2. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the challenged claims. I have no financial interest in the outcome of this matter or on the pending litigation between Petitioner and Patent Owner.

3. My analysis here is based on my years of education, research and experience, as well as my investigation and study of relevant materials, including

those cited herein.

4. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

5. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. Background and Qualifications

6. I presently hold the title of Distinguished Professor in the Department of Electrical and Computer Engineering at the University of California, Davis. Since my appointment on July 1, 2020, I have held the position of professor for the past 22 years and have served as a faculty member at several US universities for over 32 years. I am also a private technical consultant on various technologies related to information systems. In total, I have more than three decades of research experience on a wide range of topics related to data communications and signal processing.

7. I earned my Bachelor of Science degree in 1982 in wireless engineering from the Nanjing Institute of Technology (later renamed as Southeast University) in

Nanjing, China. I earned my Master of Science degree in 1987 in electrical engineering from the University of Toronto in Toronto, Canada. I earned my Ph.D. in 1990 in electrical engineering from Cornell University in Ithaca, New York.

8. My responsibilities as a Professor at University of California, Davis, include classroom instruction on various topics of communication systems and signal analysis, as well as mentoring undergraduate students and supervising graduate students in their research and development efforts on various topics related to digital communications. I have directly supervised such research and development works ranging from signal detection to wireless networking. As the chief academic advisor, I have also directly supervised the completion of over 20 Masters theses and 30 Ph.D. dissertations on various topics related to digital communications. I have served full time as a faculty member at three major research universities in the United States over the past 30 years, including Auburn University from 1990 to 1998, University of Iowa from 1999 to 2000, and University of California, Davis, from 2000 to present.

9. Since 1990, I have been selected as the principal investigator of multiple highly competitive federal and local research grants, including more than twenty major research projects supported by the National Science Foundation and two research projects funded by the U.S. Army Research Office. These competitive research projects focused on developing more efficient and effective digital

communication transceivers, networks, and signal processing tools. I have also participated in several large-scale projects supported by the Defense Advanced Research Projects Agency (DARPA) with teams of researchers. I have applied for, and received support from, other federal, state, and industry sponsors.

10. I have published over 210 peer-reviewed research articles in premier international journals, in addition to over 240 refereed technical articles at top international conferences on communications and information technologies. According to Google Scholar, my published works have been cited by over 13,000 times by peers. I also authored two books on communications technologies. My most recent book, coauthored with B.P. Lathi, is entitled, “Modern Digital and Analog Communication Systems,” 5th edition, and was published by the Oxford University Press in 2018. The 4th edition of this book (published in 2009) had been widely adopted as an introductory textbook to communication systems.

11. In addition to the over 450 published technical papers that have been cited over 15,000 times according to Google Scholar, I am also co-inventor of 4 issued U.S. patents on communication technologies.

12. I am a member of the Institute of Electrical and Electronics Engineers (IEEE) and was elevated to the grade of Fellow in January 2003 for contributions made in signal processing for communication. The IEEE is the world’s largest professional society of engineers, with over 400,000 members in more than 160

countries. The IEEE has led the development of many standards for modern digital communications and networking, most notably, the IEEE 802 series of network standards. The IEEE Grade of Fellow is conferred by the Boards of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership.

13. I have served the IEEE in the following capacities:

- Chief Information Officer of the IEEE Communications Society from Jan. 2018 to present.
- Chief Marketing Officer of the IEEE Communications Society from Jan. 2020 to present.
- General Chair of the 2016 IEEE International Conference on Acoustics, Speech, and Signal Processing, the flagship conference of the IEEE Signal Processing Society.
- Chair of the Steering Committee for the IEEE Transactions on Wireless Communications from 2008 to 2010.
- Distinguished Lecturer of the IEEE Communications Society from January 2008 to December 2009.
- Technical Program Chair of the 2006 IEEE Globecom, one of two flagship annual IEEE Communication Society conferences.

- Distinguished Lecturer of the IEEE Circuits and Systems Society from 2004 to 2005.
- Associate Editor of the IEEE Transactions on Signal Processing from 1994 to 1997 and from 2001 to 2004.
- Member of the IEEE Statistical Signal and Array Processing for Communications Technical Committee from 1993 to 1998.
- Member of the IEEE Signal Processing for Communications Technical Committee from 1998 to 2004.

14. In 2012, I received the Wireless Communications Technical Committee Recognition Award from the IEEE Communications Society, an award given to a person with a high degree of visibility and contribution in the field of “Wireless and Mobile Communications Theory, Systems, and Networks.” I received the 2020 Education Award from the IEEE Communications Society. According to the Society, this award “recognizes distinguished and significant contributions to education within the Society’s technical scope.”

15. I have also served as a technical consultant for the telecommunication industry. For example, in 1995 I consulted for Analog Devices, Inc., on the development of the first generation DOCSIS cable modem systems. I have also consulted for other companies, including Nortel Networks and NEC US Laboratories. I worked as a visiting faculty research fellow at NASA Glenn Research

Center in 1992 and at U.S. Air Force Wright Laboratory in 1993. I have served on multiple review panels of the National Science Foundation to evaluate competitive research proposals in the field of communication. I have also reviewed a large number of research proposals at the request of the National Science and Engineering Research Council (NSERC) of Canada as an expert panelist from 2010 to 2013, and also at the request of the Research Grant Council (RGC) of Hong Kong as an external reviewer.

16. I have served as an expert witness or consulting expert on a number of matters related to intellectual property, mostly in the arena of telecommunications, including cellular communications, Wi-Fi technologies, Bluetooth, and optical communications. For example, since 2007, I have been engaged to work on various litigations involving cellular, WiFi, Bluetooth, and optical communication networks.

17. Further experience and a complete list of my publications are presented in my curriculum vitae. I understand that a copy of my curriculum vitae is attached as APPLE-1004.

18. Based on my above-described near three decades of experience in communications technologies, and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to be an expert in wireless communication systems, communication networks, and signal processing.

19. Based on my experiences described above, and as indicated in my Curriculum Vitae, I am qualified to provide the following opinions with respect to the patents in this case. Additionally, I was at least a person having ordinary skill in the art as of June 4, 2008 (“Critical Date”).

III. Level of Ordinary Skill in the Art

20. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of one of ordinary skill at the time of the alleged invention, which I understand is asserted to be June 4, 2008—the filing date of the ’780 Patent. I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art, and the sophistication of the technology at the time of the alleged invention. I understand that one of ordinary skill is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that one of ordinary skill would also have knowledge from the teachings of the prior art, including the art cited below.

21. Taking these factors into consideration, on or before June 4, 2008, one of ordinary skill relating to the technology of the ’780 Patent would have had a Bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field from an accredited program, and 2-3 years of experience in design

or development of wireless communication systems/networks including ranging/positioning systems, or the equivalent. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

22. Before June 4, 2008, my level of skill in the art was at least that of one of ordinary skill. I am qualified to provide opinions concerning what one of ordinary skill would have known and understood at that time, and my analysis and conclusions herein are from the perspective of one of ordinary skill as of that date.

IV. Summary of Opinions and Materials Considered/Relied Upon

23. In reaching the conclusions described in this declaration, I have relied on the documents and materials cited herein as well as those identified in this declaration, including the '780 Patent, the prosecution history of the '780 Patent, and prior art references cited herein. These materials comprise patents, related documents, and printed publications. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions.

24. I have also relied on my education, training, research, knowledge, and personal and professional experience in the relevant technologies and systems that were already in use prior to, and within the timeframe of the earliest proclaimed priority date of the claimed subject matter in the '780 Patent, which is June 4, 2008

(“Critical Date”).

- APPLE-1001 U.S. Patent 8,345,780 to David Chauncey , *et al.*
(“the ’780 Patent”)
- APPLE-1002 Excerpts from the Prosecution History of the ’780
Patent (“the Prosecution History”)
- APPLE-1005 U.S. Patent 6,131,013 to Bergstrom, *et al.*
(“Bergstrom”)
- APPLE-1006 U.S. Patent Publication US2004/0047324 to Diener
(“Diener”)
- APPLE-1007 U.S. Patent Publication US2005/0266808 to
Reunamaki, *et al.* (“Reunamaki”)
- APPLE-1008 U.S. Patent Publication US2005/0099973 to Qiu,
et al. (“Qiu”)
- APPLE-1009 International Patent Publication Application
WO2005/062798 to Scheinert, *et al.* (“Scheinert”)
- APPLE-1010 Defendant’s Opening Claim Construction Brief,
Speir Technologies Ltd. v. Apple Inc., Case 6:22-cv-00077-ADA
(WDTX)
- APPLE-1011 Plaintiff’s Responsive Claim Construction Brief,
Speir Technologies Ltd. v. Apple Inc., Case 6:22-cv-00077-ADA

(WDTX)

- APPLE-1018 U.S. Patent Publication US 2004/0203826 to Sugar, *et al.* (“Sugar”)
- APPLE-1019 U.S. Patent Publication US 2003/0224741 to Sugar, *et al.* (“Sugar_CIP”)

25. In my opinion, the Challenged Claims of the '780 Patent are unpatentable because they are rendered obvious by the combinations of prior art references cited in this report and explained herein. The following table summarizes my opinions.

'780 Patent Claims	Prior Art Invalidity
1-4 and 7-14	Obvious over Diener and Bergstrom

V. Legal Standards

26. I am not a lawyer and do not provide any legal opinions, but I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding meaning and validity of patent claims. I have applied the legal standards described below, which were provided to me by counsel for the Petitioner.

27. It is my understanding that assessing the validity of a U.S. patent based on a prior art analysis requires two steps. First, one must construe the terms of the patent claims to understand what meaning one of ordinary skill in the art would have

given the terms. Second, after the claim terms have been construed, one may then assess validity by comparing a patent claim to the “prior art.” I understand that the teaching of the prior art is viewed through the eyes of one of ordinary skill at the time of the invention, i.e., as of the effective filing date of the patent application. My analysis as to what constitutes a relevant POSITA is set forth above.

A. Legal Standards for Claim Construction

28. I understand that, for purposes of my analysis in this IPR, the terms appearing in the patent claims should be interpreted according to their “ordinary and customary meaning.” In determining the ordinary and custom meaning, I understand that the words of a claim are first given the plain meaning that those words would have had to a person of ordinary skill in the art (“POSITA”) at the time of the invention, i.e., as of the effective filing date of the patent application. I also understand that the structure of the claims, the specification, and file history also may be used to better construe a claim insofar as the plain meaning of the claims cannot be understood. Moreover, I understand that even treatises and dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by a POSITA to a claim term at the time of the invention.

29. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention (not today).

30. I have followed these guidelines in my analysis, and, unless otherwise indicated, I have applied the plain and ordinary meaning of the claim terms.

B. Legal Standard for Obviousness

31. My understanding is that a patent claim is invalid as obvious only if the subject matter of the claimed invention “as a whole” would have been obvious to one of ordinary skill at the time of the invention, i.e., as of the effective filing date of the patent application. To determine the differences between a prior art reference (or a proposed combination of prior art references) and the claims, the question of obviousness is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. Also, obviousness grounds cannot be sustained by mere conclusory statements. Rather, it is necessary to provide some articulated reasoning with rational underpinning to support the legal conclusion of obviousness.

32. I understand that a patent claim that comprises several elements is not proved obvious by simply showing that each of its elements was independently known in the prior art. In my evaluation of whether any claim of the '780 Patent would have been obvious, I considered whether the Petition, or any evidence submitted in this proceeding, presented an articulated reason with a rational basis that would have motivated one of ordinary skill to combine the elements or concepts from the prior art in the same way as in the claimed invention.

33. It is my understanding that there is no single way to define the line between true inventiveness on one hand—which is patentable—and the application of common sense and ordinary skill to solve a problem on the other hand—which is not patentable. For instance, factors such as market forces or other design incentives may be the source of what produced a change, rather than true inventiveness.

34. I understand that the decision-maker may consider whether the change was merely the predictable result of using prior art elements according to their known functions, or whether it was the result of true inventiveness. And, the decision-maker may also consider whether there is some teaching or suggestion in the prior art to make the modification or combination of elements recited in the claim at issue. Also, the decision-maker may consider whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way. The decision-maker may also consider whether the claimed invention would have been obvious to try, meaning that the claimed innovation was one of a relatively small number of possible approaches to the problem with a reasonable expectation of success by those skilled in the art.

35. I have been instructed by counsel that if any of these considerations are relied upon to reach a conclusion of obviousness, the law requires that the analysis of such a consideration must be made explicit. I understand that the decision-maker must be careful not to determine obviousness using the benefit of hindsight and that

many true inventions might seem obvious after the fact. I understand that the decision-maker should consider obviousness from the position of one of ordinary skill at the time of the invention and that the decision-maker should not consider what is known today or what is learned from the teaching of the patent.

36. I understand that in order to determine whether a patent claim is obvious, one must make certain factual findings regarding the claimed invention and the prior art. Specifically, I understand that the following factors must be evaluated to determine whether a claim is obvious: the scope and content of the prior art; the difference or differences, if any, between the claim of the patent and the prior art; the level of ordinary skill in the art at the time of the invention; and, if available, the objective indicia of non-obviousness, also known as “secondary considerations.”

37. I understand that the secondary considerations include: commercial success of a product due to the merits of the claimed invention; a long felt need for the solution provided by the claimed invention; unsuccessful attempts by others to find the solution provided by the claimed invention; copying of the claimed invention by others; unexpected and superior results from the claimed invention; acceptance by others of the claimed invention as shown by praise from others in the field or from the licensing of the claimed invention; teaching away from the conventional wisdom in the art at the time of the invention; independent invention of the claimed invention by others before or at about the same time as the named

inventor thought of it; and other evidence tending to show obviousness.

38. I understand that, to establish a secondary consideration, the evidence must demonstrate a nexus between that secondary consideration and the claimed invention.

VI. Overview of the '780 Patent

A. Background of Related Technology

39. The '780 patent “relates to the field of communications, and, more particularly, to interference compensation and related methods.” APPLE-1001, 1:7-9. The '780 patent recognizes that “[a]s wireless communications has become prevalent in society, it is not uncommon for two wireless communications devices to interfere with the operation of each other when operating within transmission range of each other.” APPLE-1001, 1:13-17.

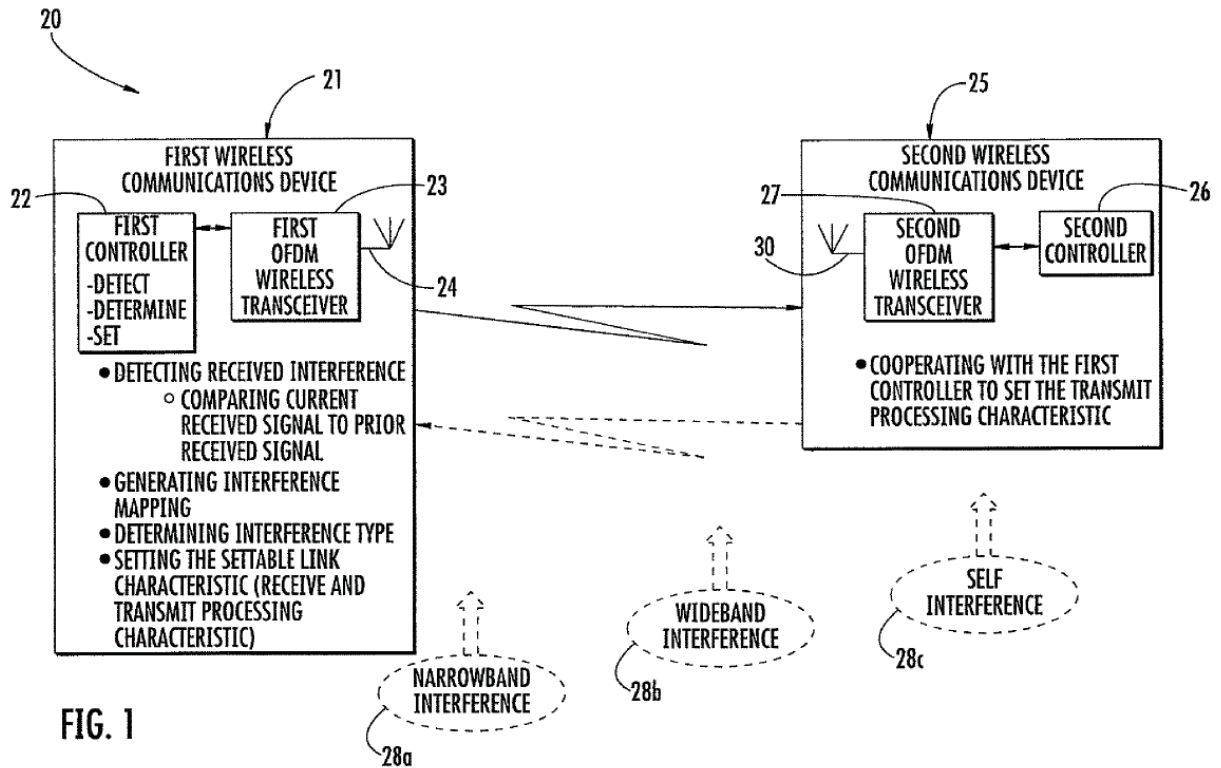
40. The '780 patent admits that “[i]nterference is typically categorized into two types: narrowband interference and wideband interference,” and “[a]nother common type of interference is self interference.” APPLE-1001, 1:25-26, 41. There had been “common approaches to compensating for” each known type of interference. APPLE-1001, 1:25-53.

41. The '780 patent also admits that various “interference compensation” techniques, such as “frequency diversity” and “spatial diversity” had been known and used in the art to compensate for interference. APPLE-1001, 2:1-28.

B. Subject Matter Overview of the '780 Patent

42. The '780 patent describes a “wireless communication system may include first and second wireless communications devices communicating with one another via a wireless communications link having a settable link characteristic,” with “an object ... to provide effective interference compensation.” APPLE-1001, Abstract, 2:32-34.

43. The described system in FIG. 1, for example, includes “first and second wireless communications devices 21, 25” which include “respective first and second controllers 22, 26” and “first and second wireless transceivers 23, 27” such as “orthogonal frequency-division multiplexing (OFDM) transceivers.” APPLE-1001, 3:65-4:5, 4:56-62.

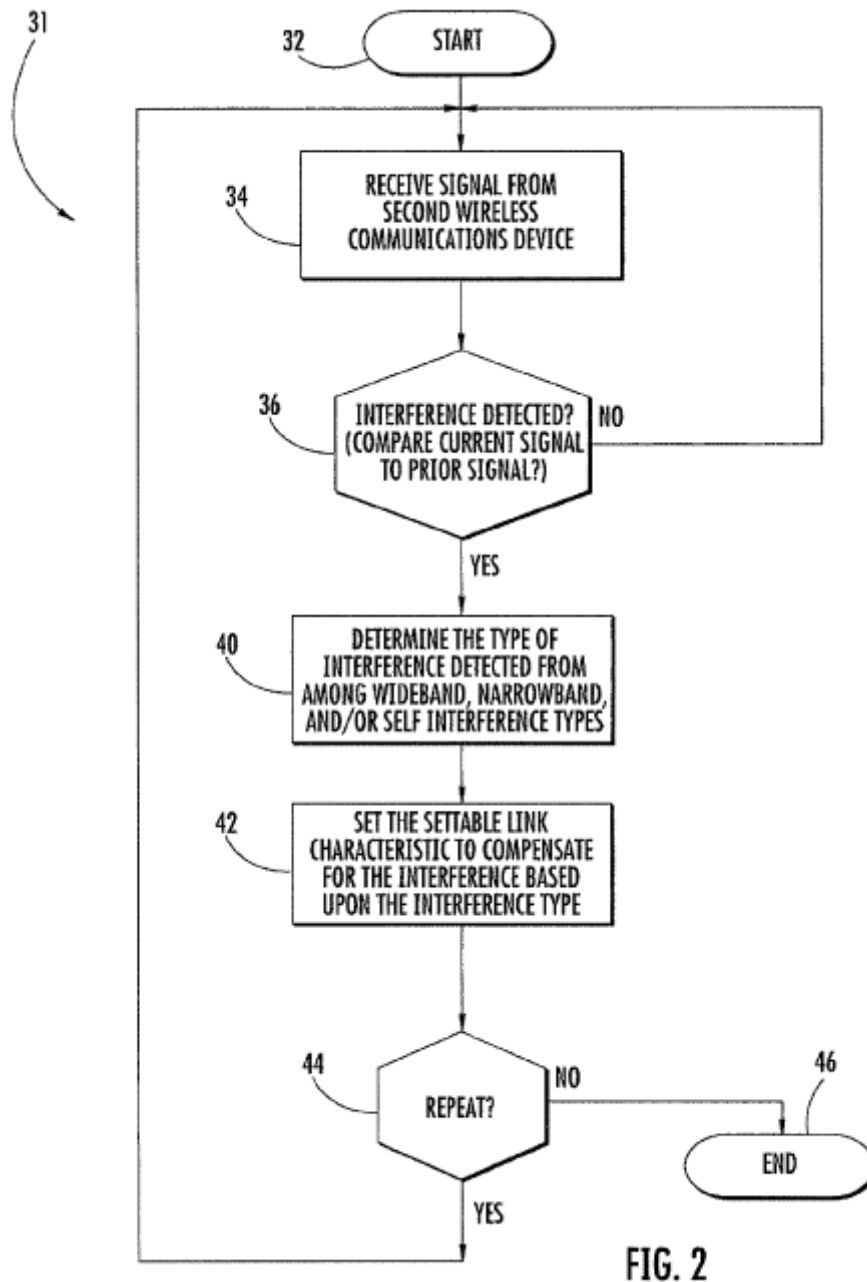


APPLE-1001, FIG. 1.

44. The '780 patent's "FIG. 2 is a flowchart of a method for compensating interference in the wireless communication system of FIG. 1." APPLE-1001, 3:26-27. "The method for compensating interference 28 a-28 c begins at Block 32, the first wireless communications device 21 receives a transmission from the second wireless communications device 25 at Block 34." APPLE-1001, 4:6-10. "At decision Block 36, the first controller 22 illustratively detects whether there is any received interference 28 a-28 c. The first controller 22 may detect the received interference 28 a-28 c based upon a comparison of a current received signal to at least one prior received signal." APPLE-1001, 4:15-19. "More specifically, the first

controller 22 may store data associated with past performance of the received signal and compare the current received signal with the stored data to determine whether there is any received interference 28 *a*-28 *c*.” APPLE-1001, 4:20-24.

45. “[I]f interference 28 *a*-28 *c* is detected, the method moves to Block 40 where the first controller 22 determines a type of the interference from among a plurality of interference types comprising narrowband interference 28 *a*, wideband interference 28 *b*, and self interference 28 *c*.” APPLE-1001, 4:41-46. “More specifically, the first controller 22 determines the interference type based upon at least one of fade characteristics (flat or frequency selective), noise characteristics (wideband or narrowband), and path characteristics (line-of-sight or multipath).” APPLE-1001, 4:47-51.



APPLE-1001, FIG. 2.

C. File History of the '780 Patent

46. As part of my preparation of this declaration, I reviewed the file history (APPLE-1002) of the '780 Patent (APPLE-1001). I understand that the '780 Patent

was filed on June 4, 2008 as U.S. Patent Application No. 12/132,757 (“the ’757 application”). APPLE-1001, Cover. The original claims were rejected under 35 U.S.C. 103(a) as being unpatentable over Aboba (US 2009/0124205) in view of Belogolovy (US 2008/0299932). APPLE-1002, 2011-10-17 Non-Final Rejection. Applicant added “self interference” in the limitation “determining a type of the received interference from among a plurality of interference types comprising wideband interference, self interference, and narrowband interference.” *Id.*, 198 (Applicant’s 2012-01-11 Response).

47. Applicant admitted that “the interference mitigation technique disclosed by Aboba et al. may differentiate between narrowband and wideband interference,” but argued Aboba “does not determine whether **such interference is self-inflicted, i.e. self-interference**, as in the claimed invention.” *Id.*, 205-206 (Applicant’s 2012-01-11 Response).

48. The amended claims were rejected again under 35 U.S.C. 103(a) as being unpatentable over Aboba in view of Belogolovy and Scharf (US 2006/0153283). APPLE-1002, 216 (2012-04-25 Non-Final Rejection). After an Examiner interview, Applicant amended the “determining” limitation further to recite “~~determining~~ determine a type of the received interference from among a plurality of interference types comprising wideband interference, self interference, and narrowband interference based upon comparing at least one characteristic of a

current received signal with the short term and long term historical characteristics of interference” and added “respective first and second controllers coupled thereto and configured to store short term and long term historical characteristics of interference.” *Id.*, 227 (Applicant’s 2012-07-25 Response). Applicant argued that this “underlined claim feature permits advantageous determination of the cause of the degradation in link performance, i.e., permitting the first controller to determine, for example, whether the degradation is the result of short term fade or true interference, and also determining the type of the received interference from among a plurality of interference types, as recited in amended independent Claim 1.” *Id.*, 237 (Applicant’s 2012-07-25 Response).

49. A Notice of Allowance issued on August-13-2012, without Examiner’s statement of Reasons for Allowance. *Id.*, 247. The ’780 Patent issued on Jan-01-2013 with 14 claims, of which claims 1, 9, and 12 are independent claims.

50. However, as discussed below, the features of the Challenged Claims are disclosed in the prior art references discussed here. None of the prior art references discussed were discussed¹ by the Examiner during prosecution. *See*

¹ Diener (APPLE-1006) is a continuation in part of the cited reference (US2004/0028003) bearing the “Diener” label on the ’780 patent or its prosecution

Sections VII-IX.

VII. Interpretation of the '780 Patent Claims at Issue

51. For purposes of my analysis in this IPR proceeding, I understand that the terms that appear in the claims of the '780 Patent should be interpreted according to their plain and ordinary meaning under the *Phillips* standard. In determining the ordinary and customary meaning, I understand that the words of a claim are first given their plain meaning that those words would have had to one of ordinary skill at the time of the invention, i.e., as of the effective filing date of the patent application. I also understand that the structure of the claims, the specification and file history also may be used to better construe a claim insofar as the plain meaning of the claims cannot be understood. Moreover, I understand that even treatises and dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by one of ordinary skill to a claim term at the time of the invention. I have followed this approach in my analysis, and for all of the claim terms considered in this declaration, I have applied the plain and ordinary meaning of those terms. I followed this approach in my analysis.

52. I also understand that the words of the claims should be interpreted as

history. APPLE-1001, cover; APPLE-1002, p3. However, the Examiner never discussed Diener or its parent in any office action. APPLE-1002.

they would have been interpreted by one of ordinary skill at the time of the invention. For purposes of my analysis here, I have used the June 4, 2008 as the date of invention.

53. Further, I understand that the Parties have submitted claim construction briefs and there are disputes on the below two terms in the co-pending district court matter. APPLE-1010, 24-30; APPLE-1011, 22-30. While might be pertinent to infringement, the parties' dispute does not change my analysis herein because the prior art invalidates the Challenged Claims under either party's interpretation.

“short term” / “long term” (Claims 1, 9, and 12)

54. I understand that, in district court, as an alternative to an indefiniteness assertion, Petitioner proposed construing “*short term*” as “on the order of seconds” and “*long term*” as “on the order of weeks, or greater” for at least the reason that the '780 Patent discloses that “[t]he history is broken into **short term (seconds) 53**, medium term (hours/days) 54, and **long term (weeks/months) 55 statistics.**”² APPLE-1010, 25-27; APPLE-1001, 4:34-36. Patent Owner opposed this construction and argued that these two terms should be given their (presumably broader) plain meaning, or alternatively, as a last resort to preserve validity of the

² **Bold** represents emphasis added and *italic* represents claim terms, unless otherwise specified.

claims, be construed such that “the ‘short term’ and ‘long term’ historical characteristics **allow the wireless system to determine the cause of the degradation in link performance, i.e., is it a short term fade or truly interference.**” APPLE-1011, 27-32, f.9. Patent Owner’s attempted alternative construction should be rejected because (1) the above bolded construction is an intended use/function, which is plainly absent from the claim language; and (2) it imposes additional limitations performed by the wireless **system**, which is not even an actively claimed entity in independent claims 9 and 12.

55. As discussed below, in this *IPR*, the prior art invalidates the Challenged Claims under either Patent Owner’s constructions (plain meaning or alternative construction) or Petitioner’s construction.

“self interference” (Claims 1, 9, and 12)

56. I understand that, in district court, Petitioner and Patent Owner agreed that the term “self-interference” encompasses at least “interference caused by two wireless communication systems being deployed too closely together or by two wireless communication systems using the same frequency band/channel.” APPLE-1010, 28; APPLE-1011, 27. While the Petitioner maintained that the “self-interference” also encompasses “interference caused by the wireless communication *device* itself” because the Applicant argued that the “self interference” is “**self-inflicted**” during prosecution to overcome prior art, Patent Owner disputed so, now

arguing that the “self-inflicted” interference is “by the design and layout of the wireless communication *system* itself” rather by the “by the wireless communication *device* itself.” APPLE-1011, 34 (emphasis in original).

57. As discussed below, in this *IPR*, the prior art invalidates the Challenged Claims under either party’s interpretation.

VIII. Overview of the Cited References

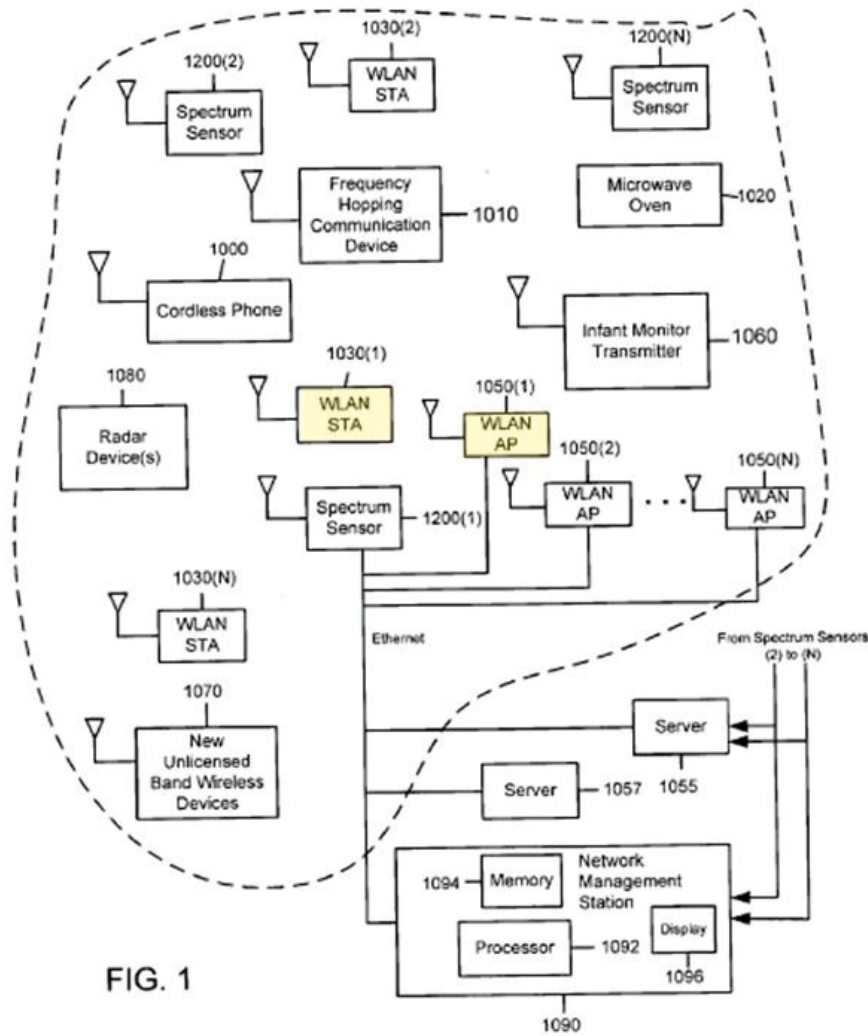
A. Diener (APPLE-1006)³

58. Diener is entitled “system and method for management of a shared frequency band using client-specific management techniques.” APPLE-1006, cover. Diener describes techniques and systems to “cooperatively manage use of a shared frequency band where signals of multiple types occur (often simultaneously), such as an unlicensed band, and interference among the users of the band may occur.” APPLE-1006, [0051]. Diener’s spectrum management system compensates for interference in the same way as the ’780 Patent, by “tak[ing] evasive action **to avoid interference** when possible, **detect[ing] and report[ing] interference** when it occurs and mak[ing] intelligent decisions to **mitigate interference** when it cannot

³ General descriptions provided for this and other references and combinations thereof are incorporated into each subsection and mapping of the claims that includes citations to these references.

be avoided.” APPLE-1006, [0060].

59. Diener discloses one or more communication systems/networks “comprising multiple devices or nodes that operate in the shared frequency band.” APPLE-1006, [0052]. Examples of such a network include a WLAN, a piconet, a network of wireless devices, “a wired network,” and “an aggregation of one or more wired and wireless networks.” APPLE-1006, [0052]. Diener makes clear that “[t]he spectrum management systems, methods, software and device features described herein new [sic] are not limited to any particular wireless network, and are equally applicable to any wireless network technologies now known or hereinafter developed for use in a shared frequency band.” APPLE-1006, [0052].



APPLE-1006, FIG. 1 (highlighted)

60. Diener shows in FIG. 1 (reproduced above), “an environment” where there are multiple *wireless communications devices* configured to communicate with one another, such as “[m]ultiple **WLAN APs 1050(1) to 1050(N)**” and their “one or more associated **client STAs 1030(1) to 1030(N)**.” APPLE-1006, [0053]. Diener describes that “the spectrum management methods described herein may be implemented in any device or network of devices operating in the frequency band

(such as those shown in FIG. 1),” such as one or more of “a cognitive radio device supporting a WLAN application” (e.g., “WLAN access point 1050(1) and its associated client station (STAs) 1030(1), 1030(2) to 1030(N), infant monitor devices 1060 as well as any other existing or new wireless devices 1070”), “spectrum sensors 1200(1) to 1200(N),” “a network management station 1090 or server 1055, [or] the host processor of an AP.” APPLE-1006, [0053]-[0056].

61. “The necessary hardware and/or software functionalities would be deployed in the hardware/software platform of that device to enable the device to act as a cognitive radio device and thereby **perform the spectrum management steps of signal detecting, accumulating/measuring, classifying and controlling/reporting.**” APPLE-1006, [0054].

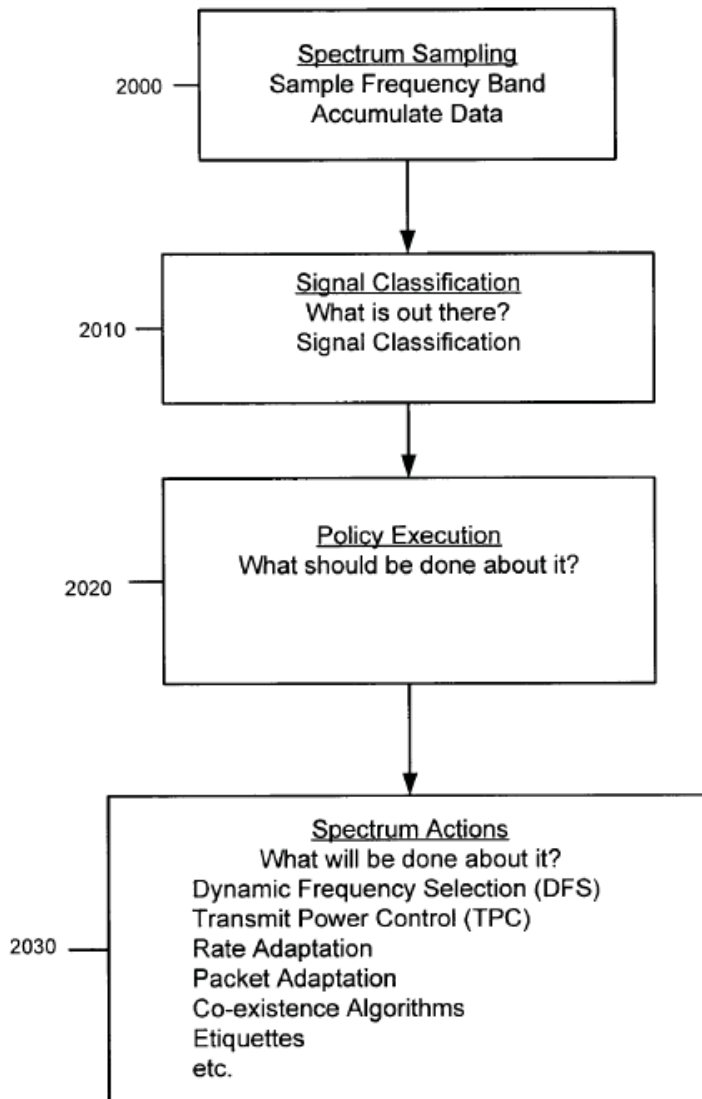
62. Diener differentiates cognitive radio devices from dumb devices. Diener refers to a “device with the ability to gather intelligence and act on it, or act on the intelligence acquired by other devices” as a “cognitive radio device,” whereas “dumb devices” “are unable to adapt their behavior.” APPLE-1006, [0013]-[0015]. Diener describes that “[c]ognitive radios benefit both the cognitive radio device users and the other ‘dumb’ device users that are operating nearby,” by, for example, “avoid[ing] interference from other devices and thereby maintain more reliable wireless connections than dumb devices.” APPLE-1006, [0015]. “Because cognitive radio devices can adapt to their environment to, for example, transmit on less

crowded frequencies, they cause less radio interference than dumb devices. This leads to improvements in the user experience for both cognitive radio and dumb device users.” APPLE-1006, [0015]. Both WLAN STAs (*i.e.*, wireless station) and APs (*i.e.*, access point) can be cognitive radio devices. APPLE-1006, [0063], [0196].

63. “A cognitive radio device ... can **detect, measure, classify** activity occurring in the frequency band, and ... can make intelligent **decisions about whether or not to change any one of its operating parameters**, such as frequency of operation, transmit power, data rate, packet size, timing of transmission (to avoid other signals), etc. Moreover, a radio device may respond to controls generated on the basis of information generated by another radio device that detects, measures and classifies activity in the frequency band.” APPLE-1006, [0197].

64. FIG. 5 of Diener is a general flow chart of an overall spectrum management process. APPLE-1006, [0026]. As shown, Diener’s cognitive radio device can (1) detect signals in a frequency band and store/accumulate signal data (e.g., “spectrum activity information”) by “spectrum sampling” (step 2000), (2) perform signal classification (step 2010), and (3) determine and apply control actions based on the classification result (steps 2020 and 2030). APPLE-1006, [0061]-[0067], [0069] (“a **real-time spectrum analyzer (SAGE) 20** and a radio receiver or radio transceiver (hereinafter “radio”) 12 in the device in order to receive and sample radio frequency energy”).

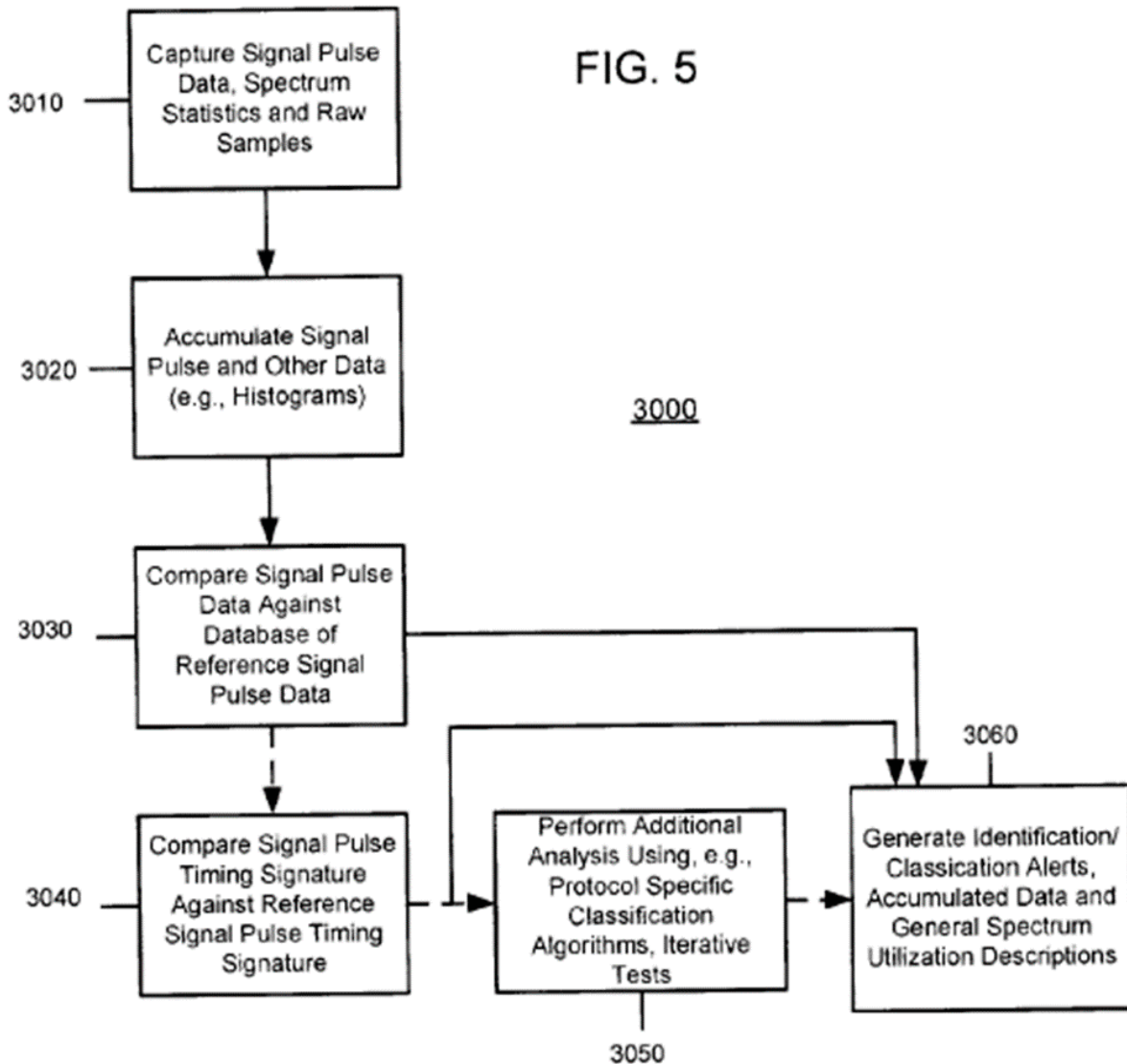
FIG. 5



APPLE-1006, FIG. 5.

65. For signal classification, Diener refers to and incorporates Sugar by reference. APPLE-1006, [0102]. As shown in FIG.5 of Sugar, Diener's cognitive radio device, by applying Sugar's classification techniques, can (1) detect and process received signals to generate signal data/ "raw spectrum information" (step

3010), (2) store/accumulate the signal data (step 3020), (3) perform signal classification by comparing “the accumulated data” “against fingerprints (profiles or reference data) for known signals.” (steps 3030-3050). APPLE-1018, [0018], [0040].



APPLE-1018, FIG. 5.

66. Both Diener and Sugar disclose that the accumulated data include, *e.g.*, “histograms signal pulse data that are useful for signal classification” and

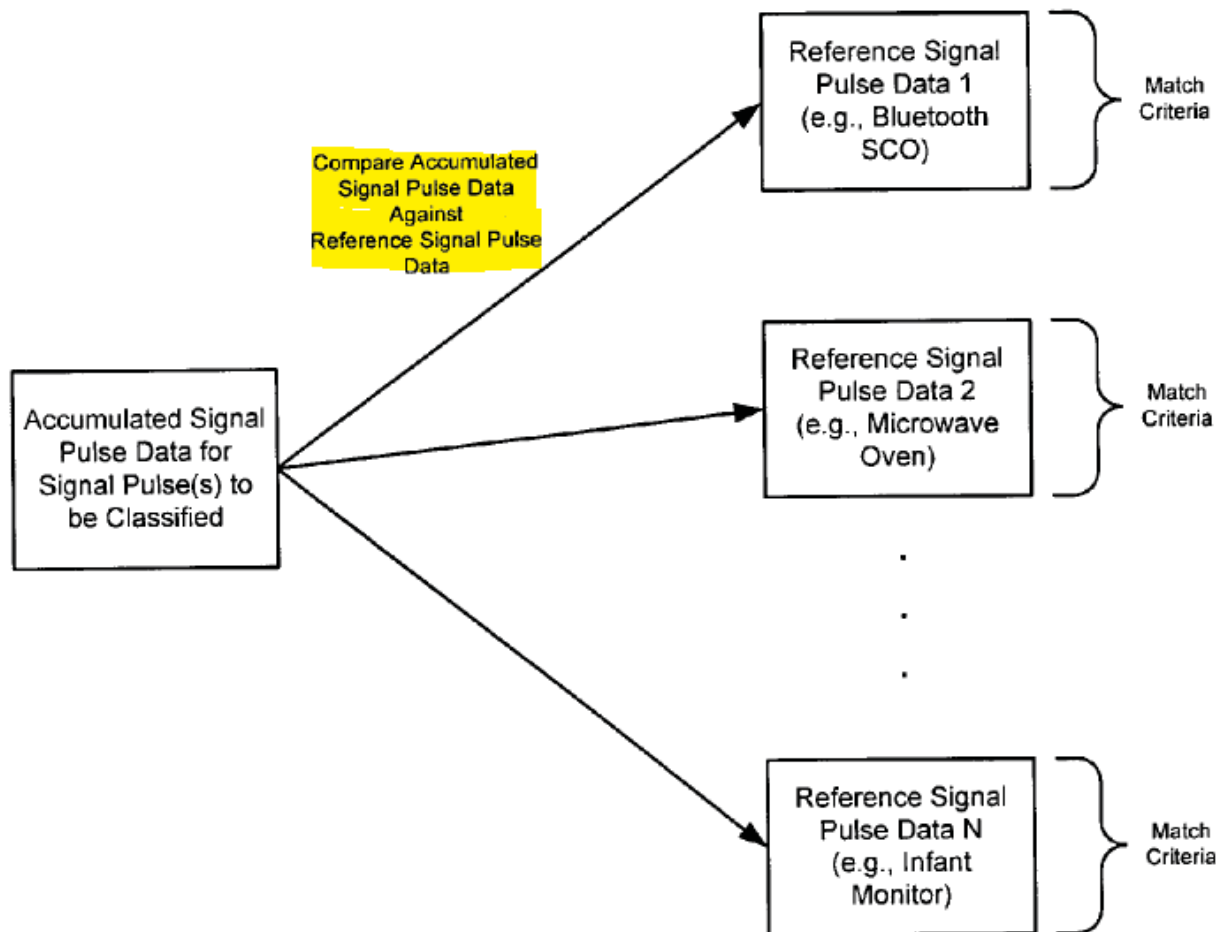
“accumulate[d] raw received signal data ... useful for location measurement.” APPLE-1006, [0099] (“The measurement engine 50 collects and aggregates output from the SAGE 20....” “Specifically, the measurement engine 50 accumulates statistics for time intervals of output data,” “accumulates pulse event data for signal pulses,” “may build histograms of signal pulse data that are useful for signal classification,” and “accumulates raw received signal data ... useful for location measurement”); APPLE-1018, [0040]. As discussed below for claim element [1.b.ii], a POSITA would have understood that Diener’s “**accumulated** signal pulse data” include “**historical** characteristics” because of accumulation of characteristics of previous signals.

67. A POSITA would have understood that Diener’s “accumulated signal pulse data” also include characteristics of a current received signal because the “accumulated signal pulse data” include outputs from the [real-time spectrum analyzer, SAGE] 20 that “obtains real-time information about the activity in a frequency band,” and outputs “data representing a real-time spectrogram of a bandwidth of RF spectrum.” APPLE-1006, [0073], [0074]. Moreover, Diener emphasizes the system’s capability of “real-time” analyses and applications. APPLE-1006, [0101], [0073], [0074]. The “accumulated signal pulse data” would include characteristics of a current received signal to provide “real-time” classification of a current received signal and “generate real-time alerts.” APPLE-

1006, [0064]-[0065]. Moreover, Diener further makes it clear that outputs from the SAGE 20 include characteristics of a current received signal because a signal detector (SD) 23 within the SAGE 20 generates characteristics of the **current received** signal, which are used for signal classification. For example, “SD 23 **identifies signal pulses in the received signal data**, ... and passes **characteristic** information about each pulse to the dual port RAM (DPR) 28,” and “[t]he [snapshot buffer (SB)] 24 collects a set of **raw digital signal samples** of the **received signal** useful for **signal classification**.” APPLE-1006, [0073], [0082], [0094].

68. For interference classification, Diener discloses comparing the accumulated statistics of the received signals (that includes characteristics of a current received signal) against historical statistics of known signals (e.g., “data templates”/“reference data (also called fingerprints)”) to classify the received signals. APPLE-1006, [0157] (“The comparison step may involve comparing pulse timing signatures of known signals against the accumulated signal pulse data ... to determine if there is a match.... They are useful to classify signals”), APPLE-1006, [0101] (“The classification engine 52 compares outputs of the SAGE 20 (accumulated by the measurement engine 50) against data templates and related information of known signals in order to classify signals in the frequency based on energy pulse information detected by the SAGE”), [0564], [0143], FIG. 9; APPLE-1018, [0040], FIG. 5.

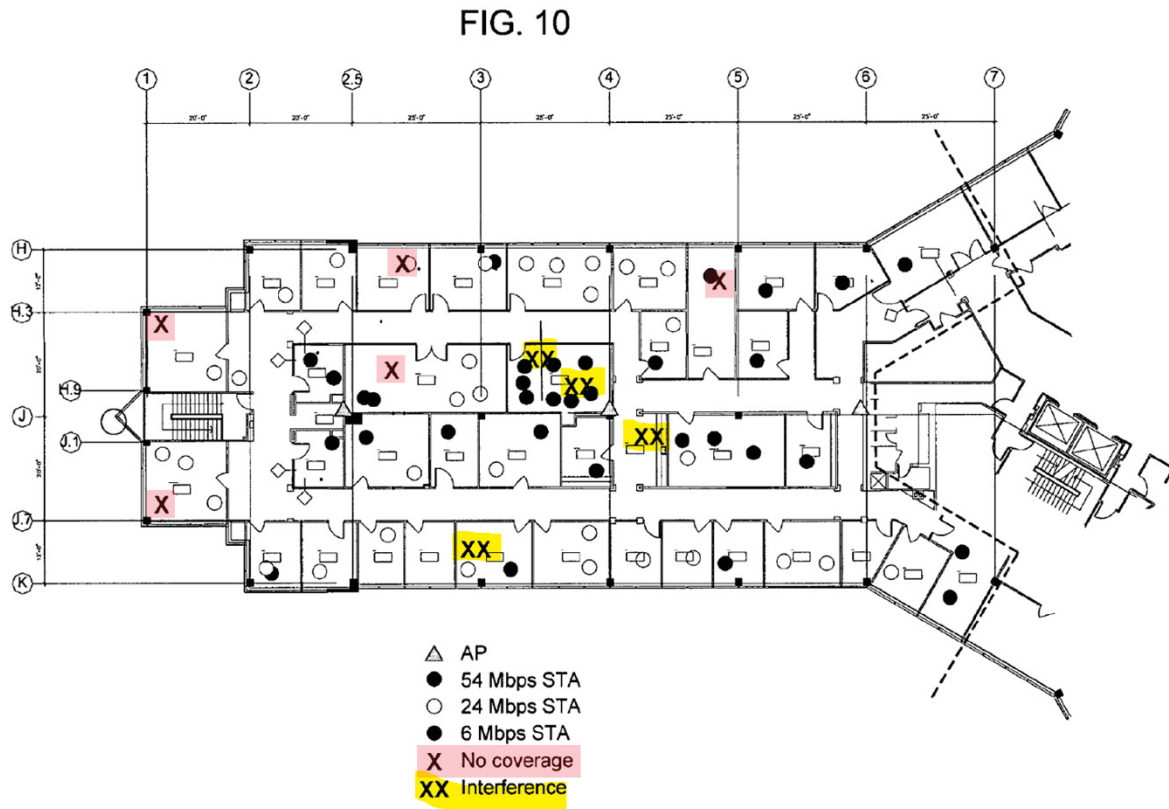
FIG. 9



APPLE-1006, FIG. 9 (highlighted)

69. In FIG. 10 (reproduced below), as an example user case, Diener shows “a coverage map” of “an enterprise” “generated by the spectrum management system” based on “spectrum information” and “location measurements made by the location engine 54.” APPLE-1006, [0030], [0190]. The coverage map includes locations and range of interferences (denoted by “XX”) in the enterprise (e.g., a “microwave oven” in a break room), as well as locations of no signal coverage (denoted

by “X,” also referred to as “no-signal-coverage location”) that typically result from severe path/link losses in those locations. APPLE-1006, [0190], [0058], [0065].



APPLE-1006, FIG. 10 (highlighted)

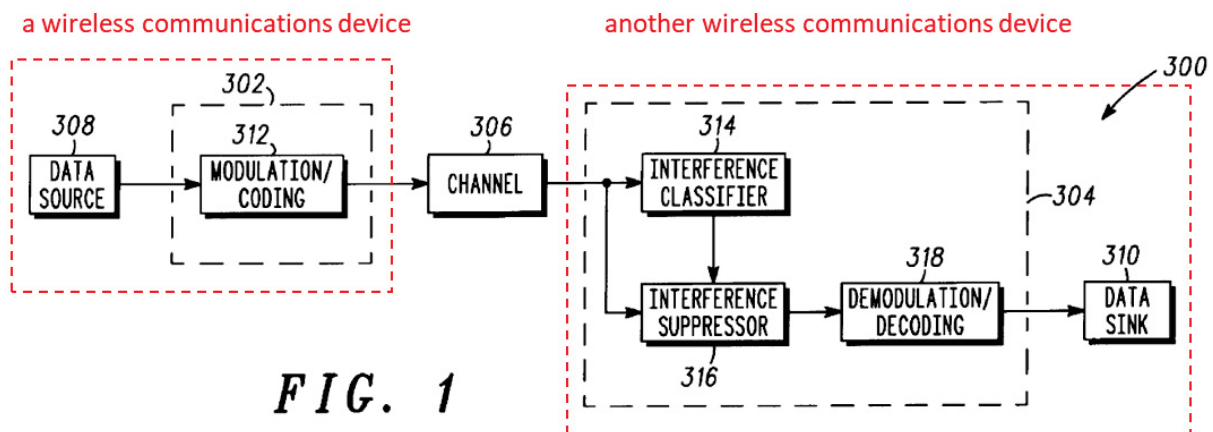
70. Diener further discloses specific interference mitigation techniques that set link characteristics to compensate for the received interference based on the classification result. For example, in response to determining that “the interference is caused by a microwave oven,” interference mitigation techniques “include adjusting the AP of the user's network to a cleaner channel, adjusting the location of the AP in the user's network, adjusting the fragmentation threshold of the AP in the user's network for better interoperability, or to increase the distance between the

user's device and the microwave oven.” APPLE-1006, [0448], FIGS. 5 and 26.

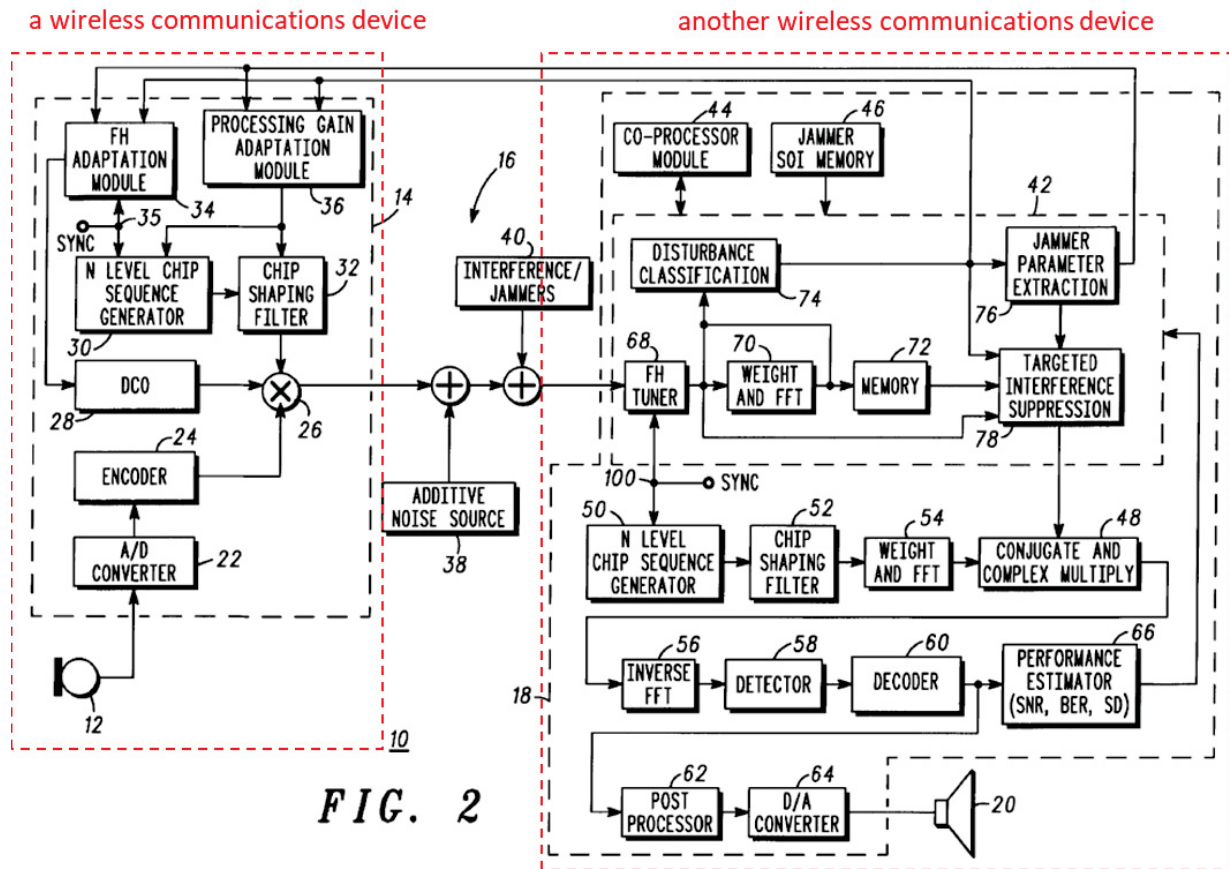
B. Bergstrom Overview (APPLE-1005)

71. Bergstrom is entitled “Method and apparatus for performing targeted **interference suppression**.” APPLE-1005, cover. Like the ’780 patent and Diener, Bergstrom describes techniques and systems that “relate in general to communications systems and, more particularly, to communications systems having interference suppression capabilities” “for reducing the impact of undesirable spectral components in a communications system.” APPLE-1005, 1:6-8; 28-31.

72. Bergstrom describes a wireless communication system including one communications device on a transmitter side and another on a receiver side, where the two devices communicate over a wireless channel. *See e.g.*, APPLE-1005, FIGS. 1 and 2, 3:20-24 (“system 300 includes a transmitter 302 which communicates with a receiver 304 through a channel 306”), 3:20-24, 3:62-67 (“system 10 includes ..., a transmitter 14, a channel 16, a receiver 18,” wherein “the channel 16 is a wireless RF link.” *Id.*, 5:40-41.



APPLE-1005, FIG. 1 (annotated)



APPLE-1005, FIG. 2 (annotated)

73. Bergstrom recognizes that the received signal includes interference from different “[i]nterference source[s] 40 [that] represent[s] the sources of all man-made interference in the channel 16.” APPLE-1005, 5:58-61. The “interference source 40 can include partial band noise jammers, spread spectrum co-channel sources, wideband noise jammers, banded co-site signal sources, chirp jammers, multitone jammers, non-banded co-site signals, and others.” APPLE-1005, 5:52-58.

74. Bergstrom discloses that “[t]he system includes **an interference**

classifier for classifying each of the undesired spectral components (if any) by **interference-type and an interference suppressor for suppressing** the undesired **interference** components in the received signal using one or more interference suppression methods that may be **‘targeted’ to the specific type of interference.**” APPLE-1005, 2:38-44, claim 1. Bergstrom explains that “[b]y targeting interference suppression by interference-type, a superior level of interference suppression performance is achieved as compared to prior art systems that use a common suppression method for all types of interference.” APPLE-1005, 2:44-48.

75. Similar to Diener, Bergstrom discloses storing historical characteristics of interference, which are compared against characteristics of a current received signal to determine an interference type. APPLE-1005, 13:14-18 (“A plurality of feature plane transformations representing different interference types can be stored in the JSOI memory 46 for comparison with transformations derived from receive signals to classify interference components in the receive signals”)

76. Bergstrom teaches that “[t]he invention is capable of **operating in real time** on a short sample set, with power consumption that is within the capabilities of modern digital signal processors (DSP). In addition, the invention is capable of optimizing bit error rate (BER) performance given a variety of interferers without sacrifice of bandwidth or system capacity and, in some cases, can improve the bit error rate (BER) of a communications system by multiple orders of magnitude. The

invention is of relatively low complexity and can be implemented using computationally efficient recognition/cancellation routines.” APPLE-1005, 2:51-61.

IX. Diener in view of Bergstrom renders obvious claims 1-4 and 7-14

A. Diener-Bergstrom Combination

77. As I discussed above in Section VIII, both Diener and Bergstrom disclose interference classification and interference mitigation based on the classification result. As detailed below, multiple independent reasons would have prompted a POSITA to combine Diener and Bergstrom. And it would have been apparent to a POSITA of ordinary creativity exercising basic common design sense that there were multiple predictable ways to achieve this result. *Id.* For example, a POSITA would have been motivated to incorporate into Diener’s system Bergstrom’s teachings on (1) classifying the received interference into a specific type from multiple different types (e.g., including *wideband interference*, and *narrowband interference*, besides *self interference* to suppress the interference), (2) suppressing the interference, for example, on the receiver side (e.g., by setting a *receive processing characteristic*), and (3) repeating the interference mitigation process as needed (e.g., for a next received signal). Bergstrom’s teachings not only reinforce or supplement Diener’s teachings on these features but also help further Diener’s system’s goal and improve the BER performance, increase throughput, and save more resources of the entire communication system over time, as discussed in

more detail below.

1. Motivation

78. **First**, a POSITA would have sought out teachings from references like Bergstrom that also disclose interference classification and interference mitigation based on suggestions within Diener. Diener expressly acknowledges there are “other signal classification techniques” and “[o]ther interference mitigation techniques,” besides the examples disclosed by Diener. APPLE-1006, [0102] (“[i]t should be understood that **other signal classification techniques** may be known in the art”); [0165] (“**[o]ther examples of interference mitigation techniques** are described in commonly assigned and co-pending U.S. application Ser. No. 10/248,434”). While Diener cites to “commonly assigned” patent applications as “[e]xamples of interference mitigation algorithms,” it would have been obvious to a POSITA that other signal classification techniques and interference mitigation techniques can be applied in Diener’s system, in addition to or as an alternative to, the explicitly disclosed or cited examples. APPLE-1006, [0066], [0165], [0604]. A POSITA looking to implement Diener’s classification would have therefore looked to known signal classification techniques and interference mitigation techniques by the Critical Date.

79. As discussed in Section VIII.B⁴, Bergstrom discloses example signal classification techniques and interference mitigation techniques. *See e.g.*, APPLE-1005, 2:38-44, claim 1. A POSITA would have realized Bergstrom’s teachings on interference classification and targeted interference suppression based on the classified interference type to **“reduc[e] the impact of undesirable spectral components** (e.g., noise, interference, and jamming) in a receive signal” as consistent with Diener’s teachings and furthering Diener’s “goal of spectrum management [that] is to take evasive action to avoid interference when possible, detect and report interference when it occurs and make intelligent decisions **to mitigate interference when it cannot be avoided.**” APPLE-1005, 28-31; APPLE-1006, [0060].

80. **Second**, a POSITA would have been motivated to incorporate Bergstrom’s “target[ed] interference suppression by interference-type” into Diener’s system, given the various advantages or benefits of Bergstrom’s techniques including “a superior level of interference suppression performance,” “real time” responses, low “power consumption,” optimized “bit error rate (BER) performance,” “relatively low complexity,” and “computationally efficient” implementations.

⁴ Discussion in the cited section(s) is incorporated into each subsection and mapping of the claims that include citations to the section(s).

APPLE-1005, 2:44-61. For example, a POSITA would have been motivated to incorporate Bergstrom's interference classification scheme to classify interference into one of the specific types disclosed by Bergstrom, and "us[e] one or more interference suppression methods that may be 'targeted' to the specific type of interference" to "suppress[e] the undesired interference components in the receive signal" and achieve the advantages promised by Bergstrom. APPLE-1005, 2:41-44.

81. The specific types of interference sources disclosed by Bergstrom include at least *narrowband interference* (e.g., of the "narrow band ...class"), *wideband interference* (e.g., "wideband class"), and *self interference* (e.g., "co-site" and "co-channel" signals), which would originate from "communication systems being deployed too closely together or by two wireless communication systems using the same frequency band/channel," (e.g., self-interference sources). APPLE-1005, 9:1-10, 8:45-50, 5:52-58. For example, Bergstrom recognizes that the received signal may contain interference from different sources and that types of "interference source 40 [that] can include partial band noise jammers, spread spectrum **co-channel sources, wideband noise jammers, banded co-site signal sources, chirp jammers, multitone jammers, non-banded co-site signals, and others.**" APPLE-1005, 5:58-61; 5:52-58. As a specific example shown in FIG. 26, "the received signal includes ... **narrow band jammers 250.**" APPLE-1005, 21:41-44. Despite different names, such as "tones, communication signals, and jammers," they all fall into "a wide range

of ... interference types.” APPLE-1005, 19:41-43. A POSITA would have understood that the interference originating from “**narrow band jammers**” would fall into *narrowband interference* (e.g., of the “narrow band class”), interference originating from “**wideband noise jammers**” would fall into *wideband interference* (e.g., “wideband class”), whereas interference originating from “**co-channel sources**” and/or “**co-site signal sources**” would fall into the scope of the *self interference*.

82. Bergstrom teaches that classifying an interference signal into a “class superset” (e.g., “narrow band” or “wideband”) before classifying it more specifically into “class subset” assists in “preclassification filtering” and “signal separation” to improve the “class subset” (i.e., more specific) classification process. *See generally* APPLE-1005, 9:1-43, 13:34-14:13. Indeed, a disclosure related to Diener, Sugar_CIP ⁵, identifies very similar benefits (i.e., improved separation and

⁵ Sugar_CIP is a continuation-in-part of the Sugar reference that is incorporated by reference in Diener. APPLE-1006, [0102]; APPLE-1018, (21); APPLE-1019, (60). Sugar_CIP discloses very similar aspects of a “system and method for classifying signals” disclosed in Diener and Sugar. APPLE-1006, FIGS. 4, 6, Abstract; APPLE-1018, FIG. 1, Abstract; APPLE-1019, FIGS. 1, 16, Abstract.

classification of “several signals [] being classified simultaneously”) to a classification process in which the system initially classifies with less precision. APPLE-1010, [0089].

83. **Third**, a POSITA would have been motivated to incorporate Bergstrom’s “targeted interference suppression,” for example, **on the receiver side** to supplement Diener’s system to achieve “real time” responses, “improve[ed] bit error rate (BER),” and other benefits disclosed by Bergstrom, such as shortening latency and saving system resources. APPLE-1005, 2:44-61. For example, a POSITA would have recognized that Diener discloses interference mitigation on a transmitter side by changing a transmit processing characteristic “such as frequency of operation, transmit power, data rate, packet size, timing of transmission (to avoid other signals), etc.” APPLE-1006, [0197].

84. A POSITA would have appreciated that, in addition to or as an alternative to waiting for a next transmission or retransmission to change the transmit processing characteristic, directly suppressing interference in the already received signal on the **receiver** side as taught by Bergstrom can also “improve the bit error rate (BER),” allow correct decoding of the already received signal, reduce latency, improve system throughput, and save system resources that would have been consumed by retransmission. APPLE-1005, 2:44-61; APPLE-1006, [0057] (discussing “[w]hen interference occurs, a signal from one device to another may

not be received properly, causing the sending device to retransmit (and therefore reducing throughput), or possibly entirely destroying the communication link between two communication devices.”).

85. In fact, Bergstrom discloses its interference suppression scheme (including, for example, an “inverse whitening procedure” as one of the interference suppression methods) can be repeated each time a signal is received. APPLE-1005, 19:9-10 (“[t]he inverse whitening procedure is then repeated for the next receive signal”), FIG. 21. A POSITA would have found it obvious and advantageous to repeat Bergstrom’s determined interference suppression scheme on a next receive signal, or on each received signal in general so as to improve the BER performance, increase throughput, and save more resources of the entire communication system over time.

2. Reasonable Expectation of Success

86. As I discussed above in in Section VIII, Diener and Bergstrom both describe techniques for interference classification and mitigation in the context of wireless devices. Moreover, given Diener’s indication of using “other signal classification techniques” and “[o]ther interference mitigation techniques” than those that have been explicitly disclosed and cited by Diener (APPLE-1006, [0102], [0165]), applying similar known techniques disclosed by Bergstrom for similar purposes of interference classification and mitigation would have been natural and

straightforward from a POSITA's perspective.

87. Likewise, the POSITA would have expected Bergstrom's techniques to work in the context of Diener because Bergstrom explicitly claims that **“said communications system is a wireless LAN system that overlays a narrowband/partial-band communications system”** (APPLE-1005, claim 19), which a POSITA would have understood to be compatible with the primary exemplary communications system in Diener. APPLE-1006, [0052] (**“Many of the examples described herein are made with respect to an IEEE 802.11 WLAN, mostly due in part to the expansive use that the WLAN has seen, and is expected to continue to see.”**)

88. Although Bergstrom describes examples of its invention “that incorporate spread-spectrum technologies, such as CDMA,” it also makes clear that **“[t]he principles of the present invention can be used in a wide range of applications, such as ..., commercial cellular and PCS, spread spectrum wireless LAN, ..., code division multiple access (CDMA), and others. Other applications are also possible.”**) APPLE-1005, 21:53-67. In fact, it has been known that WLAN standards have evolved from “spread spectrum” (in IEEE 802.11b) to “Orthogonal Frequency Division Multiplexing (OFDM) transmission techniques” (e.g. IEEE 802.11a, 802.11g, 802.11n, 802.11ac, and beyond) to provide higher “data rates.” *See e.g.,*:

IEEE 802.11 refers to a family of WLAN standards developed by the IEEE. In general, WLANs in the IEEE 802.11 family provide for 1 or 2 Mbps transmission in the 2.4 GHz band (except IEEE 802.11a) using either frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS) transmission techniques. Within the IEEE 802.11 family are the IEEE 802.11b and IEEE 802.11g standards.

... IEEE 802.11b employs only DSSS transmission techniques. IEEE 802.11g provides for data rates of up to 54 Mbps in the 2.4 GHz band.

For transmitting data at rates above 20 Mbps (or when all devices are IEEE 802.11g capable), IEEE 802.11g employs Orthogonal Frequency Division Multiplexing (OFDM) transmission techniques.

However, for transmitting information at rates below 20 Mbps, IEEE 802.11g employs DSSS transmission techniques.

APPLE-1007, [0004]-[0005].

89. Diener also discloses that “[t]he spectrum management systems, methods, software and device features described herein new [sic] are **not limited to any particular wireless network**, and are **equally applicable to any wireless network technologies now known or hereinafter developed** for use in a shared frequency band.” APPLE-1006, [0052]. Diener further discloses various device types supporting various WLAN standards such as IEEE 802.11a, 802.11b, and 802.11g, and modulation modes (e.g., QPSK, OFDM). APPLE-1006, [0058]-[0059], [0150]. A POSITA would have reasonably expected that Bergstrom’s disclosed techniques can be successfully incorporated into Diener’s system, given general

applicability of both Bergstrom's and Diener's teachings, as well as the trend of technology development in the field. *Id.*.

90. Furthermore, a POSITA would have found it obvious to apply Bergstrom's "principles of the present invention" to other well-known "digital cellular communications systems" and "wireless LAN" as envisioned by Bergstrom, such as the communication system of Diener. *Id.*. In fact, Diener envisions a communication system that includes "a multitude of devices that use disparate technologies" and proposes "features and functions described herein to better facilitate band sharing and coexistence between [the] multitude of devices." APPLE-1006, [0013]. A POSITA would have reasonably expected a successful outcome from combining Bergstrom's teachings with Diener's system (for example, in at least one of the "cognitive radio devices" in Diener's system) in view of Diener's disclosed compatibility with various different technologies. *Id.*.

91. Moreover, the Diener-Bergstrom combination represents a combination of known elements each performing the functions that had been known to produce the predictable result of classifying an interference among a plurality of interference types and applying a corresponding interference mitigation scheme based on the classification result. *Id.* As such, a POSITA would have reasonably expected a successful outcome from incorporating Bergstrom's teachings on interference classification and mitigation into Diener's system, especially given that

Diener has provided methods and structures which can incorporate Bergstrom's teachings. For example, for interference classification, Diener already provides that "the classification engine 52 may output information describing one or more of the center frequency, **bandwidth**, power, pulse duration, etc. of the classified signal, which ... may **particularly [sic] useful** for a classified signal that is determined to interfere with operation of other devices in the frequency band." APPLE-1006, [0101]. As one example, a POSITA would have readily recognized that the **bandwidth** information provided by Diener would be "**particularly useful**" for classifying interference between wideband interference and narrowband interference as taught by Bergstrom, and thus would have reasonably expected a successful outcome of the combination. *Id.*.

92. Indeed, Diener already provides that "necessary hardware and/or software functionalities would be deployed in the hardware/software platform of that device to enable the device to act as a cognitive radio device and thereby perform the spectrum management steps of signal detecting, accumulating/measuring, classifying and controlling/reporting." APPLE-1006, [0054]. Further, Bergstrom discloses that its "invention is capable of operating in real time on a short sample set, **with power consumption that is within the capabilities of modern digital signal processors (DSP)** and its "invention is of **relatively low complexity and can be implemented using** computationally efficient **recognition/cancellation routines.**"

APPLE-1006, 2:51-61. It would have been well within a POSITA's skills to adapt Diener's system with "necessary hardware and/or software functionalities" to implement "computationally efficient recognition/cancellation routines" (e.g., by writing additional signal processing steps into software code) as taught by Bergstrom. A POSITA would have reasonably expected a successful outcome of the incorporation of Bergstrom's "relatively low complexity" implementation into Diener's system, ready for improvement. *Id.*

93. As I explain in more detail below through my feature-by-feature analysis, Diener in combination with Bergstrom renders obvious each of the Challenged Claims.

3. Claim 1

[1.pre] A wireless communication system comprising:

94. To the extent the preamble is limiting, it is my opinion that the Diener-Bergstrom combination provides [1.pre]. For example, Diener discloses that "**system**, method, software and related functions are provided for managing activity **in a radio frequency band** that is shared, both in frequency and time." APPLE-1006, [0012]. "One particular application of this technology is a **system** and method for managing communication with a plurality of **wireless** client devices **operating in a radio frequency band** shared by other types of devices where the radio frequency environment at each wireless client device may be different." APPLE-

1006, [0021]. Diener explicitly claims “**A wireless radio communication system** comprising:” “a wireless base station device;” and “a plurality of wireless client devices that communicate with the base station device.” APPLE-1006, claim 9.

[1.a] first and second wireless communications devices configured to communicate with one another via a wireless communications link having at least one settable link characteristic;

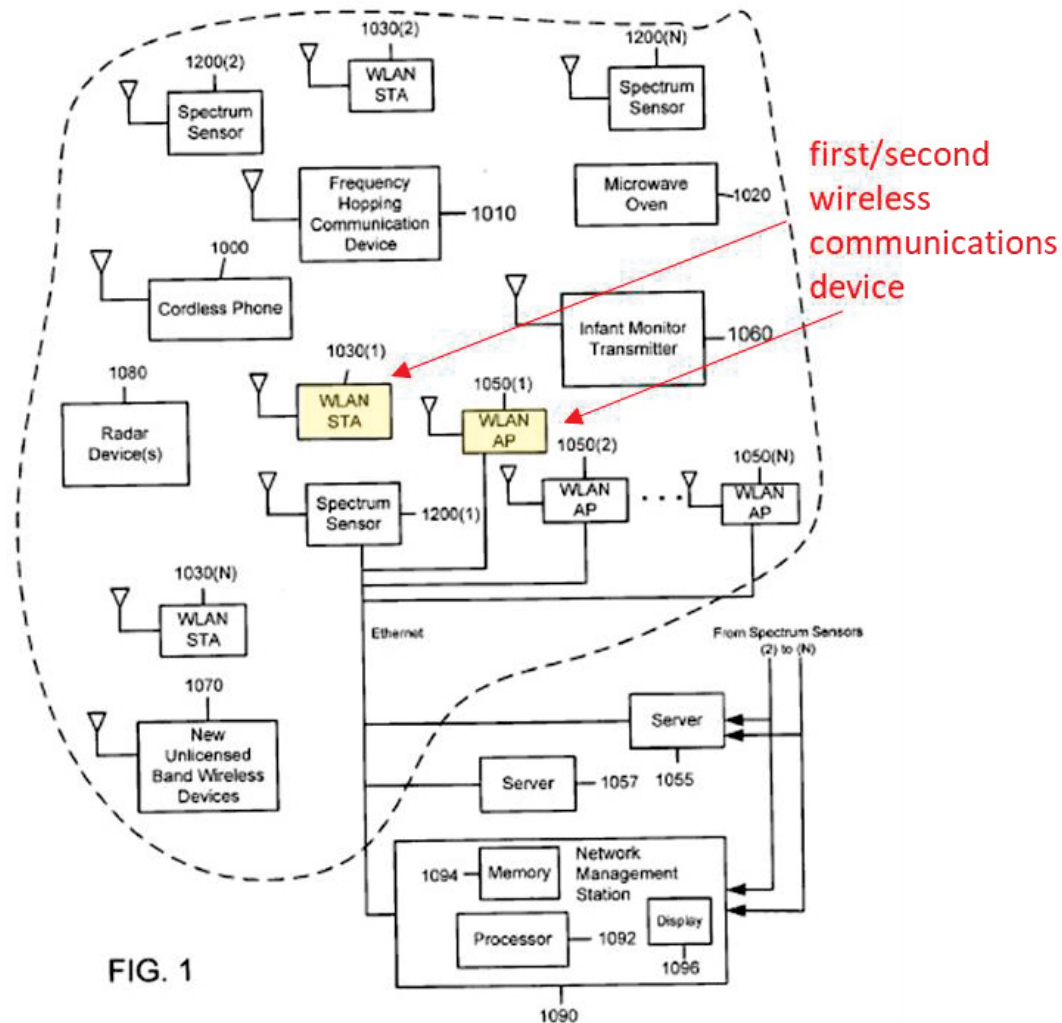
95. It is my opinion that the Diener-Bergstrom combination provides [1.a], for at least the reasons discussed below.

first and second wireless communications devices configured to communicate with one another

96. Diener discloses that “**any device or network of devices** [*first and second wireless communications devices*] operating in the frequency band (such as those shown **in FIG. 1**)” may implement “the spectrum management methods described herein.” APPLE-1006, [0054]. Diener discloses *first and second wireless communications devices* such as “a network base station device (e.g., a wireless network access point [AP] device)” and a “plurality of wireless client devices.” APPLE-1006, [0021].

97. As shown in FIG. 1 (annotated below), the system includes *first and second wireless communications devices*, such as “[m]ultiple **WLAN APs 1050(1) to 1050(N)**” and their “one or more **associated client STAs 1030(1) to 1030(N)**.” APPLE-1006, [0053]. The following annotation of FIG. 1 provides examples of the claimed *first and second wireless communications device*, but could be any of the

“cognitive” devices that implement the spectrum management methods disclosed by Diener. *Id.*



APPLE-1006, FIG. 1 (annotated).

configured to communicate with one another via a wireless communications link

98. Diener discloses that “the network base station device” and “corresponding wireless client stations” are *configured to communicate with each other* via “radio communication between the network base station device and each

of the plurality of wireless devices [*first and second wireless communications devices*]" APPLE-1006, [0021].

the wireless communications link having at least one settable link characteristic

99. Diener discloses the radio communication [*a wireless communications link*] **having at least one settable link characteristic** such as “**at least one parameter**” that can be controlled “based on the radio frequency environment.” APPLE-1006, [0021]. Diener further explains that “[e]xamples of **parameters** [*at least one settable link characteristic*] **that may be controlled** at the wireless base station device include packet fragmentation threshold (the length of a data packet), transmission data rate and transmission scheduling (synchronizing a transmission to quiescent intervals of one or more periodic interfering signals).” APPLE-1006, [0021]. *See also* discussion above for [1.e].

100. In fact, as an example mapping for elements [1.pre] and [1.a], Diener explicitly claims: “A **wireless radio communication system** comprising:” “a **wireless base station device** [*second wireless communications device*]; . . . a plurality of **wireless client devices** [*first wireless communications device*] that **communicate** with the base station device; . . . wherein the base station device and wireless client devices **operate in a radio frequency band** [*via a wireless communications link*] shared by other types of devices, . . . **wherein the wireless base station device . . . adjusts at least one operating parameter pertaining to**

radio communication [*having at least one settable link characteristic*] with the plurality of wireless client device according to the spectrum profile information associated with the corresponding wireless client device.” APPLE-1006, claim 9.

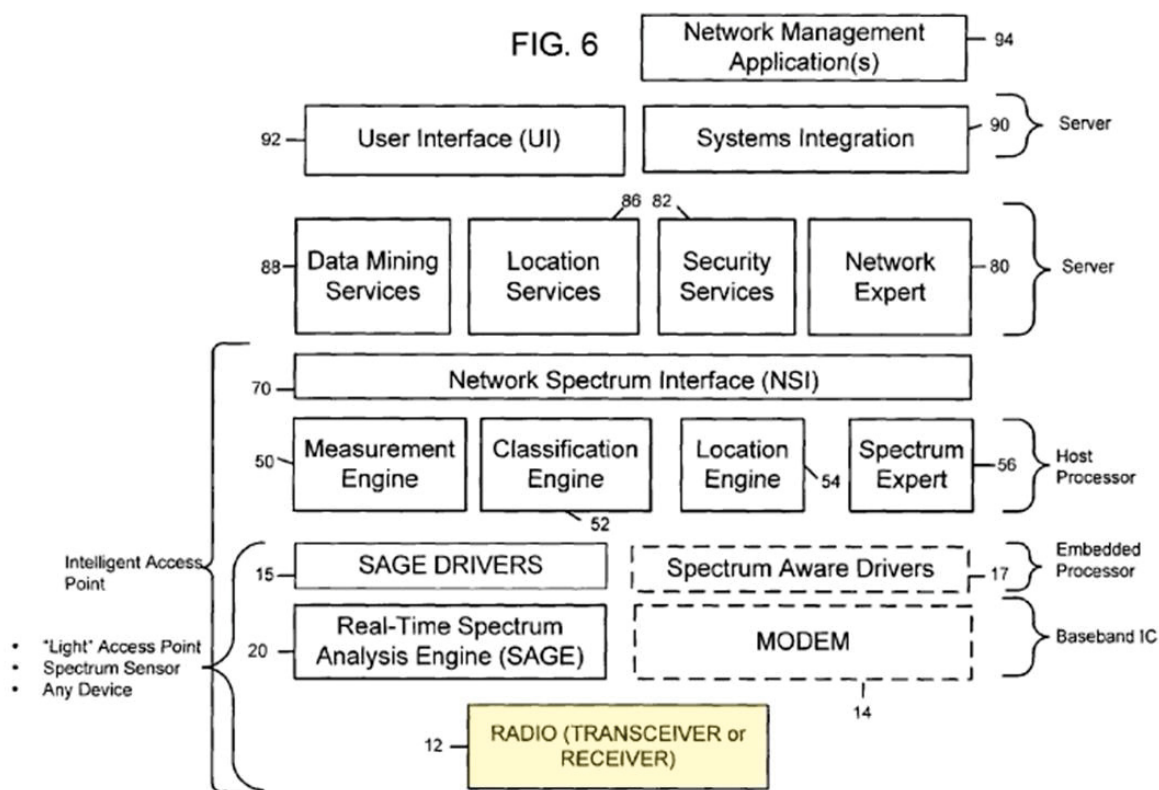
101. Bergstrom also discloses an “interference suppressor” that “includes a plurality of **interference suppression modules**” [e.g., *a settable link characteristic*]. APPLE-1004, Abstract. Bergstrom states that an “interference classifier” analyzes a received signal and “identifies and classifies interference components” and that an “interference suppressor” “selects one or more suppression methods that work best for the types of interference identified.” APPLE-1004, 3:39-61. A POSITA would have understood that the selected “interference suppression method” or “module” is a settable link characteristic.

[1.b.i] said first and second wireless communications devices comprising respective first and second orthogonal frequency-division multiplexing (OFDM) wireless transceivers and

102. It is my opinion that Diener-Bergstrom provides [1.b.i]. For example, Diener describes that “**any device or network of devices** [*said first and second wireless communications devices*] operating in the frequency band (such as those shown **in FIG. 1**)” may implement “the spectrum management methods described herein.” APPLE-1006, [0054]. In each of Diener’s cognitive devices, “[t]here is at least a real-time spectrum analyzer (SAGE) 20 and a **radio receiver or radio transceiver (hereinafter “radio”)** 12 [*wireless transceivers*] **in the device** in order

to receive and sample radio frequency energy in the frequency band.” APPLE-1006, [0069].

103. FIG. 6 of Diener shows “a spectrum management system architecture,” where “[a]t the lowest level is the hardware that resides in **a device**” that includes “**at least ... a radio receiver or radio transceiver (hereinafter “radio”)** 12 in the device.” APPLE-1006, [0069].



APPLE-1006, FIG. 6 (highlighted)

104. It would have been obvious to a POSITA that the “**radio transceiver**” of the “device which operates in the frequency band” (e.g., “WLAN APs 1050(1)

to 1050(N)” and their “associated client STAs 1030(1) to 1030(N)”) would be *OFDM wireless transceivers* because Diener explicitly discloses OFDM as one of the example modulation modes. APPLE-1006, [0150] (showing “Modulation modes (e.g., QPSK, **OFDM**, QAM, . . .)). Moreover, Diener discloses that the WLAN devices can be “**IEEE 802.11g WLAN devices.**” APPLE-1006, [0052] (disclosing “Other **devices** that may operate in the 2.4 GHz band **are IEEE 802.11g WLAN devices.**”). It had been well known to a POSITA that “IEEE 802.11g employs Orthogonal Frequency Division Multiplexing (OFDM) transmission techniques.” APPLE-1007, [0004]. A POSITA would have recognized that Diener’s “**radio transceiver**” of the WLAN devices such as “**IEEE 802.11g WLAN devices**” [*said first and second wireless communications devices*] would be *OFDM wireless transceivers*.

[1.b.ii] respective first and second controllers coupled thereto and configured to store short term and long term historical characteristics of interference;

105. It is my opinion that Diener-Bergstrom provides [1.b.ii].

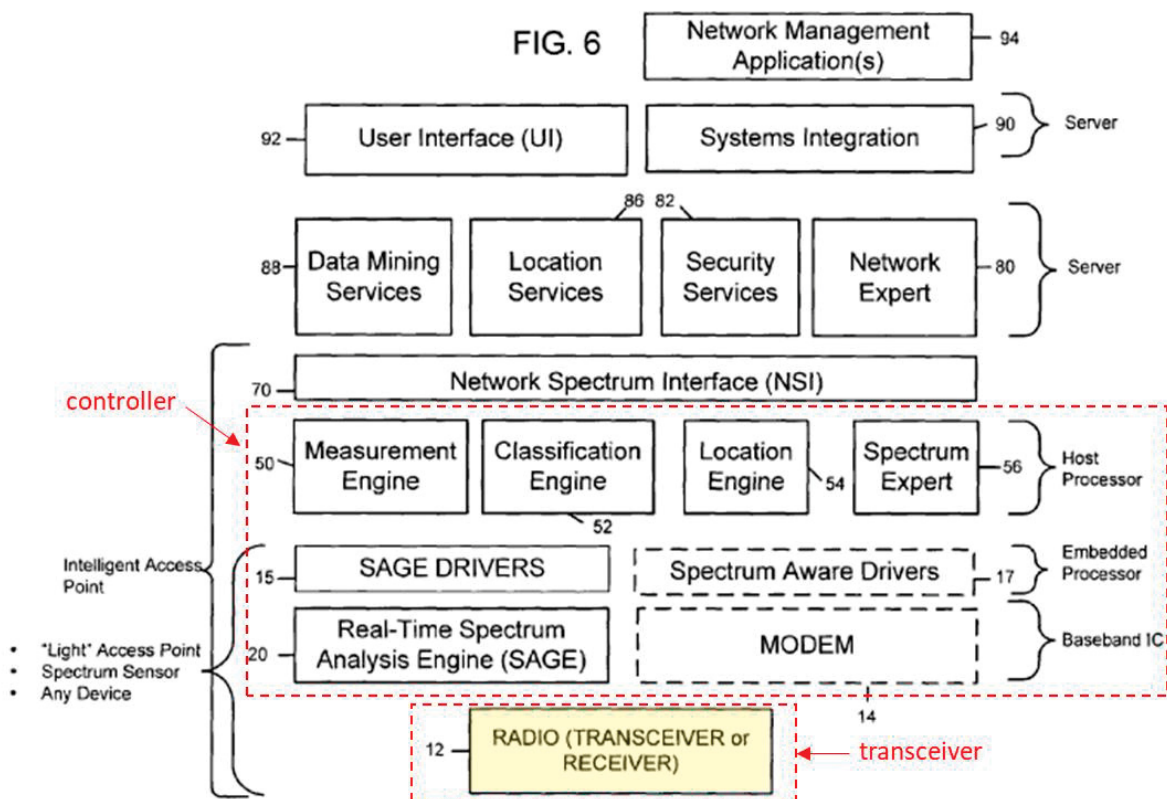
respective first and second controllers coupled thereto

106. The ’780 patent describes the “controller” in terms of functionalities, rather than in terms of hardware or software. *See e.g.*, APPLE-1001, 2:43-3:5; 4:15-51. Indeed, the ’780 patent does not disclose “hardware” or “software” at all. Thus, the ’780 patent leaves open specific implementations of the “controller” and the “controller” is broad enough to encompass a single or multiple hardware and/or

software components. Regardless, Diener discloses a “controller” that has the claimed functionalities, as well as provides examples of hardware and/or software implementation(s) of such a controller. For example, Diener discloses that *said first and second wireless communications devices* (e.g., “**any device or network of devices** operating in the frequency band (such as those shown in FIG. 1)”) *comprise respective first and second controllers* (e.g., “**necessary hardware and/or software functionalities** [that] would be **deployed in the hardware/software platform of that device to enable the device to** act as a cognitive radio device and thereby **perform the spectrum management steps of signal detecting, accumulating/measuring, classifying and controlling/reporting.**”). APPLE-1006, [0054], [0056].

107. Diener discloses a set of hardware and/or software components contained in the cognitive wireless devices, which collectively perform the functions of the “controller” recited in claim 1. *See, e.g.*, APPLE-1006, FIGS. 6 and 11. As discussed for [1.c]-[1.e] below, the *controller* of each of Diener’s cognitive wireless devices include, for example, “**real-time spectrum analyzer (SAGE) 20,**” “**a measurement engine 50, a classification engine 52,**” “**a database,**” a “**spectrum expert 56**” and “**spectrum aware drivers 17**” for “perform[ing] the spectrum management steps of **signal detecting, accumulating/measuring, classifying and controlling/reporting.**” APPLE-1006, [0054], [0069]-[0070], [0099]-[0102],

[0162]-[0176], FIG. 6. Diener's "*controller*" being divided into several modules is consistent with the '780 patent's disclosure of the "first controller" including multiple modules, such as "an enhanced interference mitigation (EIM) module 101, a media access control (MAC) module 102 coupled to the EIM module, and a physical layer (PHY) module 105 coupled to the EIM module and MAC module." APPLE-1001, 7:50-56.



APPLE-1006, FIG. 6 (annotated)

108. The *respective controllers* (including at least "SAGE 20") are *coupled to the wireless transceivers* (e.g., "radio 12"/"radio transceiver") because the

“**SAGE 20** [part of the *controller*] **may be implemented** in hardware or software and **in conjunction with the radio 12** [*coupled to a respective wireless transceiver*].” APPLE-1006, [0069]. Diener also discloses the “**SAGE 20**” (as part of the *controller*) “**processes signals received by the radio 12** [*wireless transceiver*].” APPLE-1006, [0069]. A POSITA would have readily understood that Diener’s *controllers* (including the “**SAGE 20**”) are *coupled to* respective *wireless transceivers* (e.g., “**the radio 12**”) so that the *controllers* (including the “**SAGE 20**”) can receive and process the “**signals received by the radio 12** [*wireless transceiver*].” *Id.* Indeed, FIG. 11 of Diener illustrates the SAGE 20 coupled to the radio 12 via DAC 16 and ADC 18. APPLE-1006, FIG. 11.

store short term and long term historical characteristics of interference

109. It is my opinion that Diener-Bergstrom renders obvious this limitation under either party’s constructions, for at least the reasons discussed below.

(a) ***historical characteristics of interference***

110. As alluded in Section VIII.A and discussed in more detail below, Diener discloses *historical characteristics of signals* such as “accumulated **signal** pulse data” and “reference data”/“data templates and related information **of known signals**.” APPLE-1006, [0101], [0143]. These data are used “to **classify signals**” into, for example, different types of **interferences**. APPLE-1006, [0101] (“**signals that interfere** with the operation of one or more devices”); [0172] (“**signal**

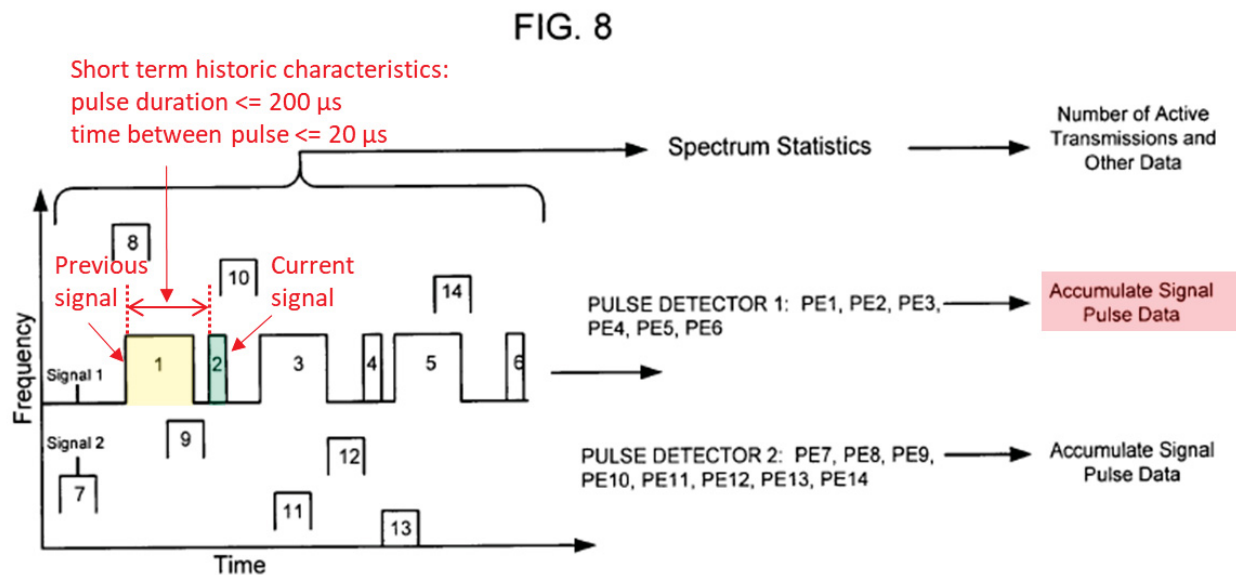
classification data indicating an **interferer**”); [0448], [0462], [0463], FIG. 26 (showing “classify interference” and different types of **interferences**). Accordingly, at least Diener’s *historical characteristics of signals* that are classified as interference are *historical characteristics of interference*.

(b) *short term*

111. Diener discloses *storing short term historical characteristics of interference* by “**collect[ing] and aggregat[ing] output from the SAGE 20**” in “accumulated signal pulse data.” APPLE-1006, [0099]. The “accumulated signal pulse data” include *short term* historical characteristics because they are “**typically [accumulated] over relatively short periods of time,**” satisfying Patent Owner’s purported plain-meaning construction. APPLE-1006, [0157], FIG. 8.

112. Diener’s “accumulated signal pulse data” also satisfy Petitioner’s Proposed construction of *short term* (“on the order of seconds”) because Diener’s “spectrum activity information” can be “accumulated and stored on a short-term basis (seconds or minutes)” and includes the “accumulated signal pulse data” that includes *historical characteristics* such as “**pulse duration, [and] time between pulses**” that are on the order of seconds or less. APPLE-1001, 4:34-36, FIG. 3; APPLE-1010, 25-27; APPLE-1006, [0157], [0161]. The “**time between pulses**” would necessarily include comparison and analysis between one pulse and another pulse received a “**short period[] of time**” ago. FIG. 8 shows an example of

“accumulated signal pulse data” that include pulses 1-6, which include short term historical characteristics such as “a signal pulse with a very short duration, no more than 200 microsec and a time between [the current signal pulse 2 and a previous signal pulse 1] of no more than 20 microsec.” APPLE-1006, [0158], FIG. 8. At the time pulse 2 is received, it would be a “*current received signal*,” while pulse 1 would be a previously received signal.



APPLE-1006, FIG. 8 (annotated)

(c) *long term*

113. Diener discloses *long term historical characteristics of interference* such as template/signature/fingerprint data of known signals (collectively referred to as “reference data”) that are used as reference for comparison in interference classification. See e.g., APPLE-1006, [0101] (“data templates and related

information of known signals”/“a database of information of known signals or signal types”), [0564] (“reference data (also called fingerprints),” [0102]; APPLE-1018, Abstract, [0013].

114. The reference data include *historical characteristics of interference* because they are “obtained from **actual measurement and analysis of those devices**” based on historical signals. APPLE-1006, [0144], [0189]. *See also* Sugar_CIP disclosing that a device creates a fingerprint definition by processing received signals). APPLE-1019, [0090]. Notably, Diener recognized a “more ‘intelligent’ program to **process historical statistics and pulse events over longer periods of time.**” APPLE-1018, [0046], APPLE-1019, [0056].

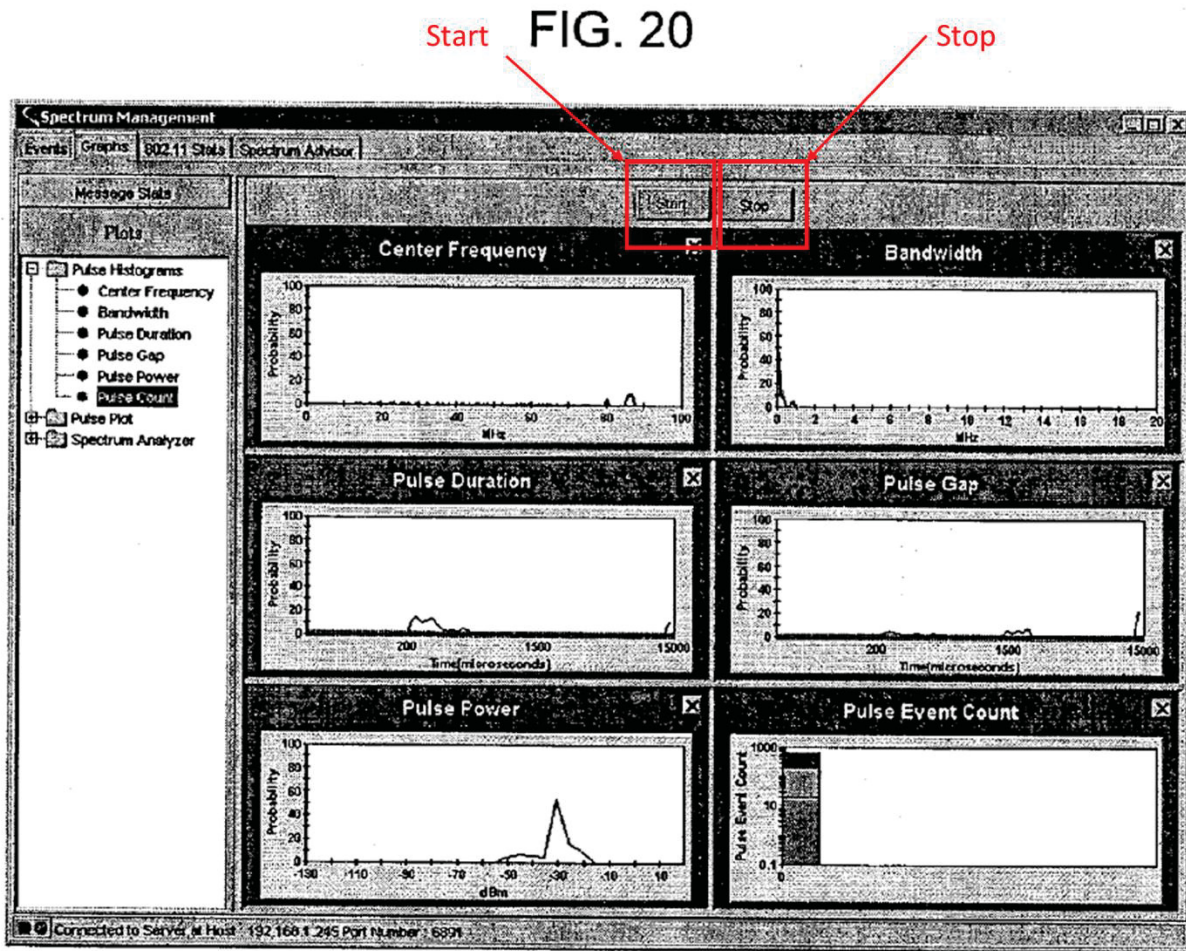
115. Diener’s reference data include the *long term historical characteristics* under both Patent Owner’s purported plain-meaning construction and Petitioner’s Proposed construction (“on the order of weeks, or greater”) because they include “a **center frequency,**” “**pulse bandwidth,**” “**fingerprint ID**” of a particular type of signal (e.g., a microwave oven) that remain valid/recurring for a long period of time such as “weeks/months” or longer. APPLE-1006, [0161]; APPLE-1018, Abstract, [0071], [0041]-[0047]. For example, Diener discloses, via Sugar, that “the **reference data** associated with each of a plurality of known signals **comprises one or more characteristics** selected from the group **consisting of: pulse center frequency, pulse bandwidth, pulse duration and time between pulses.**” APPLE-1018,

Abstract. Sugar also explains that “[a] **fingerprint definition may include: 1. Characteristics of a signal pulse: center frequency, pulse duration, bandwidth, time between pulses, etc. 2. Pulse timing signature template: definition of recurring pulse patterns, commonly related to a particular communication protocol or standard,**” among others. APPLE-1018, [0041]-[0047].

116. Also, Sugar_CIP provides more details of the pulse characteristics by showing “exemplary pulse histogram plots for center frequency, bandwidth, pulse duration, pulse gap, pulse power and pulse count” in FIG. 20. APPLE-1019, [0244], FIG. 20 (reproduced below).

FIG. 20 shows exemplary pulse histogram plots for center frequency, bandwidth, pulse duration, pulse gap, pulse power and pulse count. **As soon as the “Start” button and histogram data is available on the socket the histograms will be plotted. If the “Stop” button is pressed the plotting action is disabled and the histograms will no longer be updated with incoming data.** The following types of plots are available for viewing:

APPLE-1019, [0244]



APPLE-1019, FIG. 20 (annotated)

117. As Sugar_CIP indicates, these characteristics are collected and processed once the “Start” button is pressed until the “Stop” button is pressed. It would have been obvious to a POSITA that the histogram data can be collected over weeks/months during the operation of the system and a POSITA would have been motivated to do so for the benefit of obtaining more stable, statistically reliable data and to provide more accurate classification. APPLE-1019, FIG. 20 and [0244]-[0250].

118. Additionally, Diener discloses that “long-term storage” of the “spectrum activity information” can be used to “determine various situations such as **at what time of day interference is a problem.**” APPLE-1006, [0191]. A POSITA would have appreciated that determining “**at what time of day**” that “interference is a problem” would require storage and analyses of the “spectrum activity information” across multiple days and preferably over **weeks/months** to be statistically valid. *Id.* See also APPLE-1008, [0048], [0054] (describing averaging over “one week”), [0068], [0079] (calculating over “one month”); APPLE-1009, [0052] (database over “weeks and months”), [0083] (“deletion process” that takes place over “weeks or months”). In fact, Sugar_CIP explicitly shows that the evaluation period could span days, months, or even years as the table of “a format for the smEventMsg_t spectrum event message field” (reproduced below) showing the “EventDateTime” is displayed as “hh:mm:ss **mm/dd/yyyy**”. See APPLE-1019, [0184]:

Sub-Field Name	Description and Notes
EventType	Character string. Up to 16 characters, null terminated. Some typical examples of event types are: “Information”, “Identification”, “Interferer”, “Error”.
EventDateTime	Number of seconds past an arbitrary date, e.g., Jan. 1, 1970 when smEventMsg was received. This field is essentially a placeholder; the value must be filled in by the receiving application. 0 is sent by the target. Displayed as hh:mm:ss mm/dd/yyyy.
EventTimestampSecs	TARGET event timestamp in seconds. Times are measured from when the monitoring began of the environment, not from some absolute calendar time.

119. Sugar_CIP also provides examples of an “event log screen” in FIG. 24, wherein “the events log displays event information in a tabular format for all the RF events that the SAGE, measurement engine and classification engine have detected.” APPLE-1019, [0254]. Particularly, it includes information such as “The **Date & Time** of the event,” with the format “hh:mm:ss **mm/dd/yyyy**,” demonstrating the event logs can be recorded across days, months, or even years. It would have been obvious to a POSITA that the system is fully configured to store and analyze of the “spectrum activity information” and detect events such as different types of interferences across different “**months/days/years.**” APPLE-1019, [0257]-[0258].

FIG. 24

Alert Level	Type	Message	Data & Time	Time Stamp		ID	Source ID
				Day	Hour		
Low	Interferer	MICRO/WAVE OVEN Turned OFF	11:40:03 03/19/2003	0702	327712	2	0
High	Interferer	BLUETOOTH HEADSET Turned ON	11:40:15 03/19/2003	0708	667712	7	0
Low	Interferer	GN CORDLESS PHONE Turned OFF	11:40:19 03/19/2003	0800	664424	4	0
Low	Interferer	MICRO/WAVE OVEN Turned ON	11:40:43 03/19/2003	0813	19361E	3	0
Low	Interferer	BLUETOOTH HEADSET Turned OFF	11:40:46 03/19/2003	0815	92132E	6	0
Low	Interferer	GN CORDLESS PHONE Turned ON	11:41:00 03/19/2003	0820	26361E	5	0

Connected to Server at 10.5... 137.0.0.1 Port Number: 6591

APPLE-1019, FIG. 24.

120. Diener discloses, via Sugar, the reference data (e.g., fingerprint definition/definition data) can include other “**recurring** pulse patterns commonly **related to a particular communication protocol or standard**” which are also *long term historical characteristics* because a POSITA would have understood configurations given in a communication protocol or standard typically remain valid for “weeks/months” or even longer. APPLE-1018, [0041]-[0043], claim 7. For example, Scheinert discloses interference databases that store information for weeks and months. APPLE-1009 [0052]. Scheinert further discloses a “deletion process for a [specific type of] interferer occurs slowly (requiring weeks or months.... Only after a prolonged absence of interfering signals of interfering signals from mobiles in a neighboring [personal base station, PBS] cell can it be assumed that the neighboring PBS is permanently inactive.” APPLE-1009 [0083].

121. Moreover, the reference data include “signature”/“fingerprint” characteristics to “provide a distinctive representation of a device or class of devices.” APPLE-1006, [0157]. A POSITA would have understood they typically remain valid for a long term of “weeks/months” or even longer so that they can serve as reference/template data for signal classification/data mining. APPLE-1018, [0041]-[0043]; APPLE-1006, [0157], [0064] (“**the long-term storage** of spectrum activity information may be **useful for data mining**”). In fact, a POSITA would have reasons to evaluate/calculate/store the “signature”/“fingerprint” *characteristics of interference* could be over “a long period (for example one week)” or “a long period (for example, one month)” to adequately determine the characteristics to achieve statistical reliability, and to prevent pre-maturely deleting any possible reoccurring characteristics of interference. *See e.g.*, APPLE-1008, [0048] (“Over a **long period (for example one week)**, averages of the neighboring cell interference and variation in the neighboring cell interference between successive time slots for the averages **are calculated**”), [0054] (“[d]eviation (the deviation is **calculated over a long period (for example, one month)**) of the neighboring cell interference variations during the successive time slots corresponding to the average”) and [0068]; APPLE-1009, [0083] (“deletion process for a [specific type of] interferer occurs slowly (requiring weeks or months.... Only after a prolonged absence of interfering signals of interfering signals from mobiles in a neighboring [personal base station, PBS] cell

can it be assumed that the neighboring PBS is permanently inactive.”).

122. Furthermore, the reference data are “[**stored**] in a database,” “and/or **from a database of information provided by a regulatory authority**, such as a Federal Communication Commission in the U.S.” APPLE-1006, [0189], [0144], [0191] (“**data mining** services 88 involves **capturing spectrum activity information for long-term storage in a database**”). This reinforces a POSITA’s understanding that these characteristics are *long-term characteristics* because they could have been **stored at and accessible from, a regulatory authority’s database** which would only require long-term (e.g., in weeks or months or longer), rather than frequent, short-term update. APPLE-1006, [0144]-[0156]. *See also* APPLE-1009, [0024] (disclosing “long-term database (i.e. weeks and months)”).

123. Diener discloses *storing long term historical characteristics of interference* by disclosing that the cognitive wireless devices “**stor[e]** information describing those [RF **signatures/fingerprints**] **characteristics in a database.**” APPLE-1006, [0189], [0191], [0101]; APPLE-1018, [0029] (disclosing “**stor[ing]** locally in a device **fingerprint database 610 (also referred to as a profile or reference database)**”). *See e.g.,*

Another way to manage security in a wireless network is to **store the RF signatures of each authorized device**, such as each authorized STA or AP. The **RF signature may be created by capturing detailed**

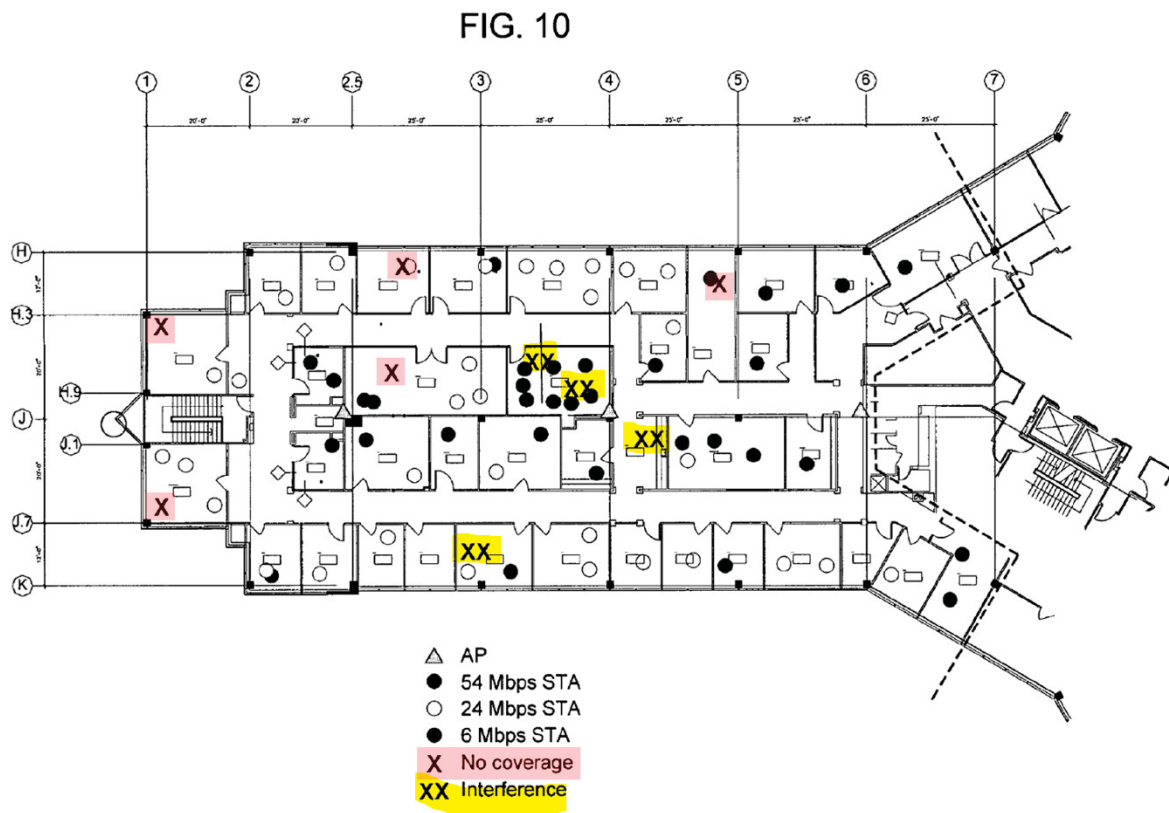
signal pulse characteristics of each authorized device obtained using a device having a SAGE functionality, and storing information describing those characteristics in a database. Each time a STA associates with an AP, its signal pulse characteristics may be compared against the database of information to determine whether it is an authorized device. This procedure protects against a user of a STA from obtaining a valid MAC address (by listening to transmissions in a WLAN), and masquerading as that STA using that MAC address. Even though the MAC address will be valid, the RF fingerprint of the fraudulent device will likely not match **the stored RF fingerprints of the authorized device in the database.**

APPLE-1006, [0189].

124. As another example of *long term historical characteristics of interference*, Diener discloses a coverage map shown in FIG. 10 which includes locations and range of interferences (denoted by “XX”) in the enterprise, as well as no-signal-coverage locations (denoted by “X”) that typically result from severe path/link losses in those locations. APPLE-1006, [0190], FIG. 10. Notably, FIG. 3 of the ’780 patent shows “path/link loss” as “long term” characteristics. APPLE-1001, FIG. 3. As such, the no-signal-coverage locations determined by Diener (which a POSITA would understand are locations experiencing path/link loss) fall squarely within the example “*long term*” characteristics of the ’780 patent.

125. Moreover, a POSITA would have understood that configurations of the

enterprise would typically remain the same in the floor map for a long term (e.g., weeks or months). The locations of the no-signal-coverage and some interferences (e.g., a “microwave oven” in a break room as repeatedly disclosed by Diener as an example interferer) would be understood to remain unchanged for a long term of weeks or months. APPLE-1006, [0058], [0065].



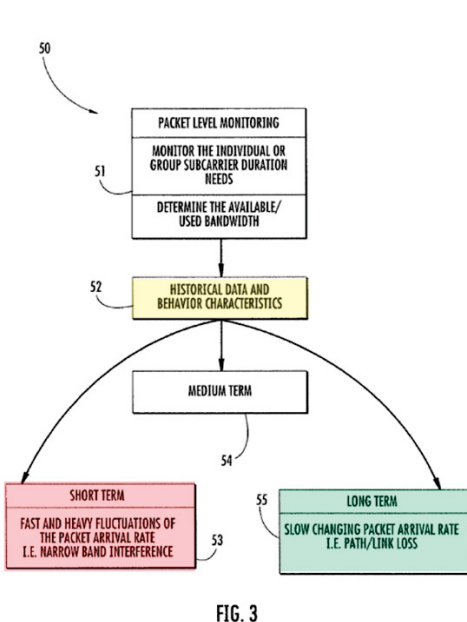
APPLE-1006, FIG. 10 (highlighted)

(d) *Patent Owner’s alternative construction*

126. Diener also discloses *storing short term and long term historical characteristics of interference* under Patent Owner’s alternative construction (“allow the wireless system to determine the **cause of the degradation in link**

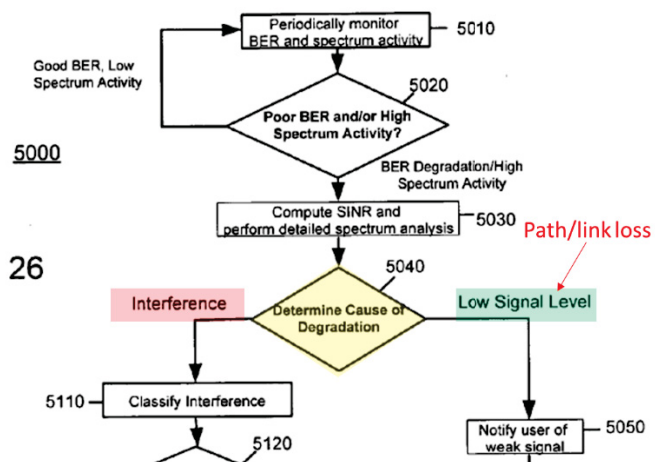
performance, *i.e.*, is it a **short term fade** or truly **interference**”). APPLE-1011, 27-32, f.9.

127. Similar to the '780 patent's thin disclosure shown in FIG. 3 related to this construction, Diener's disclosed techniques, including *storing short term and long term historical characteristics of interference* as discussed above under the other constructions, allowing the system to “**determine the cause of degradation as either interference** [i.e., truly interference]” (left branch after step 5040) “**or low signal level**” (right branch after step 5040) as shown in FIG. 26 (reproduced below). APPLE-1006, [0446].



'780 Patent

FIG. 26



Diener

APPLE-1001, FIG. 3; APPLE-1006, FIG. 26 (excerpted and annotated).

128. As discussed for [1.b.ii] and 1.d.ii], Diener discloses that the *short term*

and long term historical characteristics of interference is used to perform “signal classifications” and determine whether the signal is **true interference**. APPLE-1011, 27-32; APPLE-1006, [0064]-[0066], FIG. 5, [0172] (“signal classification data indicating an interferer.”).

129. On the other hand, a POSTIA would have readily understood that “a low signal level” is typically caused by path/link loss, characterized as “long term” characteristics by the ’780 patent in FIG. 3, because Diener discloses the remedial actions to the “low signal level” is to bring “signal level returns to adequate levels,” which include “adjusting the antennas of the device or the location of the device.” APPLE-1006, [0447]. Also, as discussed in Section VIII.A, Diener discloses an example coverage map in FIG. 10 that shows locations of “no signal coverage” in an enterprise. APPLE-1006, FIGS. 26 and 10.

130. Additionally, Diener discloses “**short-term** storage of spectrum activity information” allows the system “**to determine whether there is a performance degradation** of a device or network of devices,” i.e., “**a short term fade**,” and “[c]ertain actions can be recommended or automatically taken based on a **determine [sic] cause of the performance degradation**.” APPLE-1006, [0099]; *see also* APPLE-1006, [0199] (“**statistics may be accumulated** by software counters and allocated memory locations [i.e., data storage] in the LMAC [optional lower MAC] software. Some of **these statistics are good indicators of a**

performance degradation in a device.”) For at least the above reasons, Diener-Bergstrom renders obvious this limitation under Patent Owner’s alternative construction (“allow the wireless system to determine the **cause of the degradation in link performance**, *i.e.*, is it **a short term fade** or truly **interference**”). APPLE-1011, 27-32, f.9.

131. In terms of the *controllers* (“**necessary hardware and/or software functionalities** [that] would be **deployed in the hardware/software platform of that device to enable the device**”) to perform the storage operations, Diener discloses, for example, “[t]he **measurement engine 50** [that] may **maintain short-term storage of spectrum activity information**.” APPLE-1006, [0054], [0099]. “The data mining services 88 involves capturing **spectrum activity information** (and optionally output from the spectrum expert) **for long-term storage in a database**.” APPLE-1006, [0191]; *see also* APPLE-1018, [0029] (“Information used by the classification engine 500 to classify signals may be **stored locally in a device fingerprint database 610 (also referred to as a profile or reference database)**.... Data output by the SAGE 400 is stored in a memory 620 that the processor 600 accesses when performing the classification operations. The **memory 620 may contain the fingerprint database 610** as well.”). Accordingly, a POSITA would have recognized that the *controllers* include, among others, “**a measurement engine 50**” and “**a database**” *configured to store short term and long*

term historical characteristics of interference.

[1.c] said first controller configured to detect received interference,

132. It is my opinion that Diener-Bergstrom provides [1.c]. Diener discloses the *first wireless communications device* can be “**any device or network of devices**” such as “a **cognitive radio device**” which may implement “the spectrum management methods” to obtain “spectrum activity information” and detect and address “an interference condition (presence of another signal in the frequency band of operation, adjacent frequency channel of operation, etc., of a device or network of devices in the frequency band)” based on the “spectrum activity information.” APPLE-1006, [0054], [0061], [0065]. For example, either the “AP” or “STA” “**may have cognitive radio capability**” and be a “**cognitive radio device.**” APPLE-1006, [0062]-[0063]. Thus, as an example mapping, the *first wireless communications device* is a client device (STA), while the *second wireless communications device* is a base station device (AP) , or vice versa.

133. As discussed for [1.b.ii], Diener discloses *the first wireless communications device*, e.g., “any device or network of devices” *comprising a first controller*, e.g., “**necessary hardware and/or software functionalities** [that] would be **deployed in the hardware/software platform of that device to enable the device to act as a cognitive radio device and thereby perform the spectrum management steps.**” APPLE-1006, [0054]. Notably, the “**the spectrum**

management steps” include “**signal detecting**, accumulating/**measuring**.” APPLE-1006, [0054]. Moreover, Diener explicitly discloses the operation of *detecting received interference*: “an **interference** condition in the frequency band is **detected**,” and “**detection** of a signal that **interferes** with the operation of a device or network of devices operating in the frequency band.” APPLE-1006, [0164]-[0165]. A POSITA would have understood that Diener discloses the *first controller* having “**necessary hardware and/or software functionalities**” is configured to perform the disclosed operation of *detecting received interference*.

134. Moreover, Diener describes modules/components such as a “**classification engine 52**” as an example of the “**necessary hardware and/or software functionalities**” (*first controller*) configured to *detect the received interference*. For example, the “**classification engine 52 can detect** [*configured to detect*], for example, **signals that interfere** with the operation of one or more devices (e.g., occupy or occur in the same channel of the unlicensed band as a device operating in the band) [*received interference*].” APPLE-1006, [0101]. “The classification engine 52” detects *received* interference because it receives “outputs of the SAGE 20” that “processes signals **received** by the radio 12.” APPLE-1006, [0101], [0069]. “The “**classification engine 52** ... may be performed **locally in a device** that operates in the radio frequency band, such as an AP.” APPLE-1006, [0098].

[1.d.i] determine a type of the received interference from among a plurality of interference types comprising wideband interference, self interference, and narrowband interference

135. It is my opinion that Diener-Bergstrom provides [1.d.i] for at least the reasons discussed below.

determine a type of the received interference

136. As discussed for [1.c], Diener discloses the *first controller* (e.g., “**necessary hardware and/or software functionalities** [that] would be deployed in the hardware/software platform of that device **to enable the device to perform** the spectrum management steps.”). APPLE-1006, [0054]. Notably, the “**spectrum management steps**” performed by the hardware and/or software functionalities (i.e., *first controller*) of Diener’s device includes “**classifying.**” APPLE-1006, [0054]. Moreover, Diener explicitly discloses the operation of classifying interference or *determining a type of the received interference*: “**the interference is classified, by signal type, etc.**” and “**determin[ing] that the interferer is a type** that can be mitigated using interference mitigation techniques.” APPLE-1006, [0448]. In fact, Diener describes interference classification and signal classification interchangeably, since interference is also a signal. *See e.g.*, APPLE-1006, [0172] (“signal classification data indicating an interferer.”); APPLE-1006, [0172] (“uses signal classification and other interference timing information to make intelligent decisions on data rate”). A POSITA would have understood that Diener discloses the *first*

controller having **“necessary hardware and/or software functionalities”** configured to perform the disclosed operation of *determining a type of the received interference*.

137. Moreover, Diener describes modules/components such as the **“classification engine 52”** as examples of the **“necessary hardware and/or software functionalities”** (*first controller*) configured to *determine a type of the received interference*. For example, Diener describes “[t]he classification engine 52 may perform spectrum analysis functions **to determine and classify the types of signals** occurring in the frequency band.” APPLE-1006, [0282]. “The **classification engine 52** can detect, for example, **signals that interfere** with the operation of one or more devices.” APPLE-1006, [0101]. “The **output of the classification engine 52 includes types of signals** detected in the frequency band.” APPLE-1006, [0101].

from among a plurality of interference types

138. Diener explicitly discloses *a plurality of interference types* such as “**a type** that can be mitigated using interference mitigation techniques,” a type of “interference [that] is caused by a slow frequency hopping signal,” a type of “interference [that] is caused by a fast frequency hopping signal,” and interference from different types of devices (interference sources): “cordless phone,” “frequency hopper device,” “frequency hopper cordless phone,” “microwave oven,” “802.11x

WLAN device,” etc. APPLE-1006, [0448], [0462], [0463]. [0101], [0102].

the plurality of interference types comprising wideband interference, self interference, and narrowband interference

139. Diener-Bergstrom discloses or renders obvious *determining that a type of the received interference is self interference* under both parties’ constructions. More specifically, Diener discloses the “**classification engine 52 can detect**, for example, **signals that interfere** with the operation of one or more devices (e.g., **occupy or occur in the same channel** of the unlicensed band **as a device operating in the band**).” APPLE-1006, [0101]. Diener discloses that this **interference** may be “caused by another IEEE 802.11 network **on the same channel**.” APPLE-1006, [0448]. This interference that “**occur[s] in the same channel**” is a **co-channel interference** that meets the overlapping portion of the parties’ construction: “interference caused by two wireless communication systems being deployed too closely together **or by two wireless communication systems using the same frequency band/channel**.” APPLE-1011, 27; *see also* APPLE-1001, 1:41-46 (explaining “[c]ommon causes of self interference may include, for example, **collocation** or frequency reuse. In particular, collocation may be caused by two wireless communication systems **being deployed too closely together** while frequency reuse may be caused by two wireless communication systems **using the same frequency band/channel**.”).

140. Additionally or alternatively, Diener discloses a “location engine 54,”

which “computes the physical location of devices [(such as interferers)] operating in the frequency band.” APPLE-1006, [0163]. Diener explains “[w]hen an **interference** condition in the frequency band **is detected**, the spectrum expert 56 or network expert 80 may **command the location engine 54 to physically locate the source of the interferer.**” APPLE-1006, [0164]. It would have been obvious to a POSITA that the location information of the interferer would indicate whether the interferer is deployed too closely (i.e., is a “self-interfering” interferer), meeting the overlapping portion of the parties’ construction. APPLE-1011, 27. It would have been obvious to a POSITA that Diener’s “location engine 54” and “classification engine 52” can work in concert with each other in determining *a type of the received interference* because “there may be **interaction between** and among the measurement engine 50, **classification engine 52**, [and] **location engine 54**” and “**the classification engine, location engine** and spectrum expert can be viewed as a **client to the measurement engine** and would generate requests to, and receive data from, the measurement engine **similar to the manner in which an application program would interact with the measurement engine.**” APPLE-1006, [0177], [0269].

141. Moreover, Diener’s teaching of using the interferer’s location information to determine *self interference* is consistent with Bergstrom’s disclosure. Bergstrom acknowledges location is an important factor in determining interference

sources and identifies “co-site” and “co-channel” sources as being of interest. *See* APPLE-1005, 5:52-58 (discussing “**interference source 40 can include** partial band noise jammers, spread spectrum **co-channel sources**, wideband noise jammers, banded **co-site signal sources**, chirp jammers, multitone jammers, non-banded **co-site signals**, and others”). A POSITA in view of Diener and Bergstrom would have been motivated to leverage the location information of the interferer provided by Diener’s location engine 54 to determine whether the interference is *self interference* from a “**co-channel**”/“**co-site**” source, as disclosed by Bergstrom.

142. In addition to *self interference*, it would have been obvious to a POSITA that the *interference types also comprise wideband interference and narrowband interference* given that the ’780 patent admits it had been known that “[i]**nterference is typically categorized** into two types: **narrowband** interference **and wideband** interference” based on **bandwidth**. APPLE-1001, 1:25-40. It would have been obvious to a POSITA to configure Diener’s first controller to *determine wideband interference or narrowband interference* because Diener discloses that “**the classification engine 52 may output information describing... bandwidth... of the classified signal,**” which “may [be] **particularly useful for a classified signal that is determined to interfere** with operation of other devices in the frequency band.” APPLE-1006, [0101]. It would have been natural and well within a POSITA’s skills to classify interference to be *wideband interference or narrowband*

interference based on the **bandwidth** characteristics of detected interference. Indeed, Diener discloses determining a *wideband interference* “by examining the spectrum activity information to look for **a large bandwidth noise signal that may interfere** with one or more signals in the frequency band.” APPLE-1006, [0185]. Furthermore, Diener discloses cognitive radio devices can include “the radio 12 operating in either a **narrowband** mode or a **wideband** mode.” APPLE-1006, [0069]. “[T]he bandwidth of the frequency band analyzed [by the SAGE] may be controlled. For example, **a portion**, such as 20 MHz (**narrowband mode**), **of an entire frequency band** may be analyzed, or **substantially an entire frequency band** may be analyzed, such as 100 MHz (**wideband mode**).” APPLE-1006, [0289]. A POSITA would have understood that the cognitive radio devices can monitor and classify spectrum activities into wideband interference or narrowband interference, for example, based on whether the bandwidth of interference occupies “**a portion of**” or “**substantially an entire frequency band.**” *Id.*

143. Moreover, Diener makes it clear that “**other signal classification techniques** may be known in the art” to additionally describe and classify types of interference. APPLE-1006, [0101], [0102]. Bergstrom describes such additional signal classification techniques that a POSITA would have found obvious to incorporate into Diener’s system.

144. Bergstrom discloses techniques of interference classification,

especially classifying the disturbance/interference into “**class superset** and/or subset classes. **Class supersets can include narrow band, partial band and wideband classes.**” APPLE-1005, 9:1-4. More specifically, Bergstrom describes “**classify[ing] the interference/jamming components in the receive signal.**” APPLE-1005, 9:44-47. The “**interference/jamming components in the receive signal**” are from “interference source 40” including *a plurality of interference types comprising wideband interference* (e.g., interference from “**wideband noise jammers**”) and *narrowband interference* (e.g., interference from “**narrow band ... jammers**”), besides the above-described *self interference* (e.g., interference from “spread spectrum **co-channel sources**,” “bauded **co-site signal sources**,” “non-bauded **co-site signals**”). APPLE-1005, 5:52-58.

145. As discussed in Section IX.A, it would have been obvious to a POSITA to combine Diener and Bergstrom, for example, by modifying Diener’s *first controller* (e.g., “**necessary hardware and/or software functionalities**”) to classify interference as narrow or wide band interference according to Bergstrom’s interference classification techniques, in addition to the type of *self interference* as explicitly disclosed by Diener. APPLE-1005, 9:1-4.

146. In fact, Sugar_CIP further confirms a POSITA’s motivation to combine Diener and Bergstrom and that a POSITA would have had a reasonable expectation of success in doing so. Sugar_CIP discloses that Diener’s classification techniques

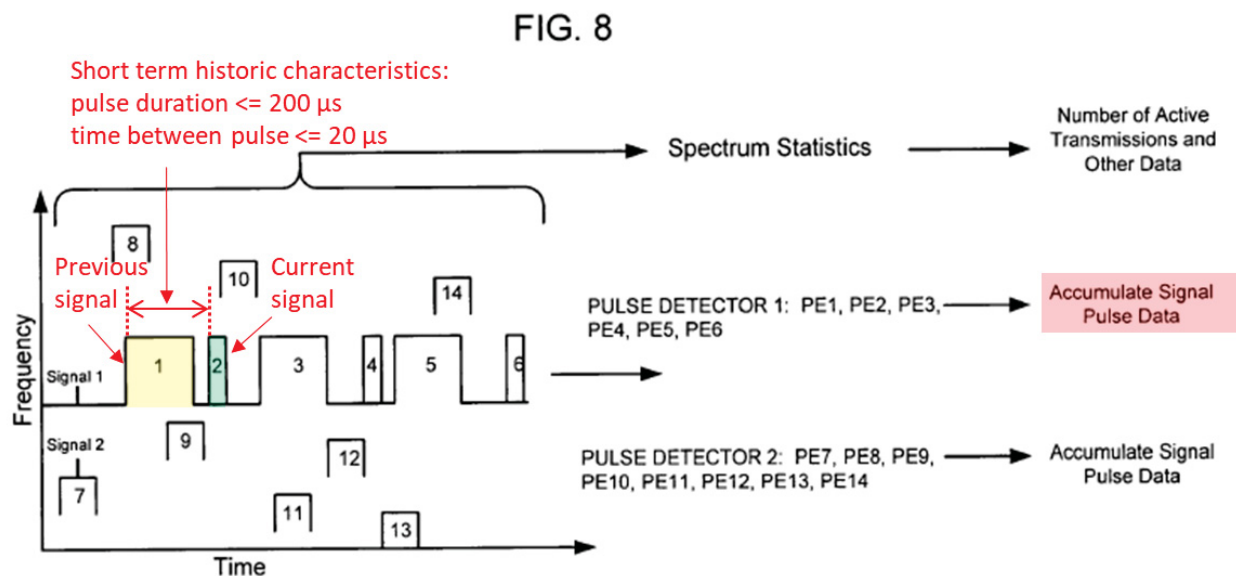
can benefit from a tiered/staged classification approach, which is also disclosed by Bergstrom. *See* APPLE-1019, [0089] (“When several signals are being classified simultaneously, it may be **useful to loosen the match requirements initially** when processing data, and then once signals have been classified with a minimum confidence level, **the match requirements can be tightened to ensure, over time, that the initial signal classifications holds over time**”); APPLE-1005, 9:1-4 (classifying the disturbance/interference into “**class superset** and/or subset classes”). Similarly, Diener also discloses the “**degree of match** between the accumulated signal pulse data and the reference signal pulse data may be **adjustable**.” APPLE-1006, [0143]. A POSITA would have found it obvious to incorporate Bergstrom’s classification with the classification disclosed by Diener, for example, to initially classify the interference loosely by “class superset” including *narrow band and wideband interference*, and then tighten the match requirements to perform a more detailed match between the accumulated signal pulse data and reference data to identify a specific source of the interference (e.g., “cordless phone”, “frequency hopper device”, “microwave oven”, “802.11x WLAN device”) as disclosed by Diener. APPLE-1005, 9:1-4; APPLE-1019, [0089]; APPLE-1006, [0448], [0462], [0463], [0101], [0102].

[1.d.ii] [determine a type of the received interference...] based upon comparing at least one characteristic of a current received signal with the short term and long term historical characteristics of interference, and

147. It is my opinion that Diener-Bergstrom provides [1.d.ii]. As I discussed above in Section VIII.A and for [1.b.ii], Diener discloses *comparing* the accumulated statistics of the received signals (that includes *at least one characteristic of a current received signal*) against reference data (*long term historical characteristics of interference*) to classify the received signals. APPLE-1006, [0157] (“The comparison step may involve **comparing pulse timing signatures of known signals** against **the accumulated signal pulse data ... to determine if there is a match....** They are **useful to classify signals**”), APPLE-1006, [0101], [0564], [0143], FIG. 9; APPLE-1018, [0040], FIG. 5. Sugar (to which Diener cites for further explanation of its classification process) discloses that the “accumulated signal pulse data” is “information, such as signal pulse data, duty cycle and other spectrum statistics, and raw snapshot samples” of the received “raw” data, which a POSITA would have understood or at least found obvious are characteristics of a current received signal, since Diener’s classification happens in “real time.” APPLE-1018, [0040]; APPLE-1006, [0102] (citing Sugar), [0073]-[0074] (describing “real-time” analysis). Additionally, Sugar teaches that the classification engine may compare “raw” signal data (e.g., samples directly from the ADC—which would necessarily include *characteristics of a current received signal*)—against certain signatures as part of the classification process. APPLE-1018, [0040]-[0048].

148. Diener also discloses *comparing at least one characteristic of a current*

received signal with short term historical characteristics of interference as part of generating the “accumulated signal pulse data.” APPLE-1006, [0157]-[0158], [0161], FIG. 8. As I discussed above for [1.b.ii], Diener’s “accumulated signal pulse data” include, for example, “**pulse duration, [and] time between pulses.**” APPLE-1006, [0157]-[0158], [0161]. As shown in FIG. 8, the “**time between pulses**” would necessarily include *comparing at least one characteristic* (e.g., a reception time) of *a current received signal* (e.g., a signal pulse such as pulse 2) with *short term historical characteristics of interference* (e.g., reception time of one or more other pulses such as pulse 1 received “**short periods of time**” ago). APPLE-1006, [0157], [0158], FIG. 8.



APPLE-1006, FIG. 8 (annotated)

149. Additionally, it is my opinion that Diener-Bergstrom provides another

example of *comparing at least one characteristic* (e.g., location and pulse data statistics) of a current received signal with long term historical characteristics of interference (e.g., the coverage map shown in FIG. 10) to determine an interference type (e.g., 54 Mbps STA, 24 Mbps STA, 6 Mbps STA, AP, self interference or wideband interference), as alluded to in Sections VIII.A, IX.3.[1.b.ii] and [1.d.i].

150. Diener notes that the coverage map is one type of “**value added services** [provided] to the location measurements made by the location engine 54.” APPLE-1006, [0190]. As I discussed above for [1.d.i], it would have been obvious to a POSITA that Diener’s “measurement engine 50,” “classification engine 52,” and “location engine 54” can work in concert with each other for interference classification. APPLE-1006, [0177], [0269]. To benefit from the “**value added service**,” it would have been obvious to a POSITA that Diener’s cognitive radio device would have leveraged the coverage map provided by “the location engine 54” with the classification service provided by “classification engine 52” to provide more accurate interference classification and more suitable remedial actions, furthering Diener’s goal of “optimiz[ing] simultaneous use of the frequency band with the other signals” and “maintain[ing] desirable performance.” APPLE-1006, [0012].

151. For example, a POSITA would have found it obvious that Diener’s cognitive radio device would be configured to *compare* location (e.g., obtained by

the “location engine 54”) and other pulse data statistics (e.g., obtained by the “measurement engine 50”) of a current signal detected in the enterprise *with* the location of Diener’s cognitive radio device (e.g., obtained by the “location engine 54”), reference data of known signals, and the coverage map (*long term historical characteristics of interference*) shown in FIG. 10. APPLE-1006, [0013] (“**Cognitive radios can also be equipped with location-sensing features** to help them determine the manner in which they can **most effectively communicate**”), [0163] (“the location engine 54 computes the physical location of devices,” e.g., “to determine a **location of a variety of devices (such as interferers)** operating in the region of the frequency band”) [0190].

152. As one predictable result, a POSITA would have found it obvious that Diener’s cognitive radio device would have been able to determine the current received signal is *self interference* if the current received signal is classified as an interference (e.g., by the classification engine 52) based on reference data of known interferers, and that Diener’s cognitive radio device and the source of the current received signal (i.e., the interference) are deployed too closely with reference to the coverage map in FIG. 10. APPLE-1006, [0013] (“location engine 54 [can] physically **locate the source of the interferer**”), FIG. 10; APPLE-1011, 27.

153. As another predictable result, a POSITA would have found it obvious that Diener’s cognitive radio device would have been able to determine the current

received signal is *wideband interference* based on a bandwidth of the current received signal that “span[s] a significant portion of the unlicensed band” and further determine that the current received signal is from a microwave oven based on the facts that (1) other pulse characteristics of the current received signal match the stored signatures of a microwave oven signal, and (2) the location of the source of the current received signal correspond to the location of a microwave oven in the coverage map of FIG. 10. APPLE-1006, [0058] (“A microwave oven will emit a burst of energy that may span a significant portion of the unlicensed band.”), [0065] (“A classification output may be, for example,” “microwave oven”); [0013], [190]. This is an example of the tiered classification rendered obvious by Diener-Bergstrom as I discussed for [1.d.i].

[1.e] set the at least one settable link characteristic to compensate for the received interference based upon the interference type.

154. It is my opinion that Diener-Bergstrom provides [1.e]. For example, Diener discloses “a cognitive radio device [*the first wireless communications device*]” *setting the at least one settable link characteristic to compensate for the received interference*, e.g., “**by adapting at least one of: its data rate, packet size, frequency channel, transmit power, etc. after classifying an interferer as a microwave oven, a frequency hopping device or alternatively, another WLAN** [*based upon the interference type*].” APPLE-1006, [0054], [0066] (disclosing determining what “controls of a communication device or network of devices to take

on the basis of the output of the signal classification step 2010”):

The policy execution step **2020** involves determining what, if **anything, should be done about the information output by the signal classification step 2010**. For example, the policies dictate what **spectrum actions in or controls of a communication device or network of devices to take on the basis of the output of the signal classification step 2010**. The output of the policy execution step **2020** may include recommended actions to a network administrator, application program or system, to take in order to remedy or adjust for a situation. In addition, in processing the spectrum activity information, **controls may be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band**. The spectrum actions step 2030 generates the particular controls to effect the actions. Examples of controls are: assigning a device to a different frequency sub-band or channel in the frequency band (dynamic frequency selection—DFS), network load balancing (on the basis of channel frequencies or time), adjusting the transmit power (transmit power control—TPC), adjusting the communication data rate, adjusting a parameter of the transmitted data packet, executing interference mitigation or co-existence algorithms, executing spectrum etiquette procedures, executing spectrum priority schemes, or re-assigning STAs to APs in a WLAN. Examples of interference mitigation algorithms are disclosed in commonly assigned and co-pending U.S. Patent Publication No. 20020061031, published, May 23, 2002. Other actions that can be taken include reporting spectrum activity information to users and administrators to enable

human intelligence interaction to diagnose problems, optimize network settings and remove interference sources.

APPLE-1006, [0066]

155. In the example of “process 5000” shown in FIG. 26, Diener discloses **“the client device, e.g., STA”** as an example of the *first wireless communications device*. APPLE1006, [0446], [0448]. Diener discloses, “in step 5110, the **interference is classified, by signal type, etc.,**” and “if in step 5120 it is determined that the **interferer is a type that can be mitigated** [i.e., *based upon the interference type*] **using interference mitigation techniques** [i.e., *to compensate for the received interference*], then **the device** [i.e., *first wireless communications device*] **executes those [interference mitigation] techniques automatically.**” APPLE1006, [0448].

156. Diener discloses multiple exemplary techniques *to set the at least one transmit processing characteristic* such as **“to adjust the AP of the user's network to a clean/unused channel”**:

In step 5160, if the interference is caused by another IEEE 802.11 network on the same channel, then a recommended user action is **to adjust the AP of the user's network to a clean/unused channel**. In step 5170, if the interference is caused by an IEEE 802.11 network on an adjacent channel, the recommended user actions may include **adjusting the AP to a channel further from the other network's channel, adjusting the physical location of the interfering network,**

or adjusting the location of the AP in the user's network. In step 5180, if the interference is caused by a microwave oven, then recommended user actions may include **adjusting the AP of the user's network to a cleaner channel, adjusting the location of the AP in the user's network, adjusting the fragmentation threshold of the AP in the user's network for better interoperability, or to increase the distance between the user's device and the microwave oven.** APPLE-1006, [0448].

157. As discussed for [1.c], Diener generally discloses *the first wireless communications device* can be, e.g., “**any device** or network of devices operating in the frequency band (such as those shown in FIG. 1).” APPLE-1006, [0054]. The *first wireless communications device comprises a first controller*, e.g., “**necessary hardware and/or software functionalities** [that] would be deployed in the hardware/software platform of that device to **enable the device to** act as a cognitive radio device and thereby **perform** the spectrum management steps” that include “**controlling**/reporting.” APPLE-1006, [0054]. Diener goes on to disclose that the above-discussed “**adapting** at least one of: its data rate, packet size, frequency channel, transmit power, etc. [i.e., *setting the settable link characteristic*]” as an example of the “**controlling**” step. *Id.*. A POSITA would have understood that Diener discloses the *first controller* configured to perform the disclosed *setting/controlling* operations.

158. Moreover, Diener provides multiple example modules of the *first controller* configured to *set the settable link characteristic to compensate for the received interference based upon the interference type*. For example, Diener discloses the *first controller* can include, among other things, “**the spectrum expert 56** [that] processes data from the SAGE 20 ..., in order to make recommendations to **adjust parameters** of a device, or **to automatically perform those adjustments in a device**,” such as to “move to another channel during that time of day” [*to set the at least one transmit processing characteristic*] to avoid or evade “interference on a particular frequency channel at a certain time of day [*to compensate for the received interference based upon the interference type*].” APPLE1006, [0448], [0165], [0183].

159. Alternatively or additionally, the *first controller* can include, among other things, the “**spectrum aware drivers 17** [that] may **receive commands** from **interference algorithms** at a higher level to adjust a transmit rate, fragmentation threshold, etc. [i.e., *configured to set the at least one settable link characteristic*].” APPLE-1006, [0071]. Diener further discloses “the spectrum aware drivers 17” may receive commands to perform dynamic packet scheduling [*set the at least one settable link characteristic*] to avoid transmitting a packet that may interfere in time and frequency with a signal from another device [*to compensate for the received interference*].” *Id.* “Furthermore, the spectrum aware drivers 17 may receive

commands to change a (center frequency) of operation, bandwidth of operation, data rate, transmit power, etc. [*set the at least one settable link characteristic*].” APPLE-1006, [0071].

4. Claim 2

[2] The wireless communication system according to claim 1 wherein said first controller is configured to repeat the detecting, determining, and setting.

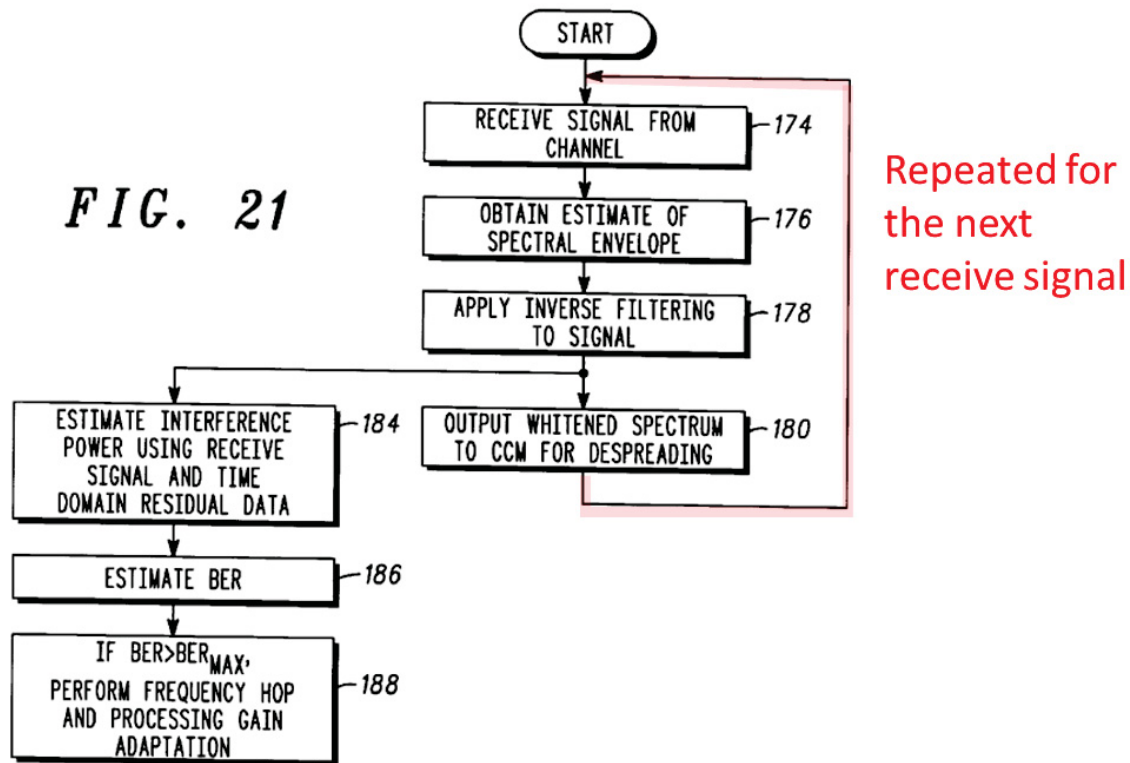
160. It is my opinion that Diener-Bergstrom provides [2]. A POSITA would have found it obvious that Diener discloses repeating the detecting, determining, and setting. For example, in the “general flow chart of a spectrum management process” shown in FIG. 5, Diener discloses the *detecting* that includes obtaining “**spectrum activity information**” by “**spectrum sampling** in step 2000” can be performed “**on demand or periodically,**” to determine spectral-based and time-based activity in the frequency band.” APPLE-1006, [0026], [0061]. The “spectrum activity information” is used in the *determining*, e.g., “**signal classification** step 2010 [that] involves processing the output of the spectrum sampling step to measure and **classify signals.**” APPLE-1006, [0065]. Based on the “output of the signal classification step 2010,” the *setting* is performed, for example, such that “**controls may be generated to adjust** one or more operating **parameters** of devices or networks of devices operating in the frequency band.” APPLE-1006, [0066].

161. Similarly, Diener discloses “another example of a spectrum management support tool process 5000” shown in FIG. 26, “**may be initiated** by a

user command to check the performance behavior of a device **on demand**, through a suitable user interface application, or by an application program that **periodically** checks the performance behavior of the device, **or in response to detecting a performance degradation.**” APPLE-1006, [0446]. The process 5000 also includes *the detecting* (e.g., step 5010 including monitoring spectrum activity information), *determining* (e.g., “in step 5110, the interference is classified, by signal type”), and *setting* (e.g., “using interference mitigation techniques” based on the determined type of interferer). APPLE-1006, [0446]-[0450], FIG. 26.

162. It would have been obvious to a POSITA that by performing the process in FIGS. 5 and 26 “on demand or **periodically**,” *the detecting, determining, and setting are repeated*. Moreover, it is well-understood by a POSITA that these steps would be repeated each time the link experiences a new environment, including the scenarios taught by Diener such as “in response to detecting a performance degradation.” APPLE-1006, [0446]. A POSITA would have readily understood that the disclosed steps in flow charts of FIGS. 5 and 26 do not happen only ONCE in a lifetime of the device.

163. Alternatively and additionally, as shown in FIG. 21 (reproduced below), Bergstrom discloses an “inverse whitening procedure [that] is then **repeated for the next receive signal.**” APPLE-1005, 19:9-10.



APPLE-1005, FIG. 21 (annotated)

164. Bergstrom discloses the “inverse whitening function suppression method” as an example of “interference suppression methods” for *set[ting] the at least one settable link characteristic to compensate for the received interference as “[t]he inverse whitening function removes this distortion from the white noise model.”* APPLE-1005, 18:40-42. The *setting* is in response to *the determining and the detecting* because Bergstrom discloses “**determin[ing] which method to use based upon the type or types of interference detected** in the disturbance classification unit 74 and the jammer parameter extraction unit 76.”) APPLE-1005, 18:31-35, 21:15-21.

165. More specifically, as shown in FIG. 21, a “signal is first **received** from the channel 16 (step 174),” and “the receive signal is **inverse filtered** using the inverse of the spectral envelope (estimated in step 176) **to remove the interference components** (step 178)” (i.e., *set[ting] the at least one settable link characteristic to compensate for the received interference*) APPLE-1005, 18:42-66. A POSTIA would have understood that step 178 of applying the inverse filtering would be a result of “determin[ing] [the inverse whitening function suppression] method to use **based upon the type or types of interference detected**” in the signal received in step 174. APPLE-1005, 18:31-35, 21:15-21. Accordingly, there are steps of *detecting received interference* and *determining a type of the received interference* after the signal *receiving* in step 174. When the “**inverse whitening procedure is then repeated for the next receive signal**,” the steps of the *detecting, determining,* and *setting* by using the “inverse whitening function [to **remove**] **this distortion from the white noise model**” would be “**repeated for the next receive signal.**” APPLE-1005, 18:40-42, 19:9-10.

166. As I discussed in Section IX.A, it would have been obvious to a POSITA to combine Diener and Bergstrom and in the Diener-Bergstrom combination, Diener’s *first controller* (e.g., “**necessary hardware and/or software functionalities ...to enable the device to** act as a cognitive radio device and thereby **perform the spectrum management steps of signal detecting,**

accumulating/measuring, classifying and controlling/reporting,” APPLE-1006, [0054]) would be *configured to repeat the detecting, determining, and setting*, for example, “for the next receive signal” or on each received signal in general so as to improve the BER performance, increase throughput, save more resources of the entire communication system over time. APPLE-1005, 19:9-10; *see also* discussion above for [1.c]-[1.e].

5. Claim 3

[3] The wireless communication system according to claim 1 wherein the at least one settable link characteristic comprises at least one receive processing characteristic.

167. It is my opinion that Diener-Bergstrom provides [3]. For example, Diener discloses *the at least one settable link characteristic comprising at least one **receive** processing characteristic* such as a location of the receiving device “to increase the distance”/“range between the user's device and the interfering device” in response to determining that “the interference is caused by” “a microwave oven”/“a Bluetooth™ device”/“cordless phone base device.” APPLE-1006, [0446]-[0449], FIG. 26.

168. As another example, Diener discloses *the at least one settable link characteristic comprising at least one **receive** processing characteristic* such as deploying a decoder for “**a new error correcting code**” of “**the received data**” based on what is “**being used by the AP.**” APPLE-1006, [0606]. More specifically,

Diener discloses an example scenario where a “**client station**” (e.g., *the first wireless communications device*) receives data from an “**AP**” and both “**client stations and APs have the ability to dynamically change error correction codes** [*one settable link characteristic*].” *Id.* “The **client station** would **detect** that a **new error correcting code**” in the **received** data “sent by the AP” and “process the **received data accordingly**” by using a decoder for the “**new error correcting code**” for “the **received data**” as part of *the receive processing characteristic*. *Id.*

169. Additionally or alternatively, Bergstrom discloses the *at least one settable link characteristic comprises the at least one receive processing characteristic* such as “**one or more suppression methods**” “to suppress interference **in the receive signal**” or “**modules**” that “work[] best with a particular type or class of interference/jamming..” APPLE-1005, 3:51-61, 8:9-17.

170. More specifically, Bergstrom discloses “**receiver 304 includes an interference classifier 314, an interference suppressor 316, and a demodulation/decoding unit 318.**” APPLE-1005, 3:39-41. The “**interference suppressor 316**” is configured to *set the at least one settable link characteristic* (e.g., “**selects one or more suppression methods that work best for the types of interference identified and uses the selected methods**”) *to compensate for the received interference* (e.g., “to suppress interference in the receive signal”) *based upon the interference type* (“suppression methods that **work best for the types of**

interference identified”):

The interference suppressor 316 receives both the classification signal from the interference classifier 314 and the signal received from the channel 306. **The interference suppressor 316 then selects one or more suppression methods that work best for the types of interference identified and uses the selected methods to suppress interference in the receive signal.** After the interference components have been suppressed, the receive signal is transferred to the demodulation/decoding unit 318 to remove all modulation and/or coding from the signal. The signal is then delivered to the data sink 310. APPLE-1005, 3:51-61.

171. Additionally, regarding FIG. 2, Bergstrom discloses the “**the interference suppression processor 42**” of the receiver 18 includes a “**targeted interference suppression unit 78** [that] includes **a library of software modules that are each capable of suppressing or removing undesired interference components** from a subject signal. **Each of the modules** in the targeted interference suppression unit 78 **works best with a particular type or class of interference/jamming**. For example, one module may be best at suppressing spread spectrum co-channel signals while another is best at suppressing the effects of frequency selective fading.” APPLE-1005, 8:9-17.

172. As discussed in Section IX.A, it would have been obvious to a POSITA to combine Diener and Bergstrom, for example, to incorporate into Diener’s *first*

controller, Bergstrom’s “**targeted interference suppression unit 78**” which is configured to *set the at least one settable **receive processing** characteristic to compensate for the received interference* (e.g., “**to determine which module is best for suppressing the interference in the receive signal**”) *based upon the interference type* (“use[ing]” “**the classification output signal** from the **disturbance classification unit 74** and the parameter signals from the jammer parameter extraction unit 76.”) APPLE-1005, 8:17-22.

6. Claim 4

[4.a] The wireless communication system according to claim 1 wherein the at least one settable link characteristic comprises at least one transmit processing characteristic; and

173. It is my opinion that Diener-Bergstrom provides [4.a]. See discussion above for [1.a] and [1.e].

174. As discussed for [1.e], Diener discloses *the at least one settable link characteristic comprising at least one **transmit processing** characteristic such as “at least one of: its data rate, packet size, frequency channel, transmit power, etc.”* APPLE-1006, [0054].

[4.b] wherein said first controller is configured to cooperate with said second controller to set the at least one transmit processing characteristic.

175. It is my opinion that Diener-Bergstrom provides [4.b]. For example, in FIG. 26, Diener discloses the *first wireless communications device* can be “**the device/“the client device, e.g., STA**” that perform “**process 5000,**” where “if in

step 5120 it is determined that the interferer is a type that can be mitigated **using interference mitigation techniques**, then the device [*first wireless communications device*] **executes those techniques automatically** (which may **involve cooperation with and/or action by other devices, such as an AP** [*second wireless communications device*].” APPLE1006, [0448].

176. Diener further discloses example manners *to set the at least one transmit processing characteristic* such as “**to adjust the AP of the user's network to a clean/unused channel**”:

In step 5160, if the interference is caused by another IEEE 802.11 network on the same channel, then a recommended user action is **to adjust the AP of the user's network to a clean/unused channel**. In step 5170, if the interference is caused by an IEEE 802.11 network on an adjacent channel, the recommended user actions may include **adjusting the AP to a channel further from the other network's channel, adjusting the physical location of the interfering network, or adjusting the location of the AP in the user's network**. In step 5180, if the interference is caused by a microwave oven, then recommended user actions may include **adjusting the AP of the user's network to a cleaner channel, adjusting the location of the AP in the user's network, adjusting the fragmentation threshold of the AP in the user's network for better interoperability, or to increase the distance between the user's device and the microwave oven**. APPLE1006, [0448].

177. As discussed for [1.b.i] and [1.e], Diener discloses that *said first and second wireless communications devices* (e.g., “**any device or network of devices** operating in the frequency band (such as those shown in FIG. 1)” such as “**WLAN APs**” and “**client STAs**”) *comprising respective first and second controllers* (e.g., “**necessary hardware and/or software functionalities [that] would be deployed in the hardware/software platform of that device to enable the device to act as a cognitive radio device and thereby perform the spectrum management steps of signal detecting, accumulating/measuring, classifying and controlling/reporting.**”) APPLE1006, [0448]. It would have been obvious to a POSITA that *said first and second controllers of said first and second wireless communications devices* would be configured to perform the disclosed “**cooperation**” operations.

7. Claim 7

[7] The wireless communication system according to claim 1 wherein said first controller is configured to determine the interference type based upon at least one of fade characteristics, noise characteristics, and path characteristics.

178. It is my opinion that Diener-Bergstrom provides [7]. For example, Bergstrom recognizes that the received signal is a “modified signal” resulting from “[s]ignals from both **additive noise source 38 and interference source 40** combine[d] with the transmit signal in the channel 16,” wherein “[f]requency **selective fading or other types of fading** can also occur in the channel 16.” APPLE-1005, 5:50-52. Bergstrom discloses “[t]he **disturbance classification unit 74** [as

part of *the first controller is configured to*] **processes the** time and/or frequency domain **receive signal** data **to produce** a maximum likelihood estimate of the disturbance **class superset and/or subset classes** [*determine the interference type*].” APPLE-1005, 9:1-4. A POSITA would have understood that the classification of the received signal by “**process[ing] the** time and/or frequency domain **receive signal** data” would be “*based upon at least ... fade characteristics*” that are included in the received signal.

179. Moreover, Bergstrom explicitly discloses the “[c]lass subsets, ..., can **include** single tone, multi-tone, swept tone, bauded communication signal, non-bauded communication signal, **partial band noise, or wideband noise**.” APPLE-1005, 9:5-8. A POSITA would have understood that the classification of “**partial band noise, or wideband noise**” would have been determined *based on noise characteristics*.

180. Also, Bergstrom discloses “**the classification output signal** from the **disturbance classification unit 74**” is used by “targeted interference suppression unit 78” “to determine which module is best for suppressing the interference in the receive signal,” wherein one specific module is “best at suppressing the effects of **frequency selective fading**.” APPLE-1005, 8:9-22. Accordingly, the “**disturbance classification unit 74** [as part of *the first controller is configured to determine the interference type*]” by outputting “**the classification output signal**” that indicates

whether or not there is “**frequency selective fading**” [*based upon at least one of fade characteristics*] so that the “targeted interference suppression unit 78” can “determine which module” to be used to suppress a particular type of interference. *Id.* See also APPLE-1005, 21:47-49 (disclosing *determination of the interference type based upon at least one of fade characteristics* because “[a]n inverse whitening function is then applied to the signal to **remove the frequency selective fading** 252 and the spectrum of FIG. 28 results”).

181. As discussed in Section IX.A, it would have been obvious to a POSITA to combine Diener and Bergstrom and the resulting Diener-Bergstrom combination renders this claim obvious.

8. Claim 8

[8] The wireless communication system according to claim 1 wherein the at least one settable link characteristic comprises at least one of transmission power, frequency diversity, time diversity, modulation, forward error correction (FEC), channel bandwidth, and adaptive filtering.

182. It is my opinion that Diener-Bergstrom provides [8]. See discussion above for [1.a], [1.e], [4.a]. As discussed for [1.e], Diener discloses *the at least one settable link characteristic comprising “at least one of: its **data rate**, packet size, frequency channel, **transmit power**, etc.”* APPLE-1006, [0054]. Diener further discloses *the at least one settable link characteristic comprising at least one of frequency diversity, channel bandwidth, and transmission power* in disclosing that “the spectrum aware drivers 17 may receive commands to **change a (center**

frequency) of operation,⁶ **bandwidth of operation**, data rate, **transmit power**, etc.” APPLE-1006, [0071].

183. Diener further discloses *the at least one settable link characteristic comprising at least one of forward error correction (FEC) and modulation*. For example, Diener further discloses *the at least one settable link characteristic* can be “**parameters that are adjustable within a particular communication protocol standard, such as the IEEE 802.11 standard**, or parameters that are outside of the standard. For example, if client stations and APs have the ability to dynamically **change error correction codes**, then **the AP may change to a different error correction code** when transmitting to a particular client station according to the radio frequency environment that the client station is experiencing.”) APPLE-1006, [0606]. *Modulation* is another example of “**parameters that are adjustable within**

⁶ The ’780 patent explains that “**frequency diversity** may [sic] used to compensate for the interference by **adjusting the operating frequency** of the wireless communications device to a frequency free of the interference.” APPLE-1001, 2:3-6. Diener’s disclosure of “**change a (center frequency) of operation**,” especially in context “to perform dynamic packet scheduling **to avoid transmitting a packet that may interfere in time and frequency with a signal from another device**,” constitutes *frequency diversity*.” APPLE-1006, [0071].

a particular communication protocol standard, such as the IEEE 802.11 standard.” For example, IEEE 802.11b uses DSSS or direct sequence spread spectrum (which was well known to be form of frequency diversity) and IEEE 802.11b further admits adjustable DSSS spreading factor as a settable link characteristic, whereas IEEE 802.11g uses either DSSS or OFDM. *See* APPLE-1007, [0004]-[0005]. As such, a POSITA would have understood that Diener further discloses *the at least one settable link characteristic comprising at least one of modulation. Id..*

184. Diener further discloses *the at least one settable link characteristic comprising at least one of time diversity.* The '780 patent explains that “[**d**]iversity **in time** can be an effective technique for **packet based systems**” and can involve “**modifying the frame timing**” or “**choos[ing] the point in time that it uses to transmit** to any particular slave (**avoiding local interference** at the slave).” APPLE-1001, 6:26-34. Diener discloses “[e]xamples of controls” include “network **load balancing** (on the basis of channel frequencies or **time**),” and “**adjusting a parameter of the transmitted data packet,**” APPLE-1006, [0066]. In a specific example, “[i]f Bluetooth is using synchronous (SCO) traffic, **schedule** any 802.11 QoS **packets so that they occur between the timing** of the SCO packets.” APPLE-1006, [0472]. “If Bluetooth is using SCO traffic, do **not transmit during the SCO periods.**” APPLE-1006, [0473]. A POSITA would have understood that Diener’s

disclosure of changing the timing of the transmitted packets to avoid interference constitutes *time diversity*. APPLE-1006, [0471]-[00474].

185. Additionally or alternatively, Bergstrom discloses *the at least one settable link characteristic comprises at least one of transmission power, frequency diversity, and adaptive filtering*. More specifically, Bergstrom discloses that “the system 10 also provides **frequency hopping adaptation** [*frequency diversity*] and **processing gain adaptation functionality** [*transmission power*] to help it adapt to hostile spectral environments.” APPLE-1005, 16:21-23.

186. Bergstrom discloses that “the targeted interference suppression unit 78 includes a plurality of interference suppression modules that can be used to suppress interference/jamming components within the receive signal” that use “techniques” including “(2) the **adaptive inverse weight technique**, and (3) the **adaptive excision technique**” [*adaptive filtering*]. APPLE-1005, 16:13-19. For example, “the operation of the **adaptive inverse weight** interference suppression method” include applying “an inverse weight **filter**” (*adaptive filtering*). APPLE-1005, 20:14-26. “In the **adaptive excision method**,..., [a]n estimate of jammer signal **bandwidth** is then used to **excise (i.e., remove) a portion of the signal spectrum from the receive signal**, including both interferer and signal” (*channel bandwidth and adaptive filtering*). APPLE-1005, 20:14-26.

187. As discussed in Section IX.A, it would have been obvious to a POSITA

to combine Diener and Bergstrom and in the Diener-Bergstrom combination, *the at least one settable link characteristic comprises at least one of frequency diversity, channel bandwidth, transmission power and adaptive filtering.*

9. Claim 9

[9.Pre] A wireless communications device operable to communicate with an other wireless communications device via a wireless communications link having at least one settable link characteristic, the wireless communications device comprising:

188. It is my opinion that Diener-Bergstrom provides [9Pre]. A *wireless communications device* in claim 9 corresponds to *the first wireless communications device* in claim 1, *an other wireless communications device* in claim 9 corresponds to the *second wireless communications device* in claim 1. APPLE-1001, claims 1 and 9.

189. As discussed for [1.Pre]-[1.c], Diener discloses either a base station device (AP) or a client device (STA) can be the *[first] wireless communications device* or the *[second/other] wireless communications device*. APPLE-1006, [0061]-[0063]. In the example of “process 5000” shown in FIG. 26, Diener discloses “**the client device, e.g., STA**” as an example of the *first wireless communications device* in claim 1 and the *wireless communications device* in claim 9, and the **AP** as an example of the *second wireless communications device* in claim 1 and *the other wireless communications device* in claim 9. APPLE1006, [0446], [0448].

[9.a] an orthogonal frequency-division multiplexing (OFDM) wireless transceiver; and

190. It is my opinion that Diener-Bergstrom provides [9.a]. See discussion above for [1.b.i].

[9.b] a controller coupled to said wireless transceiver and configured to store short term and long term historical characteristics of interference;

191. It is my opinion that Diener-Bergstrom provides [9.b]. See discussion above for [1.b.ii]).

[9.c.i] said controller configured to detect received interference,

192. It is my opinion that Diener-Bergstrom provides [9.c.i]. See discussion above for [1.c].

[9.c.ii] determine a type of the received interference from among a plurality of interference types according to wideband interference, self interference, and narrowband interference

193. It is my opinion that Diener-Bergstrom provides [9.c.ii]. See discussion above for [1.d.i].

[9.c.iii] based upon comparing at least one characteristic of a current received signal with the short term and long term historical characteristics of interference, and

194. It is my opinion that Diener-Bergstrom provides [9.c.iii]. See discussion above for [1.d.ii].

[9.c.iv] set the at least one settable link characteristic to compensate for the received interference based upon the interference type.

195. It is my opinion that Diener-Bergstrom provides [9.c.iv]. See discussion above for [1.e].

10.Claim 10

[10] The wireless communications device according to claim 9 wherein the at least one settable link characteristic comprises at least one receive processing characteristic.

196. It is my opinion that Diener-Bergstrom provides [10]. See discussion above for [3].

11.Claim 11

[11] The wireless communications device according to claim 9 wherein the at least one settable link characteristic comprises at least one transmit processing characteristic; and wherein said controller is configured to cooperate with the other wireless communications device to set the at least one transmit processing characteristic.

197. It is my opinion that Diener-Bergstrom provides [11]. See discussion above for [4.a] and [4.b].

12.Claim 12

[12.pre] A method for compensating interference in a wireless communication system comprising first and second orthogonal frequency-division multiplexing (OFDM) wireless communications devices communicating with one another via a wireless communications link having at least one settable link characteristic, the method comprising:

198. It is my opinion that Diener-Bergstrom provides [12.pre]. See discussion above for [1.pre], [1.a], [1.b.i]-[1.b.ii].

199. For example, Diener discloses “*method*” in disclosing “[a] system and

method are provided for managing communication with a plurality of wireless client devices” APPLE-1006, Abstract. *See also id.*, [0012] (disclosing “system, **method**, software and related functions are provided for managing activity in a radio frequency band”); [0052] (disclosing “**spectrum management** systems, **methods**”), [0054] (“the **spectrum management methods**”).

200. Diener further discloses that the *method is for compensating interference* by explaining that “[t]he **goal of spectrum management** is to take evasive action to **avoid interference when possible, detect and report interference** when it occurs and make intelligent decisions to **mitigate interference** when it cannot be avoided.” APPLE-1006, [0060].

201. As discussed for [1.b.i], Diener provides “*first and second orthogonal frequency-division multiplexing (OFDM) wireless communications devices*” by disclosing that the WLAN devices can be “**IEEE 802.11g WLAN devices**.” APPLE-1006, [0052] and it had been well known to a POSITA that “IEEE 802.11g employs Orthogonal Frequency Division Multiplexing (OFDM) transmission techniques.” APPLE-1007, [0004]. A POSITA would have recognized that that Diener’s WLAN devices such as “**IEEE 802.11g WLAN devices**” [*said first and second wireless communications devices*] would be *OFDM wireless communications devices*.

[12.a] detecting received interference

202. It is my opinion that Diener-Bergstrom provides [12.a]. See discussion above for [1.c].

[12.b] storing short term and long term historical characteristics of interference;

203. It is my opinion that Diener-Bergstrom provides [12.b]. See discussion above for [1.b.ii].

[12.c.i] determining a type of the received interference from among a plurality of interference types comprising wideband interference, self interference, and narrowband interference

204. It is my opinion that Diener-Bergstrom provides [12.c.i]. See discussion above for [1.d.i].

[12.c.ii] based upon comparing at least one characteristic of a current received signal with the short term and long term historical characteristics of interference; and

205. It is my opinion that Diener-Bergstrom provides [12.c.ii]. See discussion above for [1.d.ii].

[12.d] setting the at least one settable link characteristic to compensate for the received interference based upon the interference type.

206. It is my opinion that Diener-Bergstrom provides [12d]. See discussion above for [1.e].

13.Claim 13

[13] The method according to claim 12 further comprising repeating the detecting, determining, and setting.

207. It is my opinion that Diener-Bergstrom provides [13]. See discussion

above for [2].

14.Claim 14

[14] The method according to claim 12 wherein the at least one settable link characteristic comprises at least one transmit processing characteristic; and further comprising cooperating between the first and second wireless communications devices to set the at least one transmit processing characteristic.

208. It is my opinion that Diener-Bergstrom provides [14]. See discussion above for [4.a] and [4.b].

X. Additional Remarks

209. I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

I hereby declare that all statements made are of my own knowledge, are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this proceeding.

January 20, 2023
Dated: _____

By:  Digitally signed by Zhi
Ding
Date: 2023.01.20
10:39:33 -08'00'

Dr. Zhi Ding, Ph.D.
Davis, California