

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC. and VERIZON COMMUNICATIONS, INC.
Petitioners,

v.

PROCOMM INTERNATIONAL PTE. LTD
Patent Owner.

U.S. Patent No. 7,103,377
Issue Date: September 5, 2006
Title: SMALL SIGNAL THRESHOLD AND PROPORTIONAL GAIN
DISTRIBUTED DIGITAL COMMUNICATIONS

Inter Partes Review No.: IPR2024-01453

DECLARATION OF HENRY HOUH, PH.D. IN SUPPORT OF
PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO.
7,103,377

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I. INTRODUCTION

1. I am over the age of eighteen (18) and otherwise competent to make this Declaration.

2. I have been retained by Ericsson, Inc. and Verizon Communications, Inc. (Petitioners) as an independent, technical expert consultant in this proceeding before the United States Patent and Trademark Office (USPTO). I am being compensated at my rate of \$820 per hour for my services. No part of my compensation is dependent on my opinions or on the outcome of this proceeding. I have no financial interest in any of the parties to this proceeding.

3. This Declaration is in support of the Petition for *inter partes* review involving U.S. Patent 7,103,337 (the “’377 Patent” or “the Patent”) (EX-1001), entitled “Small Signal Threshold And Proportional Gain Distrusted Digital Communications” and listing Donald R. Bauman, Philip M. Wala and Jerry Edward Toms as the inventors.

4. For the purposes of this *inter partes* review as I discuss later, I have been instructed to assume that the effective filing date of the Claims of the ’377 Patent challenged by the Petitioners in this *inter partes* review is no earlier than Dec. 3, 2002.

5. I understand that, according to USPTO records, the '377 Patent is currently assigned to ADC Telecommunication, Inc. I have been instructed to assume for purposes of this proceeding that Procomm International Pte. Ltd is the patent owner.

6. The '377 Patent is directed to a method of gain control of individual signal levels in a distributed antenna system (DAS). The '377 Patent discloses a method for proportional gain distribution for controlling the aggregate signal in a single path DAS, specifically to manage the allocation of the system dynamic range among the remote units. I am familiar with the technology described in the '377 Patent as of the earliest possible priority date of December 2002.

7. In preparing this Declaration, I have reviewed the '377 Patent (EX-1001) and its prosecution history (EX-1002), as well as the patents and documents cited herein, and I have considered these documents in light of the general knowledge in the art as of December 2002. In formulating my opinions, I have relied upon my experience in the relevant art. I have also considered the viewpoint of a person of ordinary skill in the art ("POSA") in the relevant field, as of December, 2002, who I describe below (§ V.D). For convenience, the materials I considered in arriving at my opinions are listed in Appendix A.

8. I have been asked to provide my technical expertise, analysis, insights and opinions regarding the '377 Patent and relevant references that form the basis of the arguments set forth in the accompanying Petition for *inter partes* review of the '377 Patent. As described in detail below, I offer the following opinions in this Declaration:

9. A POSA would have found Claims 1, 2 and 4-5 of the '377 Patent to be anticipated by Solum.

10. Unless otherwise indicated, the emphasis in quotations has been added.

II. QUALIFICATIONS

11. My qualifications for forming the opinions set forth in this declaration are summarized here and explained in more detail in my *curriculum vitae*, which is included as Appendix B. Appendix B also includes a list of my publications and patents.

12. I received a Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology ("MIT") in 1998. I also received a Master of Science degree in Electrical Engineering and Computer Science in 1991, a Bachelor of Science degree in Electrical Engineering and Computer Science in 1989, and a Bachelor of Science Degree in Physics in 1990, all from MIT.

13. For the last 15 years I have been self-employed as an independent technical consultant which specializes in, among other things, in Web Site Development, Data Networking, Optical Networking, Telecommunications, and Media Streaming. My clients include almost every major law firm in the country.

14. My Career in the area of telecommunications began 1987 when I worked at AT&T Bell Laboratories as part of a five-year dual degree program at MIT. Later, as part of my doctoral research at MIT from 1991-1998, I was a research assistant in the Telemedia Network Systems (TNS) group at the Laboratory for Computer Science. The TNS group built a high-speed gigabit network and created applications that ran over the network. Example applications included ones for remote video capture, processing, and display of video on computer terminals. In addition to working on the design of core network components, designing and building the high speed links, and designing and writing the device drivers for the interface cards, I also set up the group's web server. Furthermore, because our group focused on real-time software processing of live streamed data, some members of our group focused on research in software radios, which was thus commonly discussed in meetings and casual conversations. One of my labmates, Vanu Bose, went on to found Vanu,

Inc., a software radio company focused on low cost base stations for rural cell carriers. Several members of our group joined Vanu's company and I continued to meet with Vanu and members of his company. Thus, I became aware of the architectures around software radios starting in the late 1990's.

15. I defended and submitted my Ph.D. thesis, titled "Designing Networks for Tomorrow's Traffic," in January 1998. As part of my thesis research, I analyzed local-area and wide-area flows to show a more efficient method for routing packets in a network, based on traffic patterns at the time.

16. From 1997 to 1999, I was a Senior Scientist and Engineer at NBX Corporation, a start-up that made business telephone systems for streaming packetized audio over data networks instead of using traditional telephone lines. NBX was later acquired by 3Com Corporation, and the phone system is still used today by numerous businesses. As part of my work at NBX, I designed the core audio reconstruction algorithms for the telephones, as well as the packet transmission algorithms. I also designed and validated the core packet transport protocol used by the phone system. The protocol was used for all signaling in the phone system. The NBX system also featured a computer interface for initiating phone calls, which

could also initiate conference calls. The NBX system also supported TAPI, the Telephony Application Programming Interface, thus allowing other computer programs to integrate with our system telephony features. We obtained U.S. Patent No. 6,697,963, entitled “Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data,” as a result of part of this work.

17. From 1999-2004, I was employed by Empirix or its predecessor company, Teradyne. Empirix was a leader in test tools for telecommunications protocols and systems, providing functional testing tools as well as load testing tools. From 2000-2001, I conceived and built a test platform for testing Voice-over-IP (VoIP). The first application on this new test platform was a cloud emulator for simulating the effects of transmitting VoIP over a busy network.

18. In 2006, as part of my role at BBN Technologies, I helped found PodZinger Inc., now known as RAMP Inc. PodZinger utilized BBN’s speech recognition algorithms to search through the spoken words in audio and video segments. While I was Vice President of Operations and Technology, PodZinger followed its initial prototype with a full streaming audio and video search solution.

19. Furthermore, I have served as expert witness in over 150 patent-related cases where I wrote expert reports and testified in over 100 depositions on topics such as network communications and telecommunications, including Internet protocols, streaming media, antenna design, and mobile wireless technologies. I have testified in Federal courts, the PTAB, and the ITC on behalf of leading companies such as Amazon, AT&T, Cisco Systems, Google, Microsoft, Comcast, Time Warner Cable, Samsung, Netflix, Disney, and Apple.

20. I have been awarded several United States patents, including the following examples:

U.S. Pat. No.	Title
7,975,296	Automated security threat testing of web pages
7,877,736	Computer language interpretation and optimization for server testing
7,801,910	Method and apparatus for timed tagging of media content
7,590,542	Method of Generating Test Scripts Using a Voice-Capable Markup Language
7,860,999	Distributed computation in network devices
6,967,963	Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data
7,359,993	Method and apparatus for interfacing external resources with a network element

21. Based on my above-described over three decades of experience in network usage and resource allocation 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 the field of wireless technology.

22. Based on my experience described above, and as indicated in my *curriculum vitae*, I am qualified to provide the following opinions with respect the patents in this case. Additionally, I am at least a person having ordinary skill in the art, as I have set forth in §IV.D below, as of the priority date of the '377 Patent.

III. RELEVANT LEGAL STANDARDS

23. I do not provide any legal opinions in this Declaration. I have been informed and understand that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims. I have been asked to provide my opinions regarding whether the challenged claims of the '377 Patent would have been anticipated in light of the prior art to a person having ordinary skill in the art at the time of the alleged invention.

24. I have been informed and understand that, to anticipate a claim under 35 U.S.C. § 102, a reference must teach every element of the claim either expressly or inherently to a person having ordinary skill in the relevant art.

25. I have also been informed and understand that in order to establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference and that it would be so recognized by persons of ordinary skill. I further understand, inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

26. I also have been informed and understand that a patent claim is not patentable as obvious (a requirement I understand to be governed by a statute, 35 U.S.C. § 103) if the differences between the patent claim and the prior art are such that the claimed subject matter as a whole would have been obvious at the time the claimed invention was made to a person having ordinary skill in the relevant art. Obviousness, as I have been informed and understand, is based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and, to the extent that they exist, certain objective indicia of non-obviousness.

27. I, however, have not offered any opinions related to obviousness in this declaration.

IV. OVERVIEW

28. The Challenged Claims are unpatentable as anticipated the prior art. The claims are directed to prior art systems and combinations of conventional components that perform conventional functions regarding distributed antenna systems and signal gain control which were well-known in the art at the time of the purported invention of the '377 patent.

29. The '377 Patent and Solum (EX-1004) each describe the same problem of exceeding the combined signal level threshold in a distributed antenna communication system and the same solution of signal gain adjustment of the individual signal levels based on a fair share threshold:

'377 Patent	Solum
Problem	
“Exceed[ing] the system’s allowable dynamic range.” EX-1001 1:50-55	“Exceed[ing] the dynamic range handling capability of the system” EX-1004 [0011]
Solution	
“Each signal level that is greater than the dynamic range fair share threshold is attenuated with a gain factor that is determined in response to a remaining portion of the total system dynamic range after attenuation of other signal levels.” EX-1001 1:59-2:1	“If one or more of the input power calculators 208_i to 208_n, reports a signal level that exceeds the threshold, signals from those input ports will be gain controlled by adjusting weights 214_i to 214_n until all input signal levels are at or below a level such that an overflow condition is avoided.” EX-1004 [0017]

30. The '377 Patent is directed to a method of gain control of individual signal levels in a distributed antenna system (DAS). In a DAS,

the dynamic range of the communication system is shared over multiple antenna ports. One problem with distributed antennas on a single signal path is that the aggregate signal level along the signal path may exceed the system's allowable dynamic range signal level. EX-1001 1:50-55.

31. The '377 Patent describes the solution to the dynamic range problem is to measure each of the plurality of signal levels and compare to a dynamic range fair share threshold. Each signal level that is greater than the dynamic range fair share threshold is attenuated with a gain factor that is determined in response to a remaining portion of the total system dynamic range after attenuation of other signal levels. EX-1001 1:59-2:1; 7:10-14.

32. Solum is a parallel disclosure in which the same problem is described as well as the identical solution. Like the '377 Patent, Solum describes that in distributed systems, the dynamic range of the system is limiting on the system's performance, and the individual signal levels when combined may saturate (exceed) the dynamic range if the individual signal levels are not controlled. EX-1004 [0002], [0003], [0005] [0011].

The operational range of a system that combines and distributes signals within buildings or other areas where wireless signal propagation is likely to be a problem, whether the signals are digital or analog or some combination of both, is limited by the

dynamic range handling capability of the system. In a distributed system, ... signals of varying levels are present at input ports, at signal combiners and at output ports. A large signal at a single input port may potentially saturate the output port (e.g., cause an overflow condition) if the large signal exceeds the dynamic range of the system and is not controlled in some way.

EX-1004 [0002].

33. Like the '377 Patent, Solum describes a solution that attenuates the individual signal levels using weighting coefficients when the individual signal levels exceed a threshold level so that the combined signal level avoids an overflow condition at the node. EX-1004 [0005], [0017].

34. Thus, Solum discloses the same problem and same solution as that claimed in the '377 Patent, and does so using the same architecture. Thus, the Challenged Claims are anticipated by Solum.

V. BACKGROUND

A. Summary of the '377 Patent

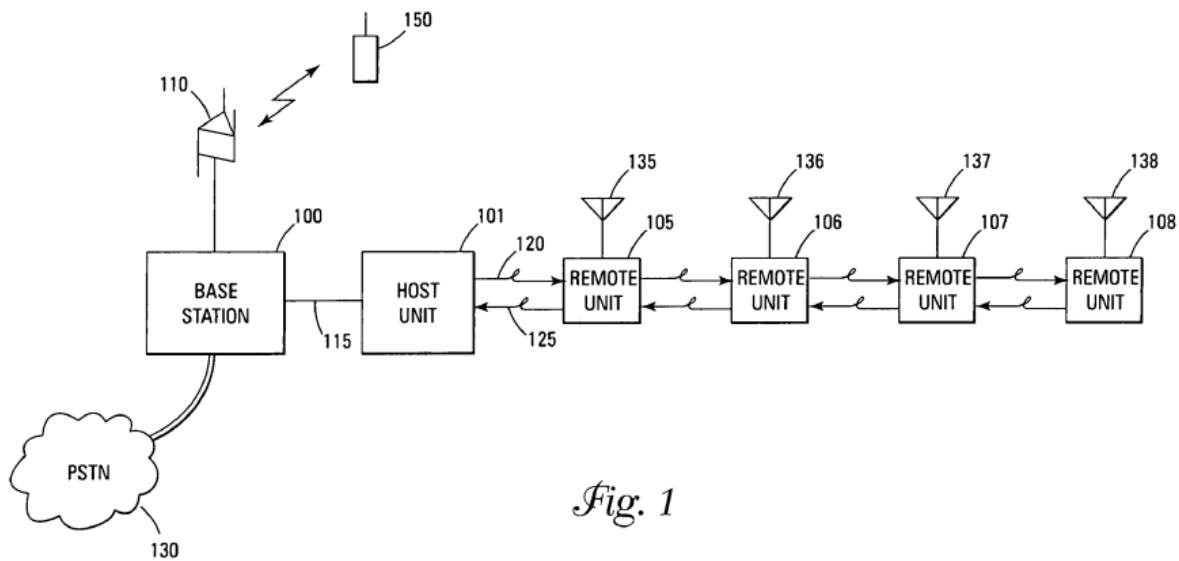
35. The '377 Patent is directed to a method of gain control of individual signal levels in a distributed antenna system (DAS). The use of a DAS provides better coverage than a conventional base station have a single antenna. The '377 Patent describes that there are problems,

however, with using a distributed antenna system. For example, for a conventional system that has only one antenna port, the entire dynamic range is available to the single port signal. When the system has multiple antenna ports, as in the DAS, the same dynamic range is shared amongst the aggregate signal level from all the ports. This reduces the dynamic range available for each port when multiple ports are simultaneously active. One problem with distributed antennas on a single signal path is that the aggregate signal level along the signal path may exceed the system's allowable dynamic range. . EX-1001 1:39-54.

36. The '377 Patent describes that one solution is a method for proportional gain distribution for controlling the aggregate signal in a single path DAS. In one embodiment, a sampling function senses a signal level at each of the plurality of distributed antennas. Each of the plurality of signal levels are compared with a dynamic range fair share threshold. EX-1001 1:59-64.

37. As illustrated in Fig. 1, the system includes a base station (100) that communicates over an RF link using an antenna (110) using any appropriate air interface standard. For example, the air interface standard can be one of Advanced Mobile Phone System (AMPS), code division multiple access (CDMA), time division multiple access (TDMA), Global

System for Mobile communications (GSM), or any other appropriate air interface standard. EX-1001 2:54-54.



38. The RF link is made up of a wireless forward link over which the base station (100) transmits to a subscriber unit (150). The subscriber unit (150) transmits back to the base station (100) over a reverse link. The subscriber unit (150) is either a mobile station or a fixed station. The base station (100) has the transmitters and receivers that enable the subscriber unit (150) to communicate with the public switched telephone network (PSTN)(130). In one embodiment, the base station links the subscriber unit (150) to other subscriber units that are communicating with other base stations.

39. A host unit (101) is connected to the base station (100) through an RF link (115). The host unit (101) is responsible for converting the RF signal from the base station (100) to an optical signal for transmission over an optical medium. The host unit (101) also converts a received optical signal to an RF signal for transmission to the base station (100). One or more remote units (105-108) are connected to the host unit (101) through an optical medium, such as fiber optic lines (120 and 125), in a daisy-chain arrangement. The remote units (105-108) are placed in locations that require additional signal coverage due to a lack of coverage by the base station (100). The remote units (105-108) communicate with subscriber units in a particular remote units coverage area over an RF link provided by the remote unit antennas (135–138).

40. The '377 Patent describes that in order to perform the fair and balanced attenuation method, each individual antenna port input is sensed with a sampling function that is well known in the art to determine each input signal level. EX-1001 7:10-14. Each of the plurality of signal levels are compared with a dynamic range fair share threshold. EX-1001 1:59-64. Each signal level that is greater than the dynamic range fair share threshold is attenuated with a gain factor that is determined in response to a

remaining portion of the total system dynamic range after attenuation of other signal levels. EX-1001 1:61-67.

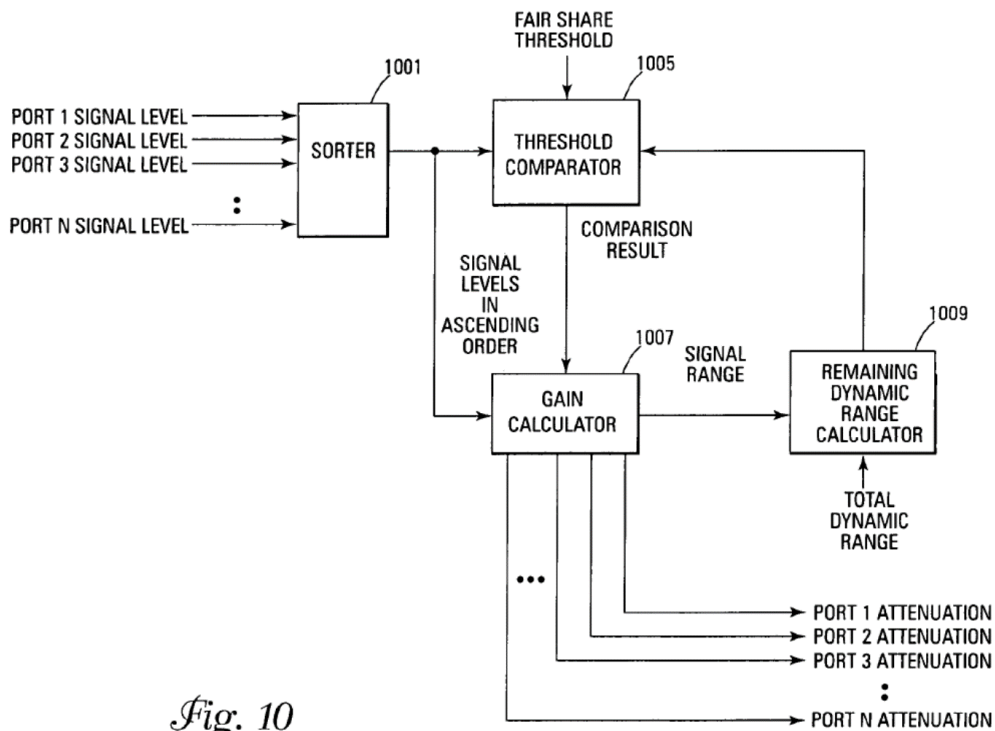


Fig. 10

EX-1001 Fig. 10.

41. The '377 Patent describes that a “fair share” threshold is input to the threshold comparator, but does not define what “fair share” means. It does however describe that the claimed method encompasses proportional gain distribution in a DAS. EX-1001 1:58-61; 7:20-21. Further, the ‘377 Patent provides an example of a dynamic range fair share threshold, but describes that in “alternative embodiments, other appropriate threshold calculations are used.” EX-1001 7:20-25.

42. The '377 Patent describes that each of the plurality of signal levels are compared with a dynamic range fair share threshold. Each signal level that is greater than the dynamic range fair share threshold is attenuated with a gain factor that is determined in response to a remaining portion of the total system dynamic range after attenuation of other signal levels. Each signal level that is less than or equal to the dynamic range fair share threshold are attenuated with a unity gain factor. EX-1001 1:64-2:3.

43. In one embodiment, the attenuation factor is not applied directly to the individual remote units' attenuation functions (810–813). Instead, if a port signal is more than 0.5 of the total dynamic range, the remote units' AGL function (815–818) instructs the appropriate attenuation function (810–813) to apply a set attenuation factor, e.g., 0.5 attenuation factor, to the port input. If the signal is equal to or less than 0.5, no attenuation factor is not applied. EX-1001 10:15-22.

44. The '377 Patent describes different methods of attenuation. These methods include stepped attenuation, continuous attenuation, and fair and balanced attenuation. EX-1001 6:38-41.

45. The Challenged Claims are directed to methods, with Claim 1 being the only independent claim:

1. A method for gain distribution in a system comprising a plurality of distributed antennas and a total system dynamic range, the method comprising:

sensing a signal level at each of the plurality of distributed antennas,

comparing at least one of the plurality of signal levels with a dynamic range fair share threshold; and

attenuating each of the at least one of the compared signal levels that is greater than the dynamic range fair share threshold with a gain factor that is determined in response to a remaining portion of the total system dynamic range after attenuation of other signal levels of the plurality of signal levels.

46. The specification of the '377 Patent describes an embodiment with a serial arrangement of the remote units; dynamic readjustment of the “fair share threshold” and sorting of the signals, however, these features are not recited in the Challenged Claims.

B. Claim Construction

47. I have been informed to give each claim term in the Challenged Claims its plain and ordinary meaning in this proceeding. It is my opinion that no specific construction of any claim term is required because the prior art I have relied upon meets each of the claim terms under any reasonable construction.

C. Priority Date of the Challenged Claims

48. I understand the application that issued as the '377 Patent was filed on Apr. 16, 2003 claiming priority benefit of U.S. Provisional Patent Application No. 60/430,435 filed on Dec. 3, 2002 and I have been instructed to assume that the earliest possible priority date of the Challenged Claims is Dec. 3, 2002.

D. Person of Ordinary Skill in the Art

49. With respect to the '377 Patent, a POSA would have been familiar with Distributed Antenna Systems and wireless communications in general. A POSA would have a working knowledge of network communication systems.

50. A POSA would have gained knowledge of these concepts through a mixture of training and work experience, such as by having a Bachelor's degree in electrical engineering or related degree and four years of experience; or by obtaining a Master's degree in electrical engineering or related degree, but having only one to two years of experience; or by having no formal education but experience in wireless communications networks of at least eight years.

E. State of the Art

51. The following section describes the state of the art for DAS wireless systems as of the priority date. The prior art references, and the discussions of what was known to a POSA, provide the factual support for the general description of the state of the art at the time of the invention, provide additional motivation to modify or combine the reference. Accordingly, these references should be considered by the Board.

1. Comparing Signal Strength to Threshold

52. Sensing signal power levels and comparing the signal strength to a threshold were well-known in the art and fundamental to gain control. For example Naidu (EX-1005), which is directed to a distributed antenna network, utilized a signal strength comparator 130_n which compares a predetermined reference level [*threshold*] with the received signal 127_n in order to control the gain of the output signal 129_n. EX-1005 5:15-26.

53. Naidu describes:

the system comprises a plurality of remote antenna units where each remote antenna unit includes a signal level comparator for comparing the level of the signals received by the respective antenna unit with a predetermined reference level,

EX-1005 4:1-6.

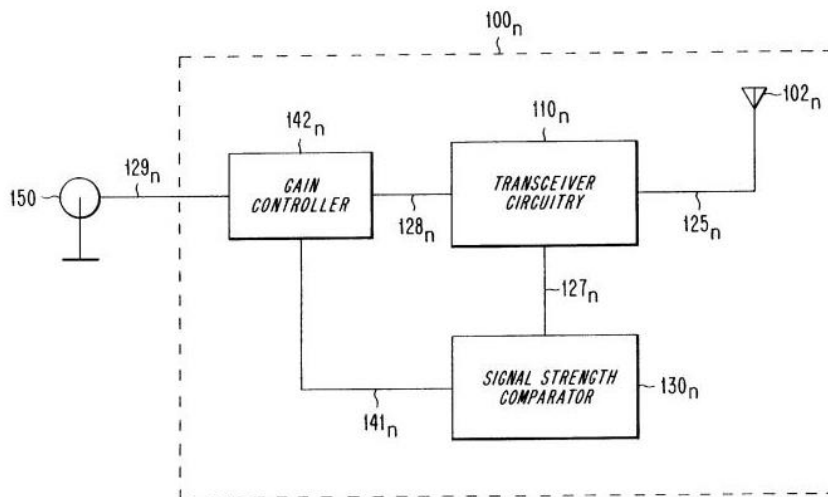


Fig. 3(a)

EX-1005 Fig. 3(a).

54. Dean also describes a DAS in which signal levels are sensed and compared to a threshold for gain control. Dean describes a signal is measured and compared to the other upstream gain reference signal levels received. EX-1007 16:6-23.

2. Attenuating Signals

55. Attenuating signals utilizing gain control was also well-known in the art. For example, Naidu teaches attenuation of signal 127n to signal 129n with a proper output level based upon the comparison in the signal strength comparator 130n. EX-1005 4:1-6.

56. Dean also discloses that the RAD (radio antenna device) is directed by a controller at the head end to decrease (or increase) the signal

power supplied to the cable plant in response to the comparison discussed above. EX-1007 16:11-14.

3. Controlling Gain Based On Dynamic Range

57. Dynamic range of signal levels in wireless systems was a well-known concept at the time of the '377 Patent. It was also known that saturation of the dynamic range was an issue in distributed antenna systems. For example, Naidu discloses “signal levels output from the remote antenna units are prevented from exceeding a maximum signal level so that strong signals do not saturate the system.” EX-1005 4:1-6.

58. Owen also discloses a distributed antenna system which controls gain (attenuation) of each of the signals with respect to the maximum dynamic range. EX-1006 10:10-25.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

59. Claims 1, 2, and 4-5 of the '377 Patent are challenged in this Petition.

B. Statutory Grounds for Challenge

60. Claims 1, 2, and 4-5 of the '377 Patent are unpatentable as being anticipated by Solum.

C. Prior Art Basis

61. I have been informed that United States Patent Application Publication 2003/0162516 titled “Distributed Automatic Gain Control System” (“Solum”), (*EX-1004*) qualifies as prior art under §102(e) for purposes of this IPR.

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Challenge 1: Claims 1, 2, and 4-5 are anticipated by Solum

1. The Solum Reference

62. As illustrated in FIG. 1, Solum discloses a wireless distribution system with a plurality of digital remote units (DRU) 202 (blue) distributed in a coverage area to receive wireless signals and provide the signals to a plurality of input ports 205. A plurality of input power calculators 208 (gold) are operatively connected to the input ports to determine power levels of the signals provided to each port.

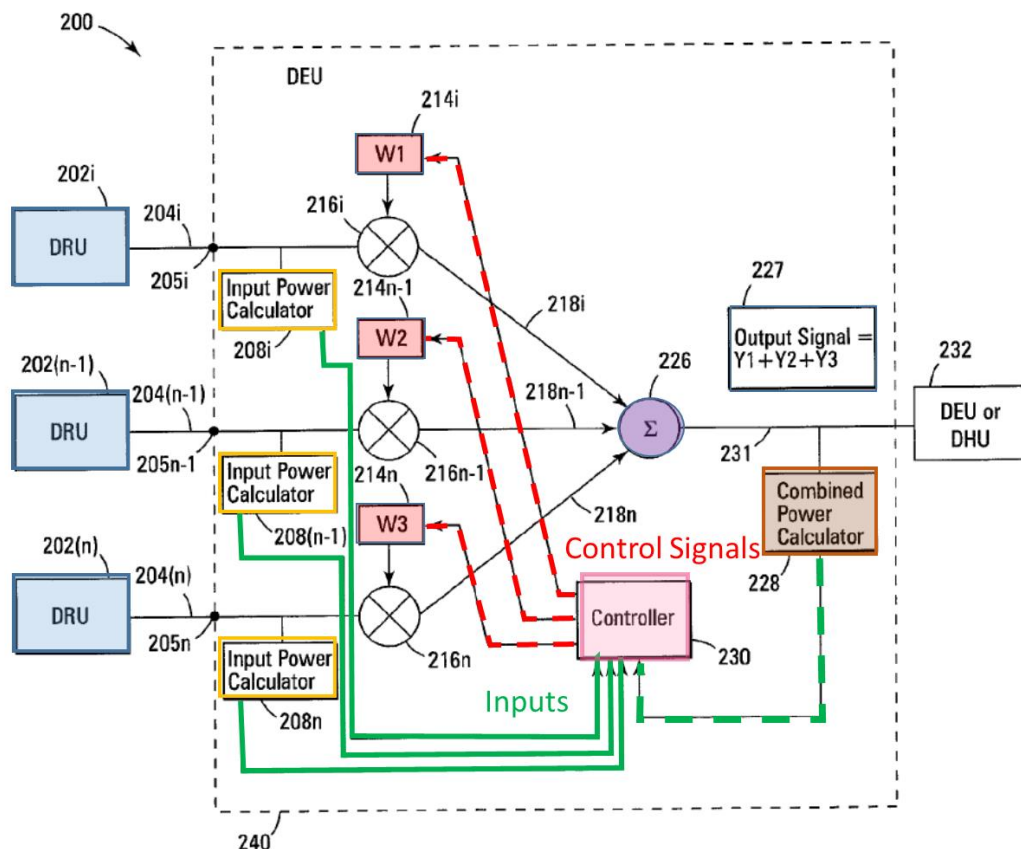


Fig. 2

EX-1004 Fig. 2¹.

63. Solum provides a plurality of variable gain controllers 214 (red) to control the gain of received signals in response to a control signal (red dashed line) from controller 230. The controller provides control signals that individually control each of the variable gain controllers based on the respective signal levels (green solid line) and the combined signal level (dashed green line) received from the combined power calculator 228

¹ All color in the figures are my annotations.

(brown). The controller 230 determines weights 214 (pink) for individually controlling the gain of signals received at multipliers 216 so that the individual signals do not exceed a predetermined threshold level. The attenuated signals are then provided to node 226 which digitally sums the signals. Combined power level calculator (brown) 228 determines the power level of the signals combined at node 226 and provides the combined power level signal to controller 230. The combined signals are then transmitted to digital host unit (DHU) 232. EX-1004 [0008],[0013],[0015].

64. Solum explains that in operation, signal levels at each input port 205 are monitored and evaluated by input power calculators 208 to determine whether any signal level exceeds a predetermined level. If one or more of the input power calculators 208 reports a signal level that exceeds the threshold, signals from those input ports will be gain controlled by adjusting weights 214 until all input signal levels are at or below a level such that an overflow condition is avoided. EX-1004 [0014].

65. The process of determining the weighting coefficients is iterative and considers the signal levels of the combined signal subsequent to attenuation. For example, when the combined signal 231 at power calculator 228 is lower than a predetermined “decay threshold”, the

weighted coefficients 214 are increased over time based on a decay time constant and a fair weighting based on input power calculators 208 is applied to the input signals 204 until a satisfactory power level is achieved at combined power calculator 228. Conversely, when the combined signal 231 at combined power calculator 228 is higher than a predetermined “attack threshold,” the weighted coefficients 214 are decreased over time based on an attack time constant and a fair weighting based on input power calculators 208, is applied to the input signals 204, until a satisfactory power level is achieved at combined power calculator 228. EX-1004 [0015].

66. Solum further describes that the weighting function is proportional to power received at each input port, as determined by the input power monitor. EX-1004 [0019]. In other words the weighting function ensures that the initial signal levels that make up a larger portion of the signal are treated differently than signals that make up small portion of the combined signal. For signals above the threshold, higher signal levels are attenuated more than signals with lower signals levels. Thus, like the ‘377 Patent, the signal gains are proportional as applied to the signals, rather than applying equal gains across all signals.

67. Monitoring of the signal levels at the input ports may take place continuously or may be triggered only after combined power calculator 228 senses a combined signal level that warrants a change in gain control of the combined signals at the node. Alternatively, signal levels at the input ports may be polled periodically to determine whether signal levels may have changed. EX-1004 [00017]. Solum's process of determining the weighting coefficients or gains is iterative and considers the signal levels of the combined signal subsequent to attenuation. Depending upon the amount of or lack of dynamic range capacity the weighting coefficients are increased or decreased respectively. EX-1004 [0015].

For example

When the signal, 231, at Power Calculator 228 is lower than a predetermined "decay threshold", the weighted coefficients 214 to 214 are increased over time based on a decay time constant and a fair weighting based on input Power calculators 208, to 208, is applied to the input signals 204 to 204 until a satisfactory power level is achieved at combined power calculator 228. Conversely, when the signal, 231, at combined power calculator 228 is higher than a predetermined "attack threshold," the weighted coefficients 214 to 214 are decreased over time based on an attack time constant and a fair weighting based on input Power calculators 208, to 208, is applied to the

input signals 204, to 204, until a satisfactory power level is achieved at combined power calculator 228.

EX-1004 [0015].

2. Detailed Application of Solum to the Challenged Claims

Claim 1

[1.0] A method for gain distribution in a system comprising a plurality of distributed antennas and a total system dynamic range, the method comprising

68. To the extent the preamble is limiting, Solum discloses a method to control the gain of received signals [*method for gain distribution*] in a system including a plurality of remote units/DRUs (blue) [*plurality of distributed antennas*] having a dynamic range handling capability [*total system dynamic range*].

A wireless distribution system according to one aspect of the present invention includes a plurality of remote units distributed in a coverage area to receive wireless signals in the coverage area and provide the signals to a plurality of input ports to receive signals comprising the signals provided by the plurality of remote units a plurality of input power monitors operatively connected to one or more of the plurality of input ports to determine power levels of signals received at the input port a plurality of variable gain controllers to control the gain of signals received at the one or more of the plurality of input ports in response to a control signal, a node to combine a

plurality of signals from the plurality of input ports, and a controller to provide control signals to individually control each of the variable gain controllers.

EX-1004 [0008].

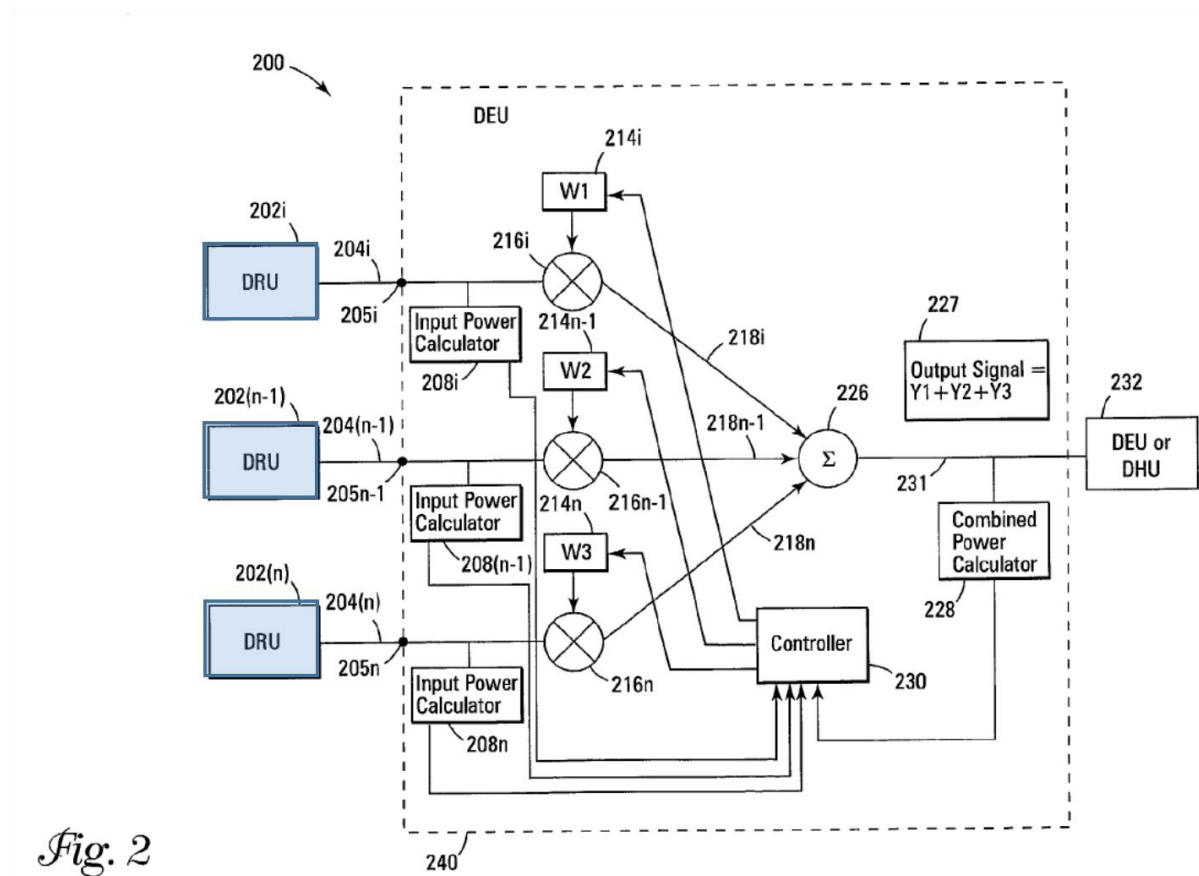


Fig. 2

EX-1004 Fig. 2.

The distributed wireless communication system has a limited dynamic range and accordingly must be protected from signals that would saturate or otherwise exceed the dynamic range handling capability of the system.

EX-1004 [0011].

69. A POSA understood that each of the digital remote units (DRUs) of Solum includes a radio transceiver with an antenna to receive wireless signals. EX-1005 9:36-40, 12:20-22.

The system 100 includes a number of digital remote units (DRUs) 102, to 102, that receive a frequency spectrum of wireless signals, such as may be transmitted by low power wireless devices in and around the building.

EX-1004 [0010].

Each DRU 202_i to 202_n, includes an input port or receiver that receives, processes and digitizes a wireless bandwidth.

EX-1004 [0013].

[1.1] sensing a signal level at each of the plurality of distributed antennas;

70. Solum discloses monitoring [*sensing*] the signal level at each of the plurality of remote units [*plurality of distributed antenna units*] by the input power calculator 208 (gold) to determine if the signal level exceeds a threshold:

Signal levels at each input port 205_i, to 205_n, are monitored and evaluated by input power calculators 208_i, to 208_n, to determine whether any transmission link 204_i to 204_n, is providing a signal that exceeds a predetermined level.

EX-1004 [0017].

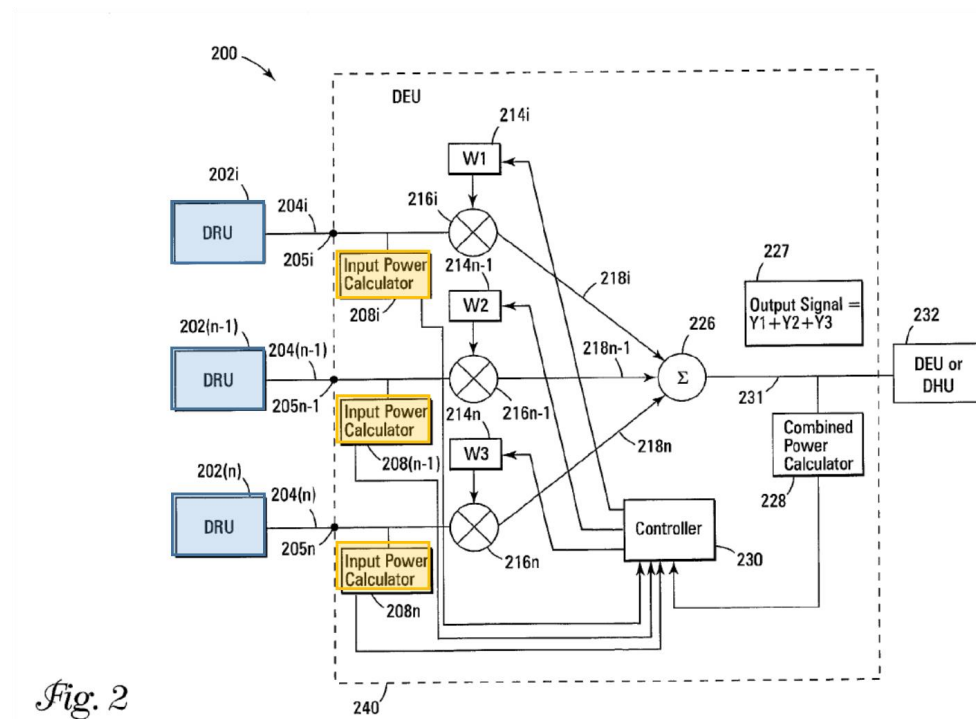


Fig. 2

EX-1004 Fig. 2.

71. In Solum, the signals levels at each remote unit are monitored [sensed] via the respective input ports 205_{i-n}. This is the same manner as described in the '377 Patent ("each individual antenna port input is sensed with a sampling function that is well known in the art to determine each input signal level" EX-1001 7:11-13). EX-1004 [0017]. A POSA understood the signal level at the antenna input port is highly reflective of the signal level at the antenna of the DRU because only de minimis losses would be expected between an antenna port and the output port of the

DRU. Thus, a POSA understood that sensing the signal level at the input port is sensing the signal level at the antenna of DRU.

[1.2] comparing at least one of the plurality of signal levels with a dynamic range fair share threshold; and

72. Solum discloses comparing each of the received signal levels with a predetermined level [*dynamic range fair share threshold*].

Signal levels at each input port 205_i, to 205_n, are monitored and evaluated by input power calculators 208_i, to 208_n, to determine whether **any transmission link 204_i to 204_n, is providing a signal that exceeds a predetermined level.**

EX-1004 [0017].

If one or more of the input power calculators 208_i to 208_n, reports **a signal level that exceeds the threshold**, signals from those input ports will be gain controlled by adjusting weights 214_i to 214_n until all input signal levels are at or below a level.

EX-1004 [0017].

73. While Solum describes that the threshold is related to the dynamic range of the system, Solum does not refer to its threshold as a *dynamic range fair share threshold*. EX-1004 [0011]. However, Solum does describe that the weighting function is proportional to power received at each input port, as determined by the input power monitor.

[A] controller to provide control signals to control the gain of each of the variable gain controllers based on a weighting function that is proportional to power received at each input port, as determined by the input power monitors such that the combined power as determined by the combined power monitor does not exceed a predetermined level.

EX-1004 [0019].

74. For signals above the threshold, higher signal levels are attenuated more than signals with lower signals levels. EX-1004 [0014]. Thus, like the '377 Patent, the signal gains are proportional as applied to the signals, rather than applying equal gains across all signals. Thus, a POSA understood that Solum's threshold is a *dynamic range fair share threshold* because just like the '377 Patent, the threshold is used to identify which signals require attenuation; such that all signals are treated fairly (proportionally) rather than each treated them equally.

[1.3] attenuating each of the at least one of the compared signal levels that is greater than the dynamic range fair share threshold with a gain factor

75. Solum discloses controlling the gain [attenuating] of a received signal by adjusting the gain weighting coefficients (red) [gain factor] via the gain control signals (dashed red lines), from the controller, when the signal level measured at 205i as determined by the respective input power

calculator 208_i (**gold**) exceeds the predetermined level/threshold [*greater than the dynamic fair share threshold*]. The weighting coefficients [*gain factors*] are applied to the signals [*attenuating*] via multipliers 216 (**blue**).

Each input port 205_i, to 205_n, has associated with it an input power level calculator 208_i, to 208_n, to determine power levels of signals received over transmission links 204_i to 204_n. The input power level calculators 208_i to 208_n provide power level signals to controller 230. Controller 230, which may be a dedicated controller or part of a larger system-wide controller, **determines weights for gain control of the distribution system. Controller 230 determines weights 214 to 214 for individually controlling the gain of signals received over transmission links 204 to 204, at multipliers 216, to 216, so that the signals do not exceed a predetermined threshold level.**

EX-1004 [0014].

Signal levels at each input port 205_i to 205_n are monitored and evaluated by input power calculators 208_i, to 208_n, to **determine whether any transmission link 204_i to 204_n is providing a signal that exceeds a predetermined level.**

EX-1004 [0017].

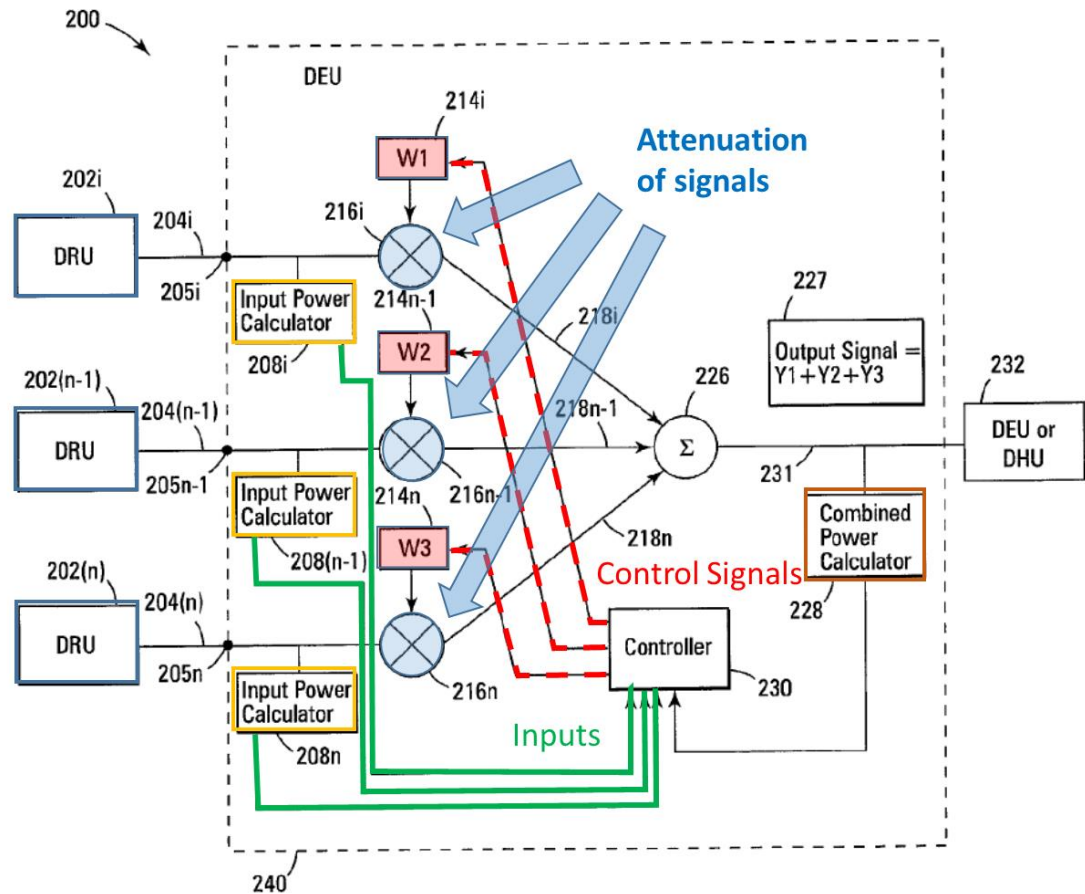


Fig. 2

EX-1004 Fig. 2.

[1.4] [a gain factor] that is determined in response to a remaining portion of the total system dynamic range after attenuation of other signal levels of the plurality of signal levels.

76. Solum discloses the weighted coefficients for a signal are determined as a function of [responsive to] at least the power level of the signal i (determined by the respective input power calculator 208_i), the power level of the other signals (determined by the respective input power calculators 208_{i-n}), and the power level of the combined signal (determined

by the combined input power calculator 228) [*after attenuation of other signal levels*] with respect to the total dynamic range handling capability of the system [*a remaining portion of the total system dynamic range after attenuation of other signal levels of the plurality of signal levels.*] EX-1004, [0015],[0017], [0019];

77. As shown in Fig. 2 of Solum, the input power calculators 208 (gold) provide input (solid green) regarding the signal level received on input port 205 to the controller 230, the controller also receives input (dashed green) from the combined power calculator 228 (brown).

[A] controller to provide control signals to control the gain of each of the variable gain controllers based on a weighting function that is proportional to power received at each input port, as determined by the input power monitors such that the combined power as determined by the combined power monitor does not exceed a predetermined level.

EX-1004 [0019].

78. The controller receives feedback input (dashed green) from the combined power calculator (brown) relating to whether the combined signal exceeds or is lower than a predetermined threshold [*total system dynamic range*]. A POSA understood that a decision with respect to the

predetermined threshold is a measure of the utilization of the total dynamic range capacity of the system. EX-1004 [0014[, [0015].

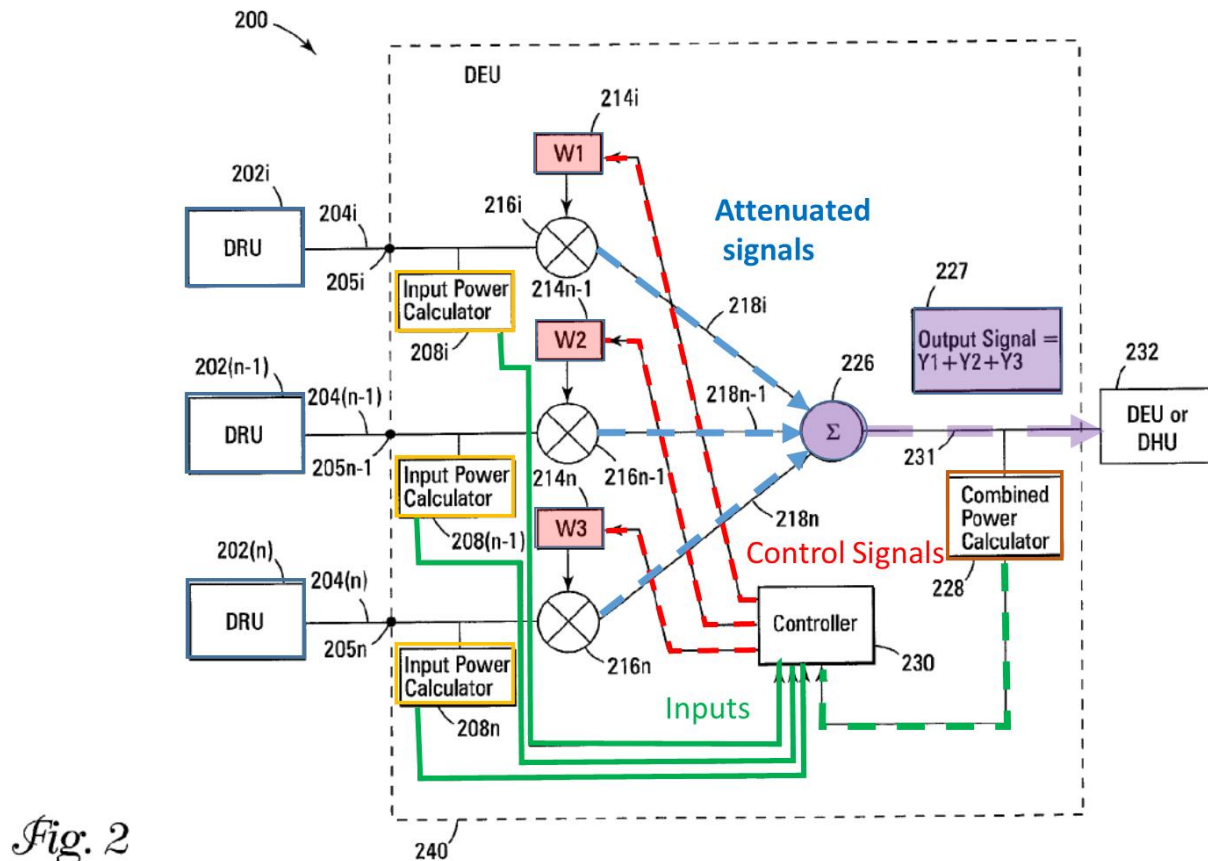


Fig. 2

EX-1004 Fig. 2.

79. Just like the '377 Patent, Solum's process is continuous and thus the measuring of the combined signals and the determination of the weighting coefficients [*gain factors*] are iterative, forming a feedback loop. Solum in the determination of the weighting coefficients [*gain factors*] considers the signal level of the combined signal (**purple dashed line**)

which is formed from contributing signals 218_i-218_n (blue dashed lines) representing respective signals received at ports 205 and attenuated by multipliers 216 (light blue), as feedback. EX-1004 [0015], [0017], [0019].

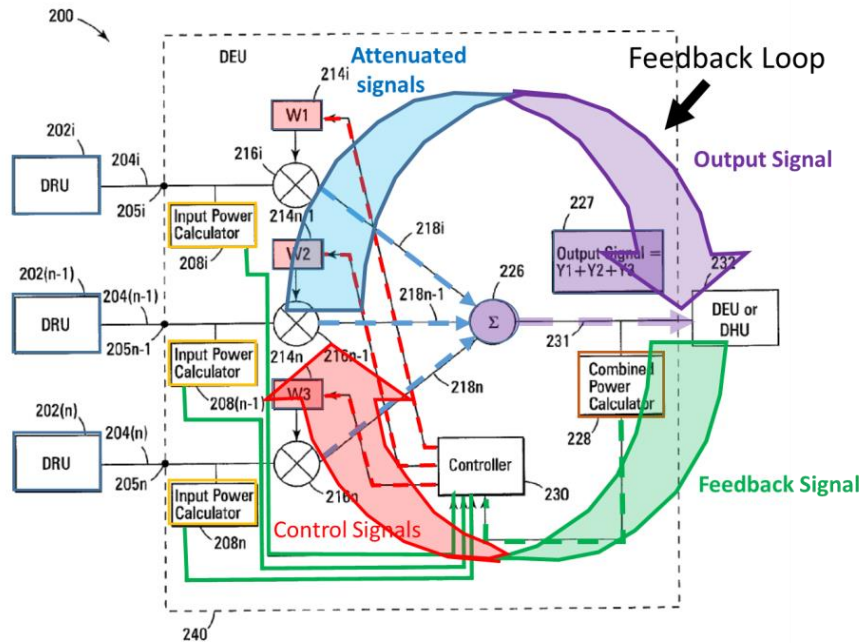


Fig. 2

EX-1004 Fig. 2.

80. Solum discloses determining the dynamic range utilization by comparing the power level of the combined signal (purple) to a predetermined threshold (e.g. “decay threshold” or “attack threshold”). Depending upon whether the dynamic range is underutilized (i.e. capacity available) or over utilized (i.e. overflow condition) the weighting coefficients are increased (via a “decay time constant”) or decreased (via an “attack time constant”) respectively. EX-1004 [0015], [0017].

When the signal, 231, at **Power Calculator 228 is lower than a predetermined “decay threshold”, the weighted coefficients 214 to 214 are increased over time based on a decay time constant** and a fair weighting based on input Power calculators 208, to 208, is applied to the input signals 204 to 204 until a satisfactory power level is achieved at combined power calculator 228. **Conversely, when the signal, 231, at combined power calculator 228 is higher than a predetermined “attack threshold,” the weighted coefficients 214 to 214 are decreased over time based on an attack time constant** and a fair weighting based on input Power calculators 208, to 208, is applied to the input signals 204, to 204, until a satisfactory power level is achieved at combined power calculator 228.

EX-1004 [0015] (emphasis added).

81. Because the signals being combined are continually changing a POSA understood that upon feedback that the combined power level of the aggregated attenuated signals 218_{i-n} is lower than a decay threshold, which is a measure of the unused portion of the systems total dynamic range capacity after attenuation of the individual signals , Solum discloses that the weighted coefficients are subsequently increased. Solum discloses the weighting coefficients [*gain factor*] are determined as a function of this feedback (i.e. the system’s unused dynamic range after attenuation of other

signals) and thus Solum discloses the gain factor *is determined in response to a remaining portion of the total system dynamic range after attenuation of other signal levels of the plurality of signal levels.*

Claim 2

The method of claim 1 wherein the dynamic range fair share threshold is initially determined by an inverse of a quantity of the plurality of distributed antennas.

82. Solum does not expressly state that the dynamic range fair share threshold is initially determined by an inverse of a quantity of the number of antennas. However, a POSA understood that the initial threshold is set as a function of the number of antennas. As the number of antennas goes up, the number of signals at port 205 go up. For a given dynamic range, the threshold level for each signal at port 205 must go down as the number of antennas goes up so as to not exceed the combined signal threshold—which defines an inverse relationship between the threshold level and the number of antennas [*threshold is initially determined by an inverse of a quantity of the plurality of distributed antennas.*]

Claim 4

The method of claim 1 and further including attenuating with unity gain signal levels that are less, than or equal to the dynamic range fair share threshold.

83. Solum discloses only attenuating signals exceeding a predetermined level, therefore as understood by a POSA, signals not exceeding [*less than or equal to*] the predetermined level [*fair share threshold*] are not attenuated thus have a gain of 1 [*unity*].

[the] controller 230 [determines] which signal or signals exceed a threshold level and will attenuate those signals. So that the combined power at 228 avoids an overflow condition at the node.

EX-1004 [0017].

Claim 5

The method of claim 1 wherein if the signal level is greater than the dynamic range fair share threshold, the gain factor applied to a first signal level is inversely proportional to the first signal level.

84. Solum discloses the coefficient weights [*gain factor*] applied to signal exceeding the predetermined level [*dynamic range fair share threshold*] are inversely proportional to the respective signal level.

The weights of coefficients 214 to 214 are set by the controller based on the individual input power calculators 208_i to 208_n. Thus, the smaller the input signal the larger the corresponding weighted coefficient. EX-1004 [0014].

CONCLUSION AND DECLARATION

My findings and opinions set forth in this Declaration are based on my work and examination to date. I may continue my examinations in view of additional documents or other factual evidence over the course of this proceeding that may necessitate supplementing and/or refining my opinions. I reserve the right to add to, alter, or delete my opinions and my Declaration upon discovery of additional information. I reserve the right to make such changes as necessary.

In signing this Declaration, I understand that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in this case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and 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 Title 18 of the United States Code.

[SIGNATURE ON FOLLOWING PAGE]

Date: 9/15/2024

By: Henry H. Houh.
Henry Houh Ph.D

APPENDIX A

Petitioner's Exhibit List

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 7,103,377 (“the ’377 Patent”)
1002	Prosecution history of the ’377 Patent (“File History”)
1004	U.S. Patent Application Publication No. US2003/0162516 to Solum (“Solum”)
1005	International Patent Application Publication No. WO1998000996A1 to Naidu et al. (“Naidu”).
1006	International Patent Application Publication No. WO01/95427 to Owen (“Owen”)
1007	U.S. Patent No. 5,867,763 to Dean et al. (“Dean”)

APPENDIX B – Curriculum vitae

Henry H. Houh

henry.houh@gmail.com
cell: 781-325-8273

Education

Massachusetts Institute of Technology, Cambridge, MA

- PhD in Electrical Engineering and Computer Science, February 1998. “Designing Networks for Tomorrow's Traffic,” thesis supervised by Professor David Tennenhouse and Professor John Guttag. GPA 4.7/5.0
- Master of Science in Electrical Engineering and Computer Science, February 1991. “Demonstration of a laser repetition rate multiplier,” thesis. GPA 4.5/5.0
- Bachelor of Science in Electrical Engineering and Computer Science, June 1989. “Boundary element analysis of arbitrarily shaped dielectric structures,” thesis. GPA 4.7/5.0
- Bachelor of Science in Physics, February 1990. GPA 4.7/5.0

MITx, Cambridge, MA

- September 2020 – present: Enrolled in Statistics and Data Science MicroMasters program, a sequence of five MIT-offered graduate-level courses in statistics and machine learning, culminating in a MicroMasters certificate, expected 2022. Have completed four of five required courses.

Experience

BlocksCAD Inc. (H3XL spin-out)

- 2014 - present: Founder and member of Board of Directors. BlocksCAD is a visual Computer-Aided Design (CAD) program, designed to teach children mathematics and geometric visualization. BlocksCAD is being used in U.S. schools and worldwide in maker spaces, with 350,000+ users. BlocksCAD was selected to be part of the LearnLaunch 2017 Boost Accelerator, the MIT Play Labs 2018 Summer Accelerator, and the MassChallenge 2018 Boston Cohort. Recipient of DARPA DSO grant in 2014, and SBIR grant from the USDA in 2019.

H3XL Inc. d/b/a Einstein's Workshop (formerly Lexington Robotics)

- 2009 - present: Founder and President. Started local league providing science and engineering education programs based on LEGO Mindstorms, LEGO WeDo, and FIRST LEGO League. In 2012, grew program into a full science, technology, engineering and math enrichment program and creative/maker space, in 7,000 square feet of space. Serve 2,000+ kids and families annually. As of end of 2021, have delivered an estimated 220,000 student-instruction-hours of STEM courses. Principle Investigator for 2-year DARPA grant to improve 3D Computer Aided Design tool developed in-house for the purposes of teaching 8 year olds and up 3D CAD.

Houh Consulting Inc. / Independent Consultant

- 2009 - present: Technical consultant specializing in Social Networking, Web 2.0, Web Site Development, Data Networking, Optical Networking, Telecommunications, Media Streaming and Voice Over IP. Clients include: Akin Gump Strauss Hauer & Feld LLP, Arnold & Porter Kaye Scholer LLP, BBN, Baker Botts LLP, Barnes & Thornburg LLP, BBN Technologies, Beus Gilbert McGroder PLLC, Bracewell LLP, Christensen O'Connor Johnson Kindness PLLC, Cooley LLP, Covington & Burling LLP, Cozen O'Connor P.C., DLA Piper, Davis Polk & Wardwell LLP, Desmarais LLP, Duane Morris LLP, Erise IP, P.A., Faegre Baker Daniels LLP, Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, Fish & Richardson P.C., Goldman Ismail Tomaselli Brennan & Baum LLP, Haynes and Boone, LLP, Kaye Scholer, Kellogg Huber Hanson Todd Evans & Figel PLLC, Kirkland & Ellis LLP, Klarquist Sparkman, LLP, McCarthy Tetrault LLP, McGuireWoods LLP, Morgan, Lewis & Bockius LLP, Munger Tolles & Olson LLP, Orrick, Herrington & Sutcliffe LLP, O'Melveny & Myers LLP, Orrick, Herrington & Sutcliffe LLP, Paul Hastings LLP, Paul, Weiss, Rifkind, Wharton & Garrison LLP, Perkins Coie LLP, Quinn Emanuel Urquhart & Sullivan, LLP, Sidley Austin LLP, Smith Baluch LLP, Sterne, Kessler, Goldstein & Fox PLLC, Troutman Sanders LLP, Venable LLP, Weil, Gotshal & Manges LLP, Wiley Rein LLP, Wilmer Cutler Pickering Hale and Dorr LLP, and Winston & Strawn LLP.

Eons

- 2008 - 2009: Chief Technology Officer. Created product that Eons acquired from BBN Technologies. Integrated BBN product with Eons social networking platform and significantly increased the Eons group creation rate. Helped evaluate advertisement platform offerings and rolled out the "Boom Network" advertising network. Eons raised \$32 million from General Catalyst Partners, Charles River Ventures, Sequoia Capital, and Intel Capital.

BBN Technologies

- 2007 - 2008: Delta Division, Vice President of Technology. Grew "Boomerang" counter-sniper project engineering team and significantly de-risked \$10 million worth of product deliveries. Boomerang was a significant asset leading to the acquisition of BBN by Raytheon in 2009. Created new business plan and grew team; launched new fully-featured social networking web site in 5 months. Served as lead expert witness in patent

infringement lawsuit, resulting in \$58 million jury award to client; verdict for patents I testified on were upheld on appeal which resulted in a \$120 million settlement.

- 2004 - 2007: Delta Division, Director of Technology, responsible for commercializing IP and creating new businesses. Hired and grew division's initial engineering team. Wrote three business plans, two of which are funded and active. For call center business plan, acted as general manager, hiring and managing engineering team, inside sales team, and identifying and recruiting a new general manager. Identified and recruited other key employees to Delta Division, including senior members of team leading to successful internal sales growth and spin-outs of projects. Contracted by BBN to BBN spin-out PodZinger as VP of Operations and Technology. Identified sales team for counter-sniper system, leading to \$10 million dollars of new sales within 6 months and \$100+ million in additional orders in the following two years.

PodZinger Inc. (BBN spin-out, also known as EveryZing and now RAMP)

- 2006: Vice President of Operations and Technology. Significantly upgraded capability of consumer-facing search site and redeployed web site from company to co-location facility. Identified key portions of infrastructure for upgrading and cost reduction. Helped write business plan, evaluating advertisement models of revenue. Hired in operations replacement and phased back to BBN.

Commonwealth Capital

- 2004: Entrepreneur-in-residence (informally), performed technical due diligence on business plans, brainstormed ideas for new businesses with venture partner. With venture partner, left for portfolio company BBN to form core of commercialization team.

Empirix, Inc./Teradyne, Inc.

- 2001 - 2004: Chief Technologist, Engineering Manager, Web Application Test Group. Researched potential new product areas; developed product plan and prototype. Responsible for three new and existing products. Managed off-shore development team. Chief architect for all web testing products. Re-architected core testing product, helped write javascript interpreter. Provided technical vision for core product.
- 2000 - 2001: Chief Technologist, Communication Infrastructure Test Group. Responsible for incorporating new technology internally, tracking new technologies, technical evaluation of partnerships and potential acquisitions. Helped develop division strategy. Developed plans which formed core capabilities for successful new products introduced in 2004-5.
- 2000 - 2001: Engineering Manager, Communications Infrastructure Test Group. Execution of new product plan developed in prior role. Grew team from four existing engineers to team of over 30 on immediate team and over 40 on project. Delivered new platform in one year. Platform and derivatives accounted for large portion of booked products for the division within 2 years and is currently (2008) a key portion of new product offerings.

- 2000: Empirix was formed as a spin-out of Teradyne in January 2000. Reported to CEO in carve-out of Empirix from Teradyne.
- 1999: (Teradyne) Director of Business Development, Software Test Units. Reported directly to Chairman of the Board/Founder and then to general manager of software test unit (6 divisions of Teradyne). Evaluated and researched acquisition and partnership candidates. Internally assessed technology position in market and gaps in product lines. Worked with senior division staff to develop new product strategies. Attended internal Teradyne divisional board meetings. Chairman served as my mentor.

3Com Corporation/NBX Corporation

- 1999: Software Engineer 5. Continued work after 3Com acquisition of NBX. Built cross-division relationships for new products and research directions. NBX was acquired by 3Com in March 1999.
- 1997 - 1999: (NBX) Senior Scientist and Engineer. Work in IP Telephony. Architected next-generation product. Protocol design and validation for core protocol now used tens of millions of times daily. Led team in integration of IP protocols into current product. Designed audio reconstruction algorithms. Developed applications for bug analysis and diagnosis of system problems. Implementation of network simulator. Work on collaborative projects with external partners. Worked to identify gaps in product. Representative at numerous trade shows. Innovated novel methods of using product.

MIT Department of Electrical Engineering and Computer Science, Cambridge, MA

- 1991 - 1998: Research assistant, Telemedia Network Systems Group. Design, development, and implementation of Gigabit ATM network for distributed multimedia system. Studied host interface design issues. ATM network simulation.
- Spring 1989, Fall 1990, Spring 1995: Teaching assistant, Computation Structures digital systems course. (Spring 1995 Head TA)
- 1988 - 1989: Head laboratory teaching assistant for Computation Structures. Responsibilities included writing and revising lab assignments, and maintaining the lab.
- 1987: Laboratory teaching assistant for Computation Structures.
- 1987: Design, construction, and programming of 16-bit computer.

Agora Technology Group, Incorporated

- 1994 - 1996: Founder and CEO. Conceived and oversaw development of targeted advertising-supported Web sites. Responsible for company's vision and direction. Attended the first two WWW Conferences, presenting a workshop and paper at the first, and appearing on the "Commercialization and Economics of the Web" panel and chairing the "Where Commercial Services and the Web Are Headed" panel at the second. Sold company intact; is currently an operating stand-alone company.

AT&T Bell Laboratories, Holmdel, NJ

- 1989 - 1990: Implementation of cascadable all-optical fiber logic gate. Modelocking of all-fiber erbium laser. Construction of modelocked laser repetition rate booster. Strong optics laboratory and fiber optic experience.
- Summer 1988, 1987: Research in integrated optics. Analysis of rectangular waveguides using microwave modeling. Fabrication of integrated optical components.

Honors

- MIT Alumni Association Great Dome Award, 2010, Baker 60th Anniversary Reunion Co-Chair (highest group award given by MIT Alumni Association)
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 2008, Member of MIT Chairman's Salon committee
- MIT Alumni Association Bronze Beaver Award, 2007 (highest individual award given by MIT Alumni Association)
- MIT Alumni Association Volunteer Honor Roll, February 2004
- MIT Alumni Association Lobdell Award, 1999
- Boston Museum of Science Gold Pin for 1000 hours of Volunteer Service, April 1999
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 1997, Member of Alumni Online Communications Committee

Patents and Patent Publications

- U.S. Patent #9,697,231, H. Houh, J. Stern, R. Spina, M. Meter, "Methods and apparatus for providing virtual media channels based on media search," July 4, 2017.
- U.S. Patent #9,697,230, H. Houh, J. Stern, "Methods and apparatus for dynamic presentation of advertising, factual, and informational content using enhanced metadata in search-driven media applications," July 4, 2017. See also WO2007056485.
- U.S. Patent #7,975,296, L. Apfelbaum, H. Houh, T. Mayberry and G. Friedman, "Automated security threat testing of web pages," July 5, 2011. See also US20030159063, WO2003067405.
- U.S. Patent #7,877,736, H. Houh and J. N. Stern, "Computer language interpretation and optimization for server testing," January 25, 2011. See also US20050138104, WO2005043300.
- U.S. Patent #7,801,910, H. Houh and J. N. Stern, "Method and apparatus for timed tagging of media content," September 21, 2010. See also US20070112837, US20090222442, WO2007056535.
- U.S. Patent #7,590,542, D. C. Williams, W. C. Hand, H. Houh, A. R. Seeley, "Method of Generating Test Scripts Using a Voice-Capable Markup Language," September 15, 2009. See also EP1530869, US20030212561, WO2003096663.
- U.S. Patent #6,967,963, H. H. Houh, P. Anderson, C. Gadda, "Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data," November 22, 2005. See also EP1060400, WO2000033092, CA2318774.

- U.S. Patent #5,144,375, M. C. Gabriel, H. H. Houh, N. A. Whitaker, “Sagnac Optical Logic Gate,” September 1, 1992. Also issued as European Patent # EP0456422, July 23, 1997, German Patent #DE69126913, August 28, 1997
- U.S. Patent Application Publication No. 20020015387, “Voice Traffic Packet Capture and Analysis Tool for a Data Network” (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016708, “Method and Apparatus for Utilizing a Network Processor as Part of a Test System” (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016937, “Method and Apparatus for Utilizing a Network Processor as Part of a Test System.” (Abandoned in 2007) See also WO2002011413.
- U.S. Patent Application Publication No. 20070106646, “User-directed navigation of multimedia search results” (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106660, “Method and apparatus for using confidence scores of enhanced metadata in search-driven media applications” (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106685, “Method and apparatus for updating speech recognition databases and reindexing audio and video content using the same” (Abandoned in 2015)
- U.S. Patent Application Publication No. 20070118873, “Methods and apparatus for merging media content” (Abandoned in 2015)
- U.S. Patent Application Publication No. 20090222442, “User-directed navigation of multimedia search results” (Abandoned in 2016)
- U.S. Patent Application 11/395,732, “Search snippet creation for audio and video data” (Abandoned in 2009)
- U.S. Patent Application 11/774,931, “Methods and apparatus for managing a social networking web site”
- U.S. Patent Application 11/774,947, “Methods and apparatus for organizing media files”
- U.S. Patent Application 11/774,956, “Methods and apparatus for managing an online event”
- U.S. Provisional Patent Application 61/086,909, “Measuring and ranking relationship activity”
- U.S. Provisional Patent Application 61/086,914, “Detecting media object commonality”
- U.S. Provisional Patent Application 61/086,904, “Message categorization based on message characteristics”
- U.S. Provisional Patent Application 61/086,905, “Photo tagging to request action”

Trials, Testimony and Depositions

- Case No. 1:06CV682 (CMH/BRP), Verizon vs. Vonage, U.S. District Court for the Eastern District of Virginia, filed expert report, was deposed and testified at trial.
- Case No. 1:08CV157 (CMH/TRJ), Verizon vs. Cox, U.S. District Court for the Eastern District of Virginia, was deposed and testified at trial.
- Case No. 5:09-cv-476, Two-Way Media vs. AT&T, U.S. District Court for the Western District of Texas, filed expert report, testified at trial.

- Case No. 2:10-cv-248 (RAJ/FBS), ActiveVideo Networks vs. Verizon, U.S. District Court for the Eastern District of Virginia, filed expert report and was deposed as an expert witness.
- Case No. 1:11-cv-00880-TSE-JFA, Bear Creek Technologies, Inc. vs. Verizon Services Corp., et al, U.S. District Court for the Eastern District of Virginia, was deposed as an expert witness.
- Case No. 3:10-CV-298-BBC, AlmondNet, Inc. vs. Microsoft Corp., U.S. District Court for the Western District of Wisconsin, filed expert report.
- Case No. 6:10-cv-00597, Guardian Media Technologies, Ltd. Vs. AT&T Operations, Inc. et al., U.S. District Court for the Eastern District of Texas, Tyler Division, filed expert report.
- Case No. ESCV2010-02282C, The Octopus Solution LLC v. Gary Brown et al., Essex, MA Superior Court, testified at trial.
- Investigation No. 337-TA-882, In the matter of Certain digital media devices, including televisions, Blu-ray disc players, home theater systems, tablets and mobile phones, components thereof and associated software, U.S. International Trade Commission, filed expert reports, was deposed and testified at hearing.
- Investigation No. 337-TA-995, In the matter of Certain communications or computing devices, and components thereof, U.S. International Trade Commission, filed expert reports, and was deposed.
- Case No. 8:12-cv-122-LES-TDT, Prism Technologies LLC v. AT&T Mobility LLC, U.S. District Court for the District of Nebraska, filed expert report, was deposed and testified at trial.
- Case No. 11-2684 (JWL), Sprint Communications Co., L.P., v. Comcast Cable Communications, LLC, et al., U.S. District Court for the District of Kansas, filed expert report and was deposed.
- Case No. 11-2686 (JWL), Sprint Communications Co., L.P., v. Time Warner Cable, Inc., et. al., LLC, et al., U.S. District Court for the District of Kansas, filed expert report, was deposed, and testified at trial.
- Case No. 12-487 (SLR), Cox Communications, Inc., et al., v. Sprint Communications Company L.P., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- Case IPR 2014-00039, Microsoft Corporation v. B.E. Technology LLC, U.S. Patent No. 6,628,314. Submitted declaration and cross-examined in deposition.
- Case IPR 2014-00086, Apple, Inc. v. Evolutionary Intelligence, LLC, U.S. Patent No. 7,010,536. Submitted declaration and cross-examined in deposition.
- Case No. 6:11-CV-421, Stragent, LLC v. Intel Corporation, U.S. District Court for the Eastern District of Texas, Tyler Division, deposed and testified at trial as a fact witness.
- IPR2014-01366, IPR2014-01367, IPR2014-01368, Samsung et al. v. Straight Path, submitted IPR declarations and was deposed.
- IPR2015-1006, IPR2015-1007, Cisco v. Straight Path, submitted IPR declarations.
- IPR2014-01457, IPR2014-01459, Microsoft v. Biscotti, submitted IPR declaration and was deposed.
- IPR2016-00302, Apple v. Nonend, submitted IPR declaration.
- IPR2014-00812, Yelp and Twitter v. Evolutionary Intelligence, submitted IPR declaration.

- IPR2015-00307, Cisco v. AIP, submitted IPR declaration.
- Microsoft v. Acacia, submitted IPR declaration.
- IPR2015-00342, AT&T Mobility LLC and Cellco Partnership d/b/a Verizon Wireless v. Solocron, submitted IPR declaration.
- Mediatube v. Bell Canada, Canadian Federal Court, submitted expert report and testified at trial.
- CBM2016-00036, Google v. At Home Bondholder's Liquidating Trust, submitted CBM declaration.
- IPR2016-01198, IPR2016-01201, Apple, Inc. v. VoIP-Pal.com, Inc., submitted IPR declaration and was deposed.
- Case No. 3:14-cv-2824-VC, Trend Micro Incorporated v. Rpost Holdings, Inc., et al, submitted expert report and was deposed
- Akamai v. Limelight Networks, IPR2016-01631, IPR2016-01711, IPR2017-00249, IPR2017-00349, submitted IPR declarations and was deposed
- Hyperlinc Technologies v. Verizon Sourcing, No. 650151/2015 New York Supreme Court, submitted declaration and was deposed
- Cascades Streaming Technologies v. Big Ten Networks, submitted expert reports and was deposed
- Klaustech, Inc. v. Google LLC., Case No. 4:10-CV-05899-JSW (N.D. Cal.), submitted expert report and was deposed
- Cisco v. Uniloc, IPR2017-00198, IPR2017-00058, submitted IPR declarations and was deposed.
- Cisco v. Uniloc, IPR2017-00597, submitted IPR declaration and was deposed
- Twitter v. Youtoo Technologies, LLC, IPR2017-01133, IPR2017-01131, submitted IPR declarations and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00375, submitted IPR declaration and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00376, IPR2017-00515, IPR2017-00775, submitted IPR declarations
- HTC Corporation v. IPA Technologies, IPR2018-00306, IPR2018-00307, submitted IPR declaration
- Hulu v. Soundview, IPR2018-00864, IPR2018-01023, submitted IPR declarations and was deposed
- XpertUniverse v. Cisco, 3:17-cv-3848, U.S. District Court for Northern District of California, submitted declaration in support of claim construction and was deposed
- Improved Search v. Microsoft, C.A. No. 16-cv-650-JFB-SRF (Del.), submitted declaration in support of claim construction
- Apple v. Uniloc, IPR2018-00361, IPR2018-00394, IPR2018-00395, IPR2019-00700, IPR2019-00701, IPR2019-01667, submitted IPR declarations
- LG Electronics v. Uniloc, submitted IPR declaration
- SRC Labs and Saint Regis Mohawk Tribe v. Microsoft, 2:18-cv-00321-JLR, U.S. District Court for Western District of Washington at Seattle, submitted declaration in support of claim construction and was deposed
- Verizon Wireless v. Barkan Wireless IP Holdings LP, submitted IPR declarations

- Verizon Wireless and Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-199, IPR2019-200, IPR2019-234, IPR2019-631, IPR2019-632, submitted IPR declarations
- Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-100, submitted IPR declaration
- Cisco Systems Inc. v. Meetrix IP LLC, IPR2019-539, IPR2019-540, IPR2019-541, IPR2019-542, IPR2019-543, IPR2019-544, submitted IPR declarations
- GMG Products LLC v. Traeger Pellet Grills LLC, PGR2019-24, PGR2019-34, PGR2019-35, PGR2019-36, submitted PGR declaration and was deposed
- Uniloc 2017 LLC v. Google LLC, 2:18-cv-00502-JRG-RSP, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Microsoft Corporation v. Uniloc 2017 LLC, IPR2020-00102, IPR2020-00103, submitted IPR declarations
- Microsoft Corporation and HP Inc. v. Syncloud Technologies, LLC, IPR2020-00316, IPR2020-01031, IPR2020-01032, IPR2020-01269, IPR2020-01270, IPR2020-01271, submitted IPR declarations
- Seven Networks, LLC v. Apple Inc, 2:19-cv-115-JRG, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Unified Patents Inc. v. Ortiz & Associates Consulting, LLC, IPR2019-00743, submitted IPR declaration
- Uniloc 2017 LLC v. Apple Inc., 3:19-cv-01905-JD, U.S. District Court for the Northern District of California, San Francisco Division, submitted declaration in support of claim construction and was deposed
- ClearPlay Inc. v. Dish Network LLC et al.; 2:14-cv-00191, U.S. District Court for the District of Utah, Central Division, submitted expert report and re-examination declarations, was deposed, and testified at trial
- AMC Networks, Inc. et al v. Sound View Innovations, LLC, IPR2020-00482, submitted IPR declaration
- Case No. 1:17-cv-01734-RGA, Sprint Communications Co., L.P., v. Charter Communications, Inc., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- CommScope Technologies LLC et al. v. Barkan Wireless IP Holdings LP et al., IPR2020-00827, IPR2020-00829, IPR2020-00831, IPR2020-00833, IPR2020-00835, IPR2020-00838, submitted IPR declarations
- Cisco Systems Inc. v. Monarch Networking Solutions LLC, IPR2020-01226, submitted IPR declaration
- CoolTV Network.com v. Blackboard, Inc., Facebook, Inc., International Business Machines Corporation, Kaltura, Inc., Limelight Networks, Inc., Microsoft Corporation, Ooyala, Inc., Snap, Inc., and Trapelo Corp., submitted declaration in support of claim construction and was deposed
- Facebook, Inc. v. Onstream Media Corporation, IPR2020-01507, IPR2020-01508, IPR2020-01525, IPR2020-01527, IPR2020-01528, submitted IPR declarations
- Hisense Co LTD. v. Maxell, LTD, IPR2020-01598, IPR2020-01600, submitted IPR declarations

- Microsoft Corp. v. O'Brien, IPR2021-00015, submitted IPR declaration and was deposed
- Sable Networks Inc. v. Cisco Systems, Inc., WA:20-CV-00288-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted declaration in support of claim construction
- Peloton Interactive, Inc. v. Icon Health and Fitness Inc et al., IPR2021-00342, submitted IPR declaration
- Hulu, LLC v. SITO Mobile R&D IP, LLC et al., CBM2020-00028, IPR2020-00158, IPR2020-00206 , IPR2020-00219 , IPR2020-00265 , IPR2020-00298 , IPR2020-00304 , IPR2020-00308 , submitted CMB and IPR declarations and was deposed
- Twitter, Inc. and Google LLC v. B.E. Technology, LLC, IPR2021-00482, IPR2021-00483, IPR2021-00484, IPR2021-00485, submitted IPR declarations
- MG Freesites LTD v. ScorpCast, LLC, IPR2021-00511, submitted IPR declaration
- Avionte, LLC v. Sandeep Acharya, Samar Basnet, and Aqore LLC, Arbitration, Hon. Jeffrey Keyes (Ret.)
- Microsoft Corporation v. WSOU Investments, LLC d/b/a Brazos Licensing and Development, IPR2021-00751, submitted IPR declaration
- SAP America, Inc. v. Express Mobile, Inc., IPR2021-01144, IPR2021-01145, IPR2021-01146, submitted IPR declarations
- StratosAudio Inc. v. Hyundai Motor America, 6:20-cv-01125-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted claim construction declaration and was deposed Peloton Interactive, Inc. v. Ifit Health and Fitness Inc, IPR2022-00029, IPR2022-00030, submitted IPR declarations and was deposed
- Investigation No. 337-TA-1263, In the matter of Certain televisions, remote controls, and components thereof, U.S. International Trade Commission, filed expert reports, was deposed, and testified at hearing
- Alexander Stross v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00861-AB(JC), filed expert reports, and was deposed
- Ralph Ledergerber v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00862-AB(JC), filed expert reports and was deposed
- John Walmsley v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00863-AB(JC), filed expert reports and was deposed
- Bernhard Kuhmstedt v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-02044-AB(JC), filed expert reports and was deposed
- Netflix, Inc. v. CA, Inc., IPR2021-01319, submitted IPR declaration and was deposed
- F45 Training Pty Ltd. v. Body Fit Training USA Inc., C.A. No. 20-1194 (LPS) (D. Del.), filed expert report
- Apple v. Fintiv, IPR2022-00976, IPR2022-01149, IPR2022-01150, IPR2023-00399, submitted IPR declarations and was deposed
- Estech Systems, Inc. v. Howard Midstream Energy Partners d/b/a Howard Energy Partners, C.A. No. 6:20-cv-777-ADA (Western District of Texas, Waco Division), filed expert reports and was deposed
- Echelon Fitness Multimedia, LLC. v. Peloton Interactive, Inc., IPR2020-01187, submitted IPR declaration and was deposed
- VIZIO. V. Maxell Ltd., IPR2022-01458, submitted IPR declaration
- Maxell, Ltd. et el. v. VIZIO, Inc., Case No. 2-21-cv-06758 (C.D. Cal.). filed declaration and was deposed

- Microsoft Corporation v. SurfCast, Inc., submitted IPR declarations
- MemoryWeb, LLC v. Samsung Electronics Co., LTD. and Samsung Electronics America, Inc., Case No. 6:21-cv-00411-ADA (Western District of Texas, Waco Division), filed declaration and was deposed
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- The Walt Disney Company et al. v. WAG Acquisition LLC, IPR2022-01227, IPR2022-01228, IPR2022-01346, submitted IPR declarations and was deposed
- Rakuten Rewards et al. v. IBM, submitted IPR declarations and was deposed
- Fubotv Media Inc. v. Sito Mobile R&D IP, LLC et al., submitted IPR declarations
- Unified Patents, LLC v. Noblewood IP LLC, IPR2022-01111, submitted IPR declaration
- Unified Patents, LLC v. Pedersen, Peter Henrik, IPR2023-00029, submitted IPR declaration
- Ericsson Inc v. Dali Wireless Inc., submitted IPR declarations
- Universal Electronics, Inc. et al. v. Roku, Inc., IPR2022-00818, submitted declarations and was deposed
- Google LLC v. Wildseed Mobile LLC et al., IPR2023-00244, IPR2023-00245, IPR2023-00246, IPR2023-00247, IPR2023-00248, submitted declarations
- Lululemon Athletica Canada Inc. et al. v. Nike, Inc., IPR2023-00180, IPR2023-00424, submitted declarations
- Zoho Corporation, et al. v. Meetrix IP, LLC, IPR2023-00371, IPR2023-00377, IPR2023-00379, IPR2023-00380, IPR2023-00382, submitted declarations
- WSOU Investments, LLC d/b/a/ Brazos Licensing and Development v. Google LLC, 6:20-cv-572, U.S. District Court for the Western District of Texas, Waco Division, submitted reports and was deposed
- Google LLC v. Safecast Limited LLC, IPR2023-00652, submitted declaration
- Investigation No. 337-TA-1338, In the matter of Certain smart televisions, U.S. International Trade Commission, filed reports and was deposed
- Cisco Systems, Inc. v. Orckit IP LLC, IPR2023-00714, submitted declaration
- SupplyPro, Inc. v. Sandvik Machining Solutions AB, et al., AAA Case No. 01-22-000-7897. submitted declaration
- TrackThings LLC v. NETGEAR, Inc., Case No. 22-00981-RGA-JLH, U.S. District Court for the District of Delaware, submitted declaration
- Walt Disney Parks & Resorts US Inc. v. Agile Journeys LLC; IPR2024-00029, submitted declaration
- Aylo Freesites Ltd v. Dish Technologies LLC; IPR2024-00043, IPR2024-00044, IPR2024-00045, IPR2024-00046, IPR2024-00047, IPR2024-00048, IPR2024-00146, IPR2024-00147; submitted declarations
- Arm Inc. et al. v. Icpillar LLC; IPR2024-00476, IPR2024-00566; Retained by Arm; submitted declarations
- Microsoft Corp et al. v. Litl LLC, IPR2024-00454, IPR2024-00455, IPR2024-00456, IPR2024-00457, IPR2024-00458; submitted declarations
- Cisco Systems Inc et al. v. InfoExpress Inc, IPR2024-00539, IPR2024-00540, IPR2024-00677, IPR2024-00678; submitted declarations
- Vizio Inc v. Multimedia Technologies Pte Ltd; IPR2024-00722, IPR2024-00723; Retained by Vizio; submitted declarations

- Sap America Inc v. Isix IP LLC; IPR2024-00615; Retained by SAP; submitted declarations
- Cisco Systems Inc et al. v. Portsmouth Network Corp; IPR2024-00505, IPR2024-00506; submitted declarations
- Aylo Freesites Ltd v. Dish Technologies LLC; IPR2024-00512, IPR2024-00513, IPR2024-00514, IPR2024-00515, IPR2024-00516, IPR2024-00517, IPR2024-00518, IPR2024-00519, IPR2024-00940, IPR2024-00941; submitted declarations
- Verizon Corporate Service Group et al. v. Headwater Partners I LLC; IPR2024-00809, IPR2024-00945; Retained by Verizon; Technology: Mobile device management; Submitted declarations
- Microchip Technology Inc v. Aptiv Technologies Ltd et al.; IPR2024-00228; Retained by Aptiv; Technology: Universal Serial Bus; Submitted declaration, 2024
- Vusion Group SA v. Hanshow Technology Co Ltd; IPR2024-00963; Retained by VusionGroup; Technology: Video analysis; Submitted declaration
- Maxell, Ltd. v. TCL Electronic Holdings Ltd. et al.; Case No. 5:23-cv-00108-RWS-JBB; U.S. District Court for the Eastern District of Texas, Texarkana Division; Retained by TCL; submitted declaration and was deposed

Publications

- “IP switching: server driven flow classification,” H. H. Houh, *Proceedings of the Washington University Workshop on Integration of IP and ATM*, November 1996.
- “Aurora at MIT,” D. D. Clark, H. H. Houh, and D. L. Tennenhouse, Editors, *MIT Laboratory for Computer Science Technical Report 673*, December 1995.
- “ViewStation Applications: Implications for Network Traffic,” C. J. Lindblad, D. Wetherall, W. Stasior, J. F. Adam, H. H. Houh, M. Ismert, D. Bacher, B. Phillips, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 1995.
- “The VuNet Desk Area Network: Architecture, Implementation, and Experience,” H. H. Houh, J. F. Adam, M. Ismert, C. J. Lindblad, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 13 (4), May, 1995.
- “Reducing the Complexity of ATM Host Interfaces,” H. H. Houh and D. L. Tennenhouse, *Hot Interconnects II Symposium Proceedings*, Stanford, August 11-12, 1994.
- “Media-intensive data communications in a ‘desk-area’ network,” J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, *IEEE Communications*, August 1994.
- “ViewStation Applications: Intelligent Video Processing Over A Broadband Local Area Network,” C. J. Lindblad, D. J. Wetherall, W. Stasior, B. Phillips, D. Bacher, J. Adam, H. Houh, M. Ismert, and D. L. Tennenhouse, *Proceedings of the 1994 USENIX Symposium on High-Speed Networking*, Oakland, CA, August 1994.
- “The Media Gateway: Live Video on the World Wide Web,” H. H. Houh, C. J. Lindblad, J. Soo, D. L. Tennenhouse, and D. J. Wetherall, *Workshop at the 1994 World Wide Web Conference*, Geneva, Switzerland, May 1994.
- “Active Pages: Intelligent Nodes on the World Wide Web,” H. H. Houh, C. J. Lindblad, and D. J. Wetherall, *Proceedings of the 1994 World Wide Web Conference*, Geneva, Switzerland, May 1994.

- “Wavelength Division vs. Code Division Access Methods for Optical Networks,” H. H. Houh, Area Exam Paper, May 1993.
- “Experience with the VuNet: A Network Architecture for a Distributed Multimedia System,” J. F. Adam, H. H. Houh, D. L. Tennenhouse, Proceedings of the 18th Conference on Local Computer Networks, pp. 70-76, September 1993
- “The VudBoard: A Simple DMA Interface,” H. H. Houh, Proceedings of the 4th Gigabit Minijam, January 1994.
- “A Software-Oriented Approach to the Design of Media Processing Environments,” D. L. Tennenhouse, J. Adam, D. Carver, H. Houh, M. Ismert, C. Lindblad, W. Stasior, D. Weatherall, D. Bacher, and T. Chang., submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- “A Network Architecture for Distributed Multimedia Systems,” J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- “The Viewstation Collected Papers,” D. L. Tennenhouse, J. Adam, C. Compton, A. Duda, D. Gifford, H. Houh, M. Ismert, C. Lindblad, W. Stasior, R. Weiss, D. Wetherall, D. Bacher, D. Carver, and T. Chang, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-590, November 1993.
- “The Viewstation Collected Papers II,” W. F. Stasior, D. L. Tennenhouse, J. F. Adam, D. R. Bacher, H. H. Houh, M. Ismert, C. J. Lindblad, B. M. Phillips, D. J. Wetherall, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-696, April 1996.
- “A System's Perspective of the Sagnac Fiber Logic Gates and Their Possible Applications,” A. Huang, N. Whitaker, C. Gabriel, H. Avramopoulos, P. M. W. French, H. H. Houh, and I. Chuang, Applied Optics, September 10, 1994
- “Complete Switching in a Three-Terminal Sagnac Switch,” H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, T. Morse, IEEE Phot. Tech. Lett. **3** (3), 235
- “Complete Switching in a Three-Terminal Sagnac Switch,” H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, IEEE/LEOS Annual Meeting, Paper PDP-13, November 1990
- “All-optical phase-locked oscillator,” N. A. Whitaker, Jr., H. H. Houh, H. Avramopoulos, T. F. Morse, IEEE/LEOS Annual Meeting, Paper ELT2.4/MOO3, November 1990
- “Passive modelocking of an all-fiber erbium laser,” H. Avramopoulos, H. H. Houh, N. A. Whitaker, M. C. Gabriel, T. F. Morse, IEEE/LEOS Conference on Optical Amplifiers and their Applications, Paper PDP-8, August 1990
- “Transverse modes, waveguide dispersion, and 30ps recovery in submicron GaAs/AlAs microresonators,” J. L. Jewell, S. L. McCall, A. Scherer, H. H. Houh, N. A. Whitaker, A. C. Gossard, and J. H. English, Appl. Phys. Lett. **55** (1), July 3, 1989

Leadership, Activities and Interests

- Leadership
 - Reading Symphony Orchestra
 - Board of Directors (Treasurer), 2022 – present
 - Discovery Museum (Acton, MA)
 - Board of Directors, 2023 – present

- Board of Directors, Development Committee, 2023 – present
- Science and Technology Advisory Council, 2012 - present
- The Discover Museum received the 2024 National Medal for Museum and Library Service, the nation’s highest honor given to museums and libraries that make significant and exceptional contributions to their communities.
- MIT Alumni Association Board of Directors
 - MIT Annual Giving Board, 3 year term, 2024 – 2027
 - National Selection Committee, 3 year term, 2020 – 2023
 - K-12 STEM Initiatives Co-chair, 2013 – 2017
 - Awards Committee Chair, 2012 – 2014
 - Awards Committee, 3 year term, 2011 – 2014
 - Vice President, 2 year term, 2004 – 2006
 - Alumni Ad-Hoc Committee, Chair, 2005-2006
 - Board Member, 2 year term, 1997 – 1999
- MIT Club of Boston
 - Board of Directors, 2006 - 2011
 - K-12 Initiatives Chair, 2009 - 2012
 - VP of Communications, MIT Club of Boston, 2003 - 2006
 - Past-President, MIT Club of Boston, 2002 - 2003
 - President, MIT Club of Boston, 2001 - 2002
 - President-Elect, MIT Club of Boston, 2000 - 2001
 - VP of Programs, MIT Club of Boston, 1999 - 2000
 - Activities Super-Chair, MIT Club of Boston, 1998 - 1999
- MIT Enterprise Forum of Cambridge, Inc.
 - Past Chair, 2009 – 2011
 - In-NOW-vation Co-chair, 2010
 - Chair, 2007 - 2009
 - Vice Chair, 2005 - 2007
 - Executive Board Member, 2002 - 2011
 - Winter Workshop Co-Chair, February 2007 - conceived idea for conference, which sold-out and produced largest attendance numbers in recent memory
 - Spring Workshop Co-Chair, Spring 2004
 - Membership Committee Chair, Fall 2003 - 2006
 - 25th Anniversary Dinner Chair, Fall 2003
 - As Membership Chair and Board Member, started Special Interest Groups in 2004; a SIG won the MIT Presidential Citation award, the MIT Alumni Association's highest award for organizations, in 2006
- Estabrook Elementary School PTA
 - Advisory committee to the superintendent on PCB issue, 2010-2011
 - 4th Grade after-school science program co-organizer, 2010-2012
 - 4th and 5th Grade before-school Math Olympiad co-organizer, 2009-2013
 - 5th Grade BBQ and Yearbook Committee, 2011, 2013
 - Family Math Night volunteer, 2008-2012
- Tau Beta Pi National Engineering Honor Society
 - Executive Councilor and Secretary, 2024 – 2026

- Advisor, MA B Chapter at MIT, 2003 - present
- District Director (National Officer), Tau Beta Pi, New England Area, 1991 - 2003
- President, MA B Chapter at MIT, Fall 1988 - Spring 1989
- Laureate award, 1989
- MIT Class of 1989
 - 35-year Reunion Gift Committee, Co-chair, 2024
 - Secretary, five consecutive 5 year terms, 1989 - 2014
 - 30-year Reunion Committee, 2019
 - 25-year Reunion Committee, 2014
 - 20-year Reunion Committee and Gift Committee, 2009
 - 15-year Reunion Committee and Gift Committee, 2004
 - 10-year Reunion Committee and Gift Committee, 1999
 - 5-year Reunion Committee, 1994
 - Interim Treasurer, 1993 - 1994
 - Instituted annual senior class career fair, now raising over \$100,000 annually for senior class activities, Fall 1988
- Strong, consistent record of leadership dating to high school
- Acting
 - ‘21’ (Sony Pictures), credited as “Chinatown Dealer,” 2007, Kevin Spacey’s movie about the MIT Blackjack Team inspired by “Bringing Down the House” by Ben Mezrich, opened nationwide on March 28, 2008. 21 was the number one movie in US for two weeks and number one globally for one week. 21 also topped the DVD sales, Blu-ray sales and DVD rental charts.
 - Spring Lake Theater Company, first New York-area off-broadway production of “A Chorus Line,” played role of Mark, Summer 1990
- Former member of the MIT Blackjack team
- Producer for 10,000 Maniacs’ 2013 album “Music from the Motion Picture”
- Executive Producer for 10,000 Maniacs’ 2015 album “Twice Told Tales”
- Violist, violist, harpist, guitarist, singer, actor: played in many amateur/semi-professional groups including Firebird Pops Orchestra, Reading Symphony Orchestra, MIT Summer Philharmonic Orchestra, Carlisle Chamber Orchestra, Rivers Symphony Orchestra, Opera51 Orchestra, Freisinger Chamber Orchestra, Merrimack Valley Philharmonic, Longwood Symphony, MIT Symphony, and Somerville Community Chorus
- Violist, “Coming Home” album by Karen Phillips, 2014
- Google Scholar citations: 2224, h-index: 22, i10-index: 27 (since 2019: 539/12/12)
- Erdos-Bacon number of 7
- Erdos-Bacon-Sabbath number of 11