

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Microsoft Corporation, Dell Inc., and Dell Technologies Inc.,
Petitioners

v.

Ozmo Licensing LLC
Patent Owner

U.S. Patent No. 8,599,814
Filing Date: July 27, 2012
Issue Date: December 3, 2013

Title: Apparatus and Method for Integrating Short-Range Wireless Personal Area
Networks for a Wireless Local Area Network Infrastructure

DECLARATION OF DR. ZHI DING
U.S. PATENT NO. 8,599,814

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LIST OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 8,599,814 (“ the 814 patent ”)
1002	Declaration of Dr. Zhi Ding
1003	Prosecution history of the 814 patent
1004	U.S. Patent Pub. 2002/0061031 A1 (“ Sugar ”)
1005	U.S. Patent Pub. 2004/0071123 A1 (“ Shin ”)
1006	Specification of the Bluetooth System, Version 1.1, February 22, 2001 (“ Bluetooth Specification ”)
1007	WO2005/006659 (“ Sinivaara ”)
1008	U.S. Patent Pub. 2004/0090924 (“ Giaimo ”)
1009	U.S. Pat. Pub. No. 2005/0180368 (“ Hansen ”)
1010	U.S. Pat. Pub. No. 2005/0174962 (“ Gurevich ”)
1011	WDTX District Court Trial Times
1012	US2006/0227753 (“ Vleugels I ”)
1013	Joint Claim Construction Statement
1014	Excerpts from the File History of 14/990,203
1015	Markman Order in the Acer Litigation
1016	U.S. Pat. No. 10,045,290
1017	802.11-1999
1018	802.11b-1999
1019	802.11g-2003
1020	DMI 2.0s Specification
1021	802.15.1-2002
1022	U.S. Patent Pub. No. 2005/0165909 (“ Cromer ”)
1023	U.S. Patent No. 7,340,015

I, Dr. Zhi Ding, hereby declare as follows:

I. INTRODUCTION

1. I have been retained by Petitioners at my normal hourly rate of \$850 per hour. No part of my compensation is dependent upon the outcome of the petition for *inter partes* review or the specifics of my testimony.

A. SUMMARY OF BACKGROUND AND QUALIFICATIONS

2. 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 30 years. I am also a private technical consultant on various technologies related to information systems. I have more than three decades of research experience on a wide range of topics related to data communications and signal processing.

3. 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.

4. 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.

5. 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.

6. 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. 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.

7. 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.

8. 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.

9. 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.”

10. I have 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. I have also 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.

11. A current copy of my *curriculum vitae*, attached hereto as Appendix A, provides further information concerning my experience and qualifications and includes a list of the matters on which I have serves as an expert witness.

II. MATERIALS REVIEWED

12. In preparing this declaration, I have reviewed and/or considered at least the documents cited in the List of Exhibits prepended hereto, and the documents referenced in this declaration. I have also reviewed the entire prosecution history of the 814 patent and its parent application, US2006/0227753 (“Vleugels I”).

III. RELEVANT LEGAL STANDARD

13. I am not an attorney. For the purposes of this declaration, I have been informed about certain aspects of the law that are relevant to forming my opinions. My understanding of the law is as follows.

14. Petitioners' counsel has informed me that a patent claim may be "anticipated" if each element of that claim is present either explicitly or inherently in a single prior art reference, and that the elements should be arranged in the reference as in the claim. Petitioner's counsel has informed me that for a claimed limitation to be inherently present, the prior art reference need not expressly disclose the limitation, so long as the claimed limitation necessarily flows from a disclosure in the reference.

15. Petitioners' counsel has informed me that a patent claim can be considered to have been obvious to a person of ordinary skill in the art at the time of the claimed invention. This means that, even if all of the requirements of a claim are not found in a single prior art reference, the claim is not patentable if the differences between the prior art and the subject matter in the claim would have been obvious to a person of ordinary skill in the art at the time of the claimed invention.

16. Petitioners' counsel has informed me that a determination of whether a claim would have been obvious should be based upon several factors, including, among others: (i) the level of ordinary skill in the art at the time of the claimed invention; (ii) the scope and content of the prior art; (iii) what differences, if any, existed between the subject matter of the claimed invention and the prior art; and (iv) secondary considerations of non-obviousness.

17. In determining the scope and content of the prior art, I have been

informed that a reference may be considered appropriate prior art if it falls within the field of the invention's endeavor. In addition, a reference is prior art if it reasonably pertinent to the particular problem(s) with which the inventor was involved. For example, I understand that a reference is reasonably pertinent if it logically would have commended itself to an inventor's attention in considering his problem. Further, if a reference relates to the same problem as the claimed invention, that supports use of the reference as prior art in an obviousness analysis.

18. Petitioners' counsel has informed me that a single reference can render a patent claim obvious if any differences between that reference and the claims would have been obvious to a person of ordinary skill in the art. Alternatively, the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to one having ordinary skill in the art. In determining whether a combination based on either a single reference or multiple references would have been obvious, it is appropriate to consider, among other factors:

- a. whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results;
- b. whether a person of ordinary skill in the art could implement a predictable variation, and would see the benefit of doing so;

- c. whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art;
- d. whether a person of ordinary skill would have recognized a reason to combine known elements in the manner described in the claim;
- e. whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and/or
- f. whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

19. I have been advised that a POSITA is a hypothetical person who is capable of understanding the scientific and engineering principles applicable to the relevant art of the claimed subject matter. I understand that a POSITA is presumed to have known the relevant prior art at the time of the alleged invention. Petitioner's counsel has further informed me that in considering obviousness, I should keep in mind that a person of ordinary skill in the art has ordinary creativity and is not an automaton. In addition, Petitioners' counsel has also informed me that in considering obviousness, it is improper to determine obviousness using the benefit of hindsight derived from the patent being considered.

20. I have been informed and understand that claims are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the patent specification and prosecution history. Such an individual is considered to possess ordinary skills and knowledge in a particular technical field, and is not an automaton. Other than the patent specification and prosecution history, I understand that it is also sometimes permissible to refer to “extrinsic” evidence which includes, among other things, relevant scientific principles, the general meaning of technical terms, and the state of the art. However, these extrinsic sources of evidence are inherently less reliable than the intrinsic evidence identified above.

21. Although the words in the claims are generally given their ordinary and customary meaning, I have also been informed that a patentee may choose to act as a lexicographer. I understand that when a patentee explicitly defines a claim term in the patent specification, then the patentee’s definition control. In addition, I have been advised that when a patentee describes a feature or embodiment in the specification in reference to the invention as a whole or as a critical component, such description(s) may limit the scope of claimed invention.

IV. SUMMARY OF OPINIONS

22. Based on my review of the 814 patent and its prosecution history, the other materials I have considered—which are identified throughout this Declaration,

and my knowledge and experience, my opinions are as follows:

- Ground 1: Claims 1, 3, 5-7, 9-13 are obvious over the combination of Sugar, Bluetooth and Shin.
- Ground 2: Claim 2 is obvious over the combination of Sugar, Bluetooth, Shin and Cromer.
- Ground 3: Claims 1, 3-4, 7-13 are obvious over the combination of Giaimo and Sinivaara.
- Ground 4: Claims 1 and 4 are obvious over the combination of Gurevich, Hansen, 802.11-1999, 802.11b and 802.11g.

V. SUMMARY OF THE 814 PATENT

A. Overview

23. The 814 patent describes a computing device that communicates over a first/primary wireless network (“PWN,” *e.g.*, a WLAN) and a secondary wireless network (“SWN,” *e.g.*, a WPAN). EX1001, 9:60-65. The computing device purportedly “coordinates the usage of the wireless medium” to “reduce interference.” *Id.*, 9:65-10:1. The 814 patent states that coordination may be achieved by using a secondary network protocol that is an “overlay protocol” that is “partially” compliant with the first network protocol. *Id.*, 10:1-7. The only example of such coordination is for the computing device to signal the devices on the first network to “defer” their wireless medium access to devices on the secondary

network. *Id.*, 10:8-10.

B. Prosecution History

24. The 814 patent was filed on January 27, 2012 and incorporated by reference of application 11/376,753, which published as U.S. Patent Pub. No. 2006/0227753 (“Vleugels I”). EX1012.

25. On December 6, 2012, the examiner rejected certain claims over Eng (U.S. Patent No. 6,771,933) and Quinn (U.S. Patent Pub. No. 2006/0015621) finding that Bluetooth was an overlay protocol with respect 802.11. EX1003, 180-182.

26. On May 7, 2013, the applicant amended the claims to additionally require that “at least some of the communications using the second wireless network protocol impinge on at least some antennae used for the first wireless network.” EX1003, 100-108. Applicant argued that the art did not disclose this limitation because the networks in the art could be in “separate spaces not in common.” *Id.*, 110. Applicant further argued that the references did not discuss any interference issues, implying the networks were in different spaces. *Id.* The examiner subsequently allowed the claims as amended. EX1003, 49-51.

VI. LEVEL OF ORDINARY SKILL IN THE ART

27. A person of ordinary skill in the art (“POSITA”) as of March 14, 2005 (earliest listed priority date) or July 27, 2012 (actual filing date), would have had at least a Bachelor’s degree in electrical engineering, computer engineering, computer

science, or a related field, with at least two years of experience in the field of wireless communication systems and protocols, with an allowance for additional education or experience that might substitute for these requirements.

28. In addition, it is also my opinion that a POSITA, as of the earliest effective filing date, would have had working knowledge of various known wireless protocols, including the Institute of Electrical and Electronics Engineers (IEEE) 802.11 protocols (*i.e.*, 802.11-1999, 802.11b, and 802.11g), the Bluetooth Specification (*i.e.*, Bluetooth Specification v.1.1), and other protocol or standards documents published by each of their respective authoring organizations/working groups—IEEE and Bluetooth Special Interest Group “Bluetooth SIG”, respectively.

VII. CLAIM CONSTRUCTION

A. “wireless personal area network (WPAN)”

29. The specification provides that invention, as whole, relates to seamlessly integrating short-range wireless personal area networks (‘WPANs’) into longer-range wireless local area networks. (‘WLANs’).” EX1001, 1:25-29. Accordingly, in my opinion, a POSITA reading this statement would have understood that the claims are limited to a short-range WPAN and a longer-range WLAN.

30. Regarding the relative ranges of the short-range WPAN, the specification unambiguously states that “WPAN is a short-range wireless network,

with typical coverage ranges on the order of 30 feet.” EX1001, 9:36-37. In addition, Vleugels I similarly states:

[0008] A personal area network or “PAN” is a short-range wireless network, with typical coverage ranges on the order of 30 feet ...

Vleugels I at [0008]. Therefore, it is my opinion that a POSITA would have understood that the patentee defined WPAN in accordance with these statements in Vleugels I and the '814 patent.

31. It is also my opinion that the specification consistently describes WPAN in accordance with these definitional phrases. For example, the specification provides that a WPAN “connect[s] peripherals to devices in close proximity.” EX1001, 9:37-38; *see also id.*, 9:48-50 (“WPAN is generally used for the interconnection of ... devices within the range of an individual person, typically within a range of 10 meters.”), Fig. 1 (identifying WPAN as a range of less than 10m).

32. Thus, in view of the foregoing, it is my opinion that a POSITA would have understood that the specification defined WPAN as “a wireless network with a typical coverage range on the order of 30 feet.”.

VIII. GROUND 1: CLAIMS 1, 3, 5-7, 913 ARE OBVIOUS OVER SUGAR, SHIN AND BLUETOOTH

A. Sugar (EX1004)

33. Sugar discloses “systems and methods for preventing the collisions or

interference” between an 802.11 network/WLAN and Bluetooth network/WPAN. EX1004, [0002], [0066]-[0067]. For example, Sugar discloses modifications to known, existing protocols, e.g., new rules related to CTS/RTS and DIFS, to promote coexistence. *Id.*, [0084]-[0107]. Therefore, in my opinion a POSITA would have understood that Sugar discloses a multi-protocol device is a “hub” that distributes and receives information from the terminals on the networks. Further, as explained in greater detail below, it is also my opinion that Sugar’s teachings regarding its “hub” renders the claimed “data forwarding logic” obvious. *Id.*, [0038]-[0039].

B. Shin (EX1005)

34. Shin discloses an apparatus and method for forwarding data between 802.11 network/WLAN and Bluetooth network/WPAN. EX1005, Title, Abstract. In particular, Shin discloses that devices on one network communicate with devices on the other network indirectly through a hub using IP addresses, wherein the hub includes data forwarding logic to route those messages based on those IP addresses. *Id.*, Fig. 3, [0007]-[0011], [0050].

C. Bluetooth Specification (EX1006)

35. The Bluetooth Specification discloses the details of the protocol, which Sugar explicitly teaches should be used. EX1004, [0078]-[0083]. Based on the express teachings of Sugar, it is my opinion that a POSITA would have found it obvious to implement aspects of Bluetooth as explained below.

D. Combination Rationale

36. In my opinion, it would have been obvious for a POSITA to combine Sugar's techniques for co-existence of WLAN and WPAN networks with Shin's techniques for IP addressing and routing between WLAN and WPAN networks.

37. Specifically, it is my opinion that it would have been obvious to implement the details in the Bluetooth Specification in the combination based on the explicit teachings in Sugar and Shin that disclose Bluetooth. EX1004, [0078]-[0083]; EX1005, [0022]-[0032].

38. In addition, it is my opinion that these references are analogous art because each is directed to the field of wireless networks. Further, Sugar is highly pertinent to the co-existence problems (EX1001, 2:39-44; EX1004, Abstract), Shin is highly pertinent to IP-addressability and data forwarding problems (EX1001, 4:1-15; EX1005, Abstract), and the Bluetooth Specification is highly pertinent to power management problems addressed by the inventor. EX1001, 12:19-13:15; EX1006, §§ 10.8 *et seq.*, 10.10 *et seq.*

39. In my opinion, a POSITA would have been motivated to combine the teachings of Sugar, Bluetooth and Shin to have an improved WLAN/WPAN hub. A POSITA implementing the hub disclosed in Shin would have been motivated by the express teaching of Sugar to use Sugar's techniques to improve the co-existence of those networks. Similarly, a POSITA implementing the hub disclosed in Sugar

would have been motivated by the express teaching of Shin to use Shin's techniques to provide the ability to address and route data between the networks. Thus, it would have been obvious to a POSITA to combine the teachings of Sugar/Bluetooth and Shin with either serving as the base reference.

40. In my opinion, a POSITA would have combined the references using known methods to yield predictable results. Shin discloses that the IP addressing and routing techniques may be implemented in the OSI software stack stored on a computer readable medium. EX1005, [0077]-[0078]. Shin explains how to implement the stack. *Id.*, Figs. 1-3, [0022]-[0051]. Thus, Shin's techniques can be implemented in any hub running networking software, like the hub in Sugar, using known programming methods to yield predictable results. Similarly, Sugar discloses its protocol modifications are implemented in software. EX1004, Fig. 2, [0046], [0148], claims 68-73. Thus, Sugar's techniques can also be implemented in Shin's hub, using known programming methods to yield predictable results. In the combination, Sugar/Bluetooth's co-existence techniques, and Shin's IP routing techniques, perform the same functions as the do separately. Indeed, it is my opinion that a hub running software is ready for improvement through additional programming using the combination of the techniques taught by these references to yield the predictable results taught by them. This is especially true as Sugar and Shin disclose embodiments having common and known components.

41. In addition, design incentives and market forces would have motivated a POSITA to combine the references to support IP routing, which was a basic networking functionality at the time, and to improve co-existence, which was a known goal in the art.

42. A POSITA would have had a reasonable expectation of success in making the combination of Sugar, Bluetooth and Shin through the use of known programming techniques, because a POSITA would have been skilled in working with the standard wireless technologies, and for the reasons given above.

E. Analysis

1. Claim 1

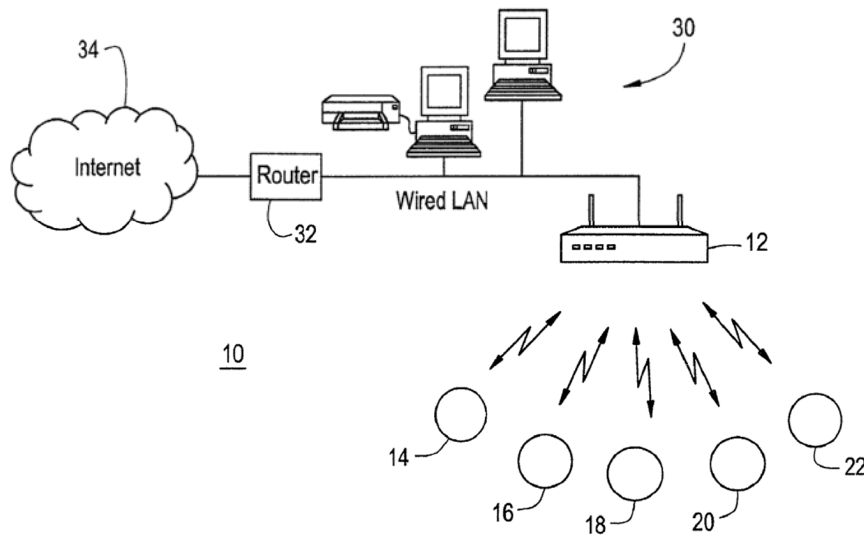
a. 1.pre

43. In my opinion, a POSITA would have understood that the combination discloses 1.pre “A network-enabled hub [laptop], usable for facilitating data communications between two or more wireless devices [WLAN device and WPAN device] that are configured to communicate indirectly with each other via the network-enabled hub [using IP addresses routed through the hub], comprising [see subsequent limitations].” EX1004, Figs. 1-2, [0038]-[0047]; EX1005, Figs. 4-5, 7-9, [0052]-[0059], [0066]-[0076].

44. For example, Sugar discloses a network enabled “hub” that it refers to as a multi-protocol device (“MPD”), with an example being a laptop. EX1004, [0039]. Sugar also discloses that the hub (i.e., MPD) facilitates data communications

with 802.11/WLAN wireless terminals and Bluetooth/WPAN wireless terminals.
EX1004, Figs. 1-2, [0038]-[0047].

FIG. 1



EX1004, Fig. 1 (hub 12, 802.11 nodes 14, 22, Bluetooth nodes 16, 20), [0042].

Sugar discloses that the MPD a device which operates as a hub or a terminal node on two or more wireless networks simultaneously (EX1004, [0038]-[0039], [0064]) and discloses techniques to improve co-existence. EX1004, Figs. 3-19, [0048]-[0107].

45. In addition, Shin further discloses a network enabled hub (61, “Bluetooth wireless LAN compound terminal”) that facilitates data communications between 802.11/WLAN and Bluetooth/WPAN devices. EX1005, Figs. 3, 6, [0040]-[0051], [0060]-[0065], [0077]-[0080], claims 1-32. Moreover, as explained below in claim 1.e, Shin discloses that the devices are configured to communicate indirectly

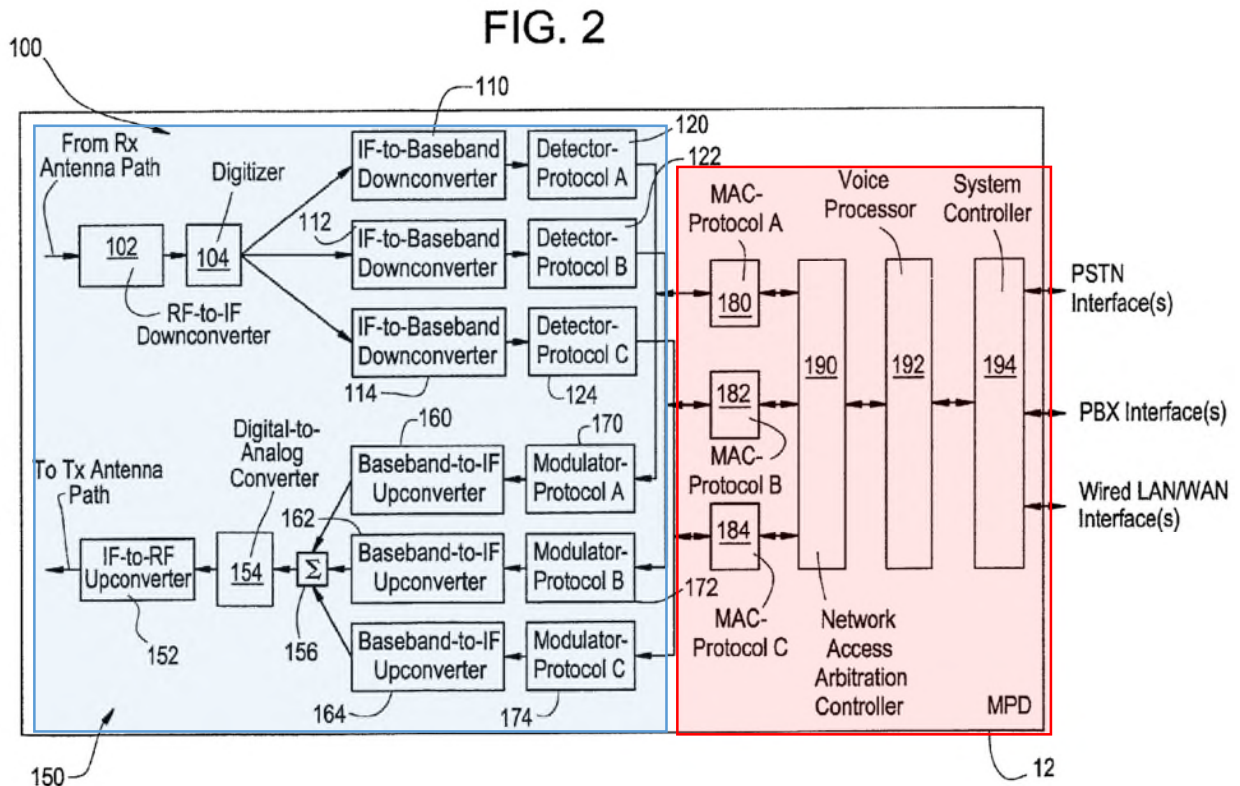
with each other via the hub using IP addresses. EX1005, Figs. 4-5, 7-9, [0052]-[0059], [0066]-[0076], claims 1-32.

46. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings of Sugar and Shin.

b. 1.a: “an interface to a wireless radio circuit that can send and receive data wirelessly, providing the hub with bi-directional wireless data communication capability”

47. In my opinion, a POSITA would have understood that the combination discloses limitation 1.a “an interface [interface between processor/circuit] to a wireless radio circuit [circuit with transmit and receive channels] that can send and receive data wirelessly, providing the hub with bi-directional wireless data communication capability [bi-directional WLAN/WPAN].”

48. For example, as shown below, Sugar discloses the claimed “interface” as the interface between the wireless radio circuit (circuit with receive and transmit channels annotated in blue) and the processor (processor executing processing blocks annotated in red).



EX1004, Fig. 2 (annotations added). Indeed, the 814 patent’s disclosure of its “interface” is a ‘black box’ communication path between a processor and a wireless radio circuit. EX1001, Fig. 6, 6:61-63.

49. Moreover, Sugar discloses the hub (e.g., laptop) comprises a wireless radio circuit comprising circuitry for receive and transmit channels 100 and 150. EX1004, Fig. 2, [0044]-[0045]. Sugar discloses that circuitry sends and receives data wirelessly, providing the hub with bi-directional WLAN and WPAN communications. *Id.* In my opinion, a POSITA would have understood that in the above annotated Figure 2 of Shin, the blocks annotated in blue (i.e., up and down converters, modulators, digitizer, D-to-A converters) are circuitry and collectively

comprise “a wireless radio circuit” as claimed. This is consistent with the plain language of the claim as well as the 814 patent’s specification. For example, I understand that the antecedent “a” to mean “one or more.” Therefore, it is my opinion that a POSITA would have understood “a wireless radio circuit” as encompassing one or more wireless radio circuit. This is also consistent with the 814 patent, wherein wireless radio circuit 27 is implemented using multiple devices. EX1001, Fig. 6, 6:58-64; EX1012 (Vleugels I), [0082]-[0085]. Moreover, it is my opinion that a POSITA would have known that the “wireless radio circuit” as claimed and disclosed in Sugar would have been implemented as either discrete components or as a System-on-Chip (“SoC”), and each choice would have been obvious, consistent with the passing reference to those known choices in Vleugels I without further explanation.

50. In further regard to the above annotated Figure 2 of Sugar, Sugar discloses processing blocks 180, 182, 184, 190, 192, 194 (highlighted in red) are implemented as code executing on a processor. EX1004, Fig. 2, [0046], [0148], claims 68-73, 95, 103, 121. Specifically, Sugar discloses that these processing blocks enable the processor to processes data received from, and generate data for transmission over, the wireless radio circuit. *Id.* Sugar also discloses that MAC processing can be performed on either side of the interface. *Id.*, [0046].

51. Shin discloses wireless radio system functionality executed on a

processor. EX1005, [0077]-[0078], claims 15-28, 32. Further, Shin expressly discloses an interface between each layer of the stack through which the bi-directional communications are passed. EX1005, [0044]-[0055]; *see also infra* claim 1.e. Indeed, Shin provides the exemplary disclosure wherein its hub communicates with various devices sharing an identical transmission medium by way of an Ethernet protocol. *Id.*, [0049]-[0055].

52. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings of Sugar and Shin.

c. 1.b

53. In my opinion, a POSITA would have understood that the combination discloses limitation 1.b “logic [processor] for processing [Sugar and Shin processing] data received via the wireless radio circuit.”

54. Sugar discloses a processor executing software stored in memory can perform the disclosed processing of received data: MAC processing (180, 182, 184), arbitration (190), digital voice data processing (192), activity data processing (194) or other application processing (e.g., video). EX1004, Fig. 2, [0046]-[0047], [0148], claims 68-73. Therefore, it is also my opinion that a POSITA would have understood this disclosure to mean the processor would execute whatever application processing was required on the received data (e.g., to present voice/video to the user or to

forward it).

55. In addition, Shin discloses its processing is implemented as a computer program. Therefore, in my opinion, a POSITA would have understood Shin's computer program which processes the received data inherently discloses, or at least renders obvious, a processor for executing that computer program. EX1005, [0077]-[0078], claims 15-28, 32.

56. Shin further discloses that the networking layer (IP) processes the received data to route it to the proper network and destination. EX1005, Figs. 3, 6, [0040]-[0051], [0060]-[0065], [0077]-[0080], claims 1-32; *see also infra* claim 1.e.

57. Therefore, in my opinion, a POSITA would have understood that a processor, such as the one taught by Sugar and/or Shin, is identical to, or at least equivalent to, processing unit 28 under the agreed construction.

58. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings of Sugar and Shin.

d. 1.c

59. In my opinion, a POSITA would have understood the combination discloses limitation 1.c "logic [processor] for generating [Sugar and Shin generating] data to be transmitted by the wireless radio circuit."

60. Sugar discloses a processor (*see* claim 1.a) executing software stored in

memory can perform any combination of the following to generate data to be transmitted: MAC processing (180, 182, 184), arbitration (190), digital voice data processing (192), activity data processing (194) or other application processing (e.g., video). EX1004, Fig. 2 [0046]-[0047]. Thus, it is my opinion that a POSITA would have understood this disclosure to mean Sugar's processor may execute whatever application processing was required to generate the data for transmission (e.g., to capture, process, and transmit voice/video from the user or to forward it).

61. Shin also discloses its processing is implemented as a "computer program," which, in my opinion, would have been understood by a POSITA to inherently disclose (or at least renders obvious) a processor for executing that computer program. EX1005, [0077]-[0078], claims 15-28, 32. Shin discloses that the networking layer generates and sends IP address data. *Id.*, [0062]-[0063]. Shin discloses the networking layer forwards data and lower layers generate corresponding signals for data transmission based on the destination network protocol. *Id.*, [0047] (forwarding), [0055] ("conversion" and "generates").

62. As I explained above, a processor is identical to, or at least equivalent to, processing unit 28 under the agreed construction. *See supra* Paragraphs 54-57, 60-61.

63. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings

of Sugar and Shin.

e. 1.d

64. In my opinion, a POSITA would have understood that the combination discloses limitation 1.d.1 “logic [1.a-1.c] for initiating and maintaining wireless network connections [802.11/WLAN and Bluetooth/WPAN connections] with nodes [14-22] of a wireless network external to the network-enabled hub [laptop], maintaining at least a first wireless network connection using a first wireless network protocol [802.11/WLAN] and a second wireless network connection using a second wireless network protocol [Bluetooth/WPAN], that can be maintained, at times, simultaneously with each other in a common wireless space [same time and common wireless space around laptop to forward data between connections].”

65. As explained above in 1.a-1.c, the combination discloses the claimed “logic.” In addition, Sugar discloses a wireless radio circuit and processor that executes a network function (including, but not limited to, functionality provided by a protocol stack) that initiates and maintains simultaneous 802.11/WLAN and Bluetooth/WPAN connections using the same RF front end. *See* 1.a-1.c.; EX1004, [0039], [0054]. In particular, Sugar discloses the hub is augmented with the appropriate software such that 802.11/WLAN and Bluetooth/WPAN connections are initiated and maintained simultaneously according to their respective standards. EX1004, [0038]-[0039], [0068]-[0073], [0078]-[0082]. Sugar further teaches its

augmented interference avoidance algorithm is executed by the processor. EX1004, Fig. 2, [0038]-[0046], [0066]-[0067].

66. Shin similarly discloses a mixed protocol stack that initiates and maintains simultaneous 802.11/WLAN and Bluetooth/WPAN connections for data forwarding between the networks. *See* 1.a-1.c, 1.e. Shin discloses its processing is implemented as “computer program.” EX1005, [0077]-[0078], claims 15-28, 32. Therefore, it is my opinion that a POSITA would have understood that Shin’s computer program inherently discloses (or at least renders obvious) a processor for executing that code.

67. The disclosure in the combination is identical, or at least equivalent to, wireless circuit 27, processing unit 28, and software platform 36 under the agreed construction of 1.d.1. The wireless circuit of the combination is a combined WLAN/WPAN transceiver that corresponds to wireless circuit 27. *See* 1.a. The processor of the combination corresponds to processing unit 28. *See* 1.b-1.c. The combination discloses a software protocol stack that supports initiation and maintenance of simultaneous WLAN/WPAN connections, including augmented processing for co-existence and IP addressing and forwarding, which corresponds to software platform 36. EX1001, 3:7-10; EX1012 (Vleugels I), [0070]-[0074].

68. The combination discloses 1.d.2 “wherein the second wireless network protocol [Bluetooth] is an overlay protocol with respect to the first wireless protocol

[802.11] in that communications using the second wireless network protocol are partially consistent with the first wireless network protocol [DIFS].”

69. In my opinion, a POSITA would have understood that the Bluetooth protocol in the combination is an overlay protocol with respect to 802.11 in that communications using the Bluetooth protocol are partially consistent, but not entirely consistent, with the 802.11 protocol. For example, the communications and protocols are partially consistent for at least four reasons. First, Sugar discloses the Bluetooth protocol is modified by adding a rule that DIFS from 802.11 should be used to reduce collisions. EX1004, Figs. 17(420), 19(530), [0095], [0107]. Sugar teaches that a device intending to send a Bluetooth transmission that might collide with an 802.11 transmission should wait for at least one DIFS period to decrease the risk of a collision. *Id.* A POSITA would have understood that this is consistent with the 802.11 protocol that also requires waiting one DIFS to reduce the risk of collision in these circumstances. EX1017 (802.11), §§ 9.2.3-5 *et seq.* A POSITA would have further understood this consistency provides the advantage of reducing interference and enhancing co-existence by reducing the risk of collision.

70. Second, Sugar discloses that the Bluetooth protocol is modified by adding “guard packets” comprising of RTS or CTS packets from 802.11 to reduce collisions. EX1004, Figs. 15-16, [0074], [0091]-[0092]. Sugar teaches guard packets should be used to reserve the wireless medium to prevent collisions. *Id.* This is

consistent with the use of guard packets in the 802.11 protocol to prevent collisions. EX1017 (802.11), §§ 7.2.1-2, 9.1-9.2.1. In my opinion, a POSITA would have understood this consistency provides the advantage of reducing interference and enhancing co-existence by reducing collisions. A POSITA would have understood that this is identical to the only disclosed example in the 814 patent. EX1001, 10:8-10.

71. Third, it is my opinion that a POSITA would have known that 802.11 and Bluetooth use a 48-bit address. EX1004, [0073], [0083]; EX1005, [0037], [0049]; EX1017 (802.11), §§5.3.3, 7.1.3.3.1-3; EX1006, §13.1. The consistent use of a 48-bit address reduces interference and enhances co-existence by avoiding the overhead associated with dynamically assigning and processing different types of addresses.

72. Fourth, in addition to the intrinsic evidence identified in Section V.B, a POSITA would have understood that Bluetooth and 802.11 operate in consistent RF frequencies, which allows both networks to use the same antenna and portions of the RF front end. See 1.a; EX1004, Figs. 1-8, [0042]-[0051].

73. Notwithstanding, a POSITA would have also understood that Bluetooth and 802.11 are not entirely consistent because they use different coverage ranges, data rates, modulation schemes, frequency hopping schemes, etc. EX1004, [0002], [0066]-[0073], [0078]-[0083]. In fact, the 814 patent teaches that Bluetooth and

802.11 are not entirely consistent. EX1001, 2:39-44, EX1003, 146.

74. The combination discloses 1.d.3 “and at least some of the communications using the second wireless network protocol impinge on at least some antennae used for the first wireless network [signals use same antenna].” Specifically, Sugar discloses the Bluetooth and 802.11 networks are in the same physical area and that their communications impinge on the same antenna and RF front end, necessitating Sugar’s co-existence strategies. EX1004, Figs. 1-8, [0042]-[0051].

75. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings of Sugar and Shin.

f. 1.e

76. In my opinion, a POSITA would have understood the combination discloses limitation 1.e “data forwarding logic, implemented in the network-enabled hub using hardware and/or software [laptop with processor IP addressing and routing], that forwards data between an originating node [WLAN or WPAN device] and a destination node [the other of WLAN or WPAN device], wherein the originating node is a node in one of the first and second wireless networks [WLAN or WPAN] and the destination node is a node in the other of the first and second wireless network [the other of WLAN or WPAN].”

77. For example, Sugar discloses that the multi-protocol device is a “hub” for communications with devices in the WLAN and WPAN (EX1004, [0038]-[0039], [0064]) and discloses modifications to the protocols to improve co-existence. EX1004, Figs. 3-19, [0048]-[0107]. In my opinion, a POSITA would have understood, or at least would have found it obvious that Sugar’s disclosure that its device is a “hub” between WLAN and WPAN networks that simultaneously supports transmission of multimedia using two protocols on an uplink and downlink as teaching the hub included data forwarding logic to forward data between nodes of the networks as claimed.

78. Shin discloses that the hub (61, “Bluetooth wireless LAN compound terminal”) includes a mixed protocol stack that includes a shared portion (network layer and above). EX1005, Figs. 3, 6, [0040]-[0051], [0060]-[0065], [0077]-[0080], claims 1-32. In my opinion, a POSITA would have understood that the disclosed protocol stack and shared portion include the ability to allocate IP addresses and forward packets between WLAN and WPAN devices based on their IP addresses.

79. Shin discloses a software protocol stack that supports data forwarding for indirect communication between WLAN and WPAN devices via the hub. EX1005, Fig. 3, [0050] (“communications between the terminals are enabled.”), [0040]-[0051], [0077]-[0078], claims 15-28, 32. Shin discloses how IP addresses are allocated to devices. *Id.*, Figs. 6, 9, [0060]-[0063], [0072]-[0076]. Shin discloses that

the hub will forward data from Bluetooth/WPAN devices to 802.11/WLAN devices based on the IP address. *Id.*, Figs. 4, 6, 7, 9 [0052]-[0055], [0064], [0066]-[0068], [0074]. Shin discloses that the hub will forward data from the 802.11/WLAN devices to Bluetooth/WPAN devices based on the IP address. *Id.*, Figs., 5-6, 8-9 [0056]-[0059], [0065], [0069]-[0071], [0076].

80. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings of Sugar and Shin.

2. Claim 3

81. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood the combination of Ground 1 discloses claim 3 “wherein the first wireless network connection [802.11] provides a link via an access point of a wireless local area network (“LAN”) [the 802.11/WLAN AP] and the second wireless network connection [Bluetooth] provides a link to a personal area network (“PAN”) serving PAN devices [Bluetooth/WPAN], such that network nodes that have access to the wireless LAN can address packets to PAN devices that are nodes in the PAN [IP addressing].”

82. Further, Sugar discloses the first, 802.11 connection provides a link via an access point (AP) of the 802.11/WLAN. EX1004, [0002], [0039]-[0041] (laptop with 802.11 connection via AP). Sugar discloses the second, Bluetooth connection

provides a link to a WPAN serving Bluetooth/WPAN devices. *Id.* Sugar discloses the coverage ranges of 100m and 10m for WLAN/WPAN, respectively, and that the WPAN can connect peripherals. *Id.*, [0002]; EX1006, pp. 921 (Definitions).

83. As I explained above in claim 1.pre and 1.e, Shin discloses the WLAN nodes can address packets to WPAN devices using IP addresses via the hub.

84. Therefore, and for the reasons explained above in Section VIII.D., it is my opinion that it would have been obvious to a POSITA to combine these teachings of Sugar and Shin.

3. Claim 5

85. In addition to my opinions set forth above in claim 1, it is also my opinion that the combination of Ground 1 discloses claim 5 “[w]herein the network-enabled hub [laptop] includes logic to coordinate a mutually agreeable inactivity period [Bluetooth power saving intervals] between the network-enabled hub and devices such that the WPAN devices can enter a sleep mode and occasionally wake up to transmit or receive data and/or control signals, [Bluetooth power saving states], with the network-enabled hub and WPAN devices synchronized so that the network-enabled hub is able to communicate with WPAN devices when WPAN devices wake up [communications after the power saving interval].”

86. In addition, for example, the Bluetooth Specification discloses (and Sugar discloses through its incorporation of the Bluetooth Specification by

reference) Active, Sniff, Hold, and Park modes. In Active Mode, unaddressed slaves can sleep until the next master transmission. *Id.*, § 10.8.1. In Sniff Mode, a slave can sleep until the next “sniff slot determined by the master and the slave.” *Id.*, §§ 10.8.2, IX.6.1. In Hold Mode, the “master and slave agree on the time duration” and the slave can sleep until the agreed timer expires. *Id.*, §§ 10.8.3, IX.6.2. In Park Mode, the slave can sleep until the next beacon interval. *Id.*, §§ 10.8.4, IX.6.3. These periods are jointly determined because they include proposals (sometimes ranges) that can be accepted or rejected. And the devices remain synchronized on the access channel so that they can communicate after the designated interval. *Id.*

87. It would have been obvious that the algorithms for these modes would have been executed by Sugar’s processor (i.e., processing unit 28) because Sugar discloses the processor performs this type of processing. *See* 1.a-1.c. In my opinion, a POSITA would have understood that the Active mode is identical to, or at least an equivalent of, the algorithm disclosed in the ’814 patent at 12:39-48 where the unaddressed slaves can sleep. Further, it is my opinion that a POSITA would have also understood that the Sniff, Hold, and Park modes are at least the equivalent of the algorithms disclosed in the ’814 patent at 12:20-13:15 that allow slaves to sleep until a determined time.

4. Claim 6

88. In addition to my opinions in claim 1, it is also my opinion that a

POSITA would have understood the combination of Ground 1 discloses “further comprising the wireless radio circuit interfaced to the logic for processing data [see 1.a-1.e], wherein the wireless radio circuit supports communications on both the first wireless network and the second wireless network [802.11/WLAN and Bluetooth/WPAN].”

5. Claim 7

89. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood the combination of Ground 1 discloses claim 7 “wherein the wireless radio circuit and the logic for processing data [see 1.a-1.e] are configured to allow the network-enabled hub to transmit on more than one radio band [multiple Bluetooth/802.11 bands].”

90. For example, Sugar discloses the circuit and logic are configured to allow the hub to transmit on different 1MHz Bluetooth radio bands and 22Mhz 802.11 radio bands within the 2.4GHz ISM band. EX1004, Figs. 11A-11D, 12B-12C, [0003]-[004], [0108], [0145]. And a POSITA would have understood that when a Bluetooth hop frequency is not in the “802.11 band,” it can proceed independently. EX1004, Fig. 4, 14A-14B, 19A, [0084], [0090], [0107].

91. Shin discloses the circuit and logic (see claim 1.a-1.e) are configured to allow the hub to transmit on the 2.4GHz and 5GHz bands to support 802.11a, b and g. EX1005, [0035]-[0036].

92. A POSITA would have understood that in the combination, it would have been obvious to implement the multi-band support of Sugar and Shin to support the Bluetooth and 802.11b radio frequency bands at 2.4 GHz, as well as the 5GHz 802.11a frequencies of Shin.

6. Claim 9

93. In addition to my opinions set forth in claim 1, it is also my opinion that the combination of Ground 1 discloses “wherein the network-enabled hub is embedded into a personal computer [laptop], a cellular phone, or a home entertainment equipment.” Indeed, Sugar expressly discloses that the hub may be a laptop. EX1004, [0039] (laptop computer).

7. Claim 10

94. In addition to my opinions set forth in claim 1, it is also my opinion that a POSITA would have understood that the combination of Ground 1 discloses claim 10 “wherein the first wireless network connection is for a wireless network [802.11/WLAN] having a first operating range [100m] and the second wireless network [Bluetooth/WPAN] is for a wireless network having a second operating range [10m], where the first operating range is larger than the second operating range [100m > 10m].” EX1004, [0002]. Indeed, a POSITA would have understood the Bluetooth second network would have a smaller operating range than the WLAN first network. More specifically, a POSITA would have understood that Bluetooth

has an operating range of 10 meters, whereas 802.11 has an operating range of 100 meters.

8. Claim 11

95. In addition to my opinions in claim 1, and for the same reasons that I set forth above in limitation 1.e, it is also my opinion that a POSITA would have understood that the combination of Ground 1 discloses claim 11 “wherein the data forwarding logic [processor executing IP stack] further comprises logic for uniquely identifying the destination node from data received from the originating node such that the network enabled hub can use that data to transmit data into the second wireless network [identify IP address and forward packets based on that IP address].” *See* Ground 1, limitation 1.e.

9. Claim 12

96. In addition to my opinions set forth above in claims 1 and 11, and for the same reasons that I set forth in limitation 1.e, it is also my opinion that a POSITA would have understood that the combination of Ground 1 discloses the hub “wherein the data identifying the destination node is a network address of the destination node.” *See* Ground 1, limitation 1.e.

10. Claim 13

97. In addition to my opinions set forth above in claims 1 and 11, and for the same reasons that I set forth in limitation 1.e, it is also my opinion that a POSITA would have understood that the combination of Ground 1 discloses the hub “wherein

the data identifying the destination node is an Internet Protocol (IP) address of the destination node [IP address].” See Ground 1, limitation 1.e.

IX. GROUND 2: CLAIM 2 IS OBVIOUS OVER SUGAR, BLUETOOTH, SHIN AND CROMER

A. Cromer (EX1022)

98. Cromer discloses “data processing networks that employ remote management to gather asset information from clients on the network.” EX1022, [0001]. Cromer discloses how to implement the industry standard Desktop Management Interface (DMI) Specification (EX1020) and still support low power wireless clients. EX1022 [0007]-[0009]. Cromer explains that a device (access point or “AP”) can cache information from a mobile system “in anticipation of a forthcoming asset information request from server 102.” *Id.*, [0027], [0021]. In response to an asset request from a server the AP provides the information if it is in the cache, or it coordinates its retrieval from the mobile station at the next opportunity. *Id.*, [0010], [0021], [0025], [0031]-[0034]. This allows the mobile station to support low power modes. *Id.*

B. Combination Rationale

99. It would have been obvious to a POSITA to combine the combined art of Ground 1 with Cromer’s technique to use data caching in the hub to support poll requests for data (e.g., to support the DMI Specification) while still supporting Bluetooth low power modes.

100. Cromer is analogous art because it relates to wireless networks, EX1022, [0023] (“Bluetooth”) and is highly pertinent to data forwarding and power management problems addressed by the inventor.

101. A POSITA would have been motivated to make the combination to improve the WLAN/Bluetooth hub for the reasons expressly taught by Cromer. The hub in the combination is what Cromer refers to as an “access point” because it provides the gateway to Bluetooth nodes. See EX1022, [0010], [0025]; Ground 1, claim 1. It would have been obvious for the combination of Sugar, Bluetooth, Shin and Cromer to implement the Bluetooth low power/inactivity states. See Ground 1, claim 5. Cromer expressly teaches that its caching and retrieval algorithm should be used when nodes may be in low power/inactive states. EX1022, [0009], [0019]-[0020], [0026]-[0029], [0034]. Cromer’s express motivations are focused on supporting the industry standard DMI, but Cromer teaches requests for other types of information may be implemented in a similar fashion. *Id.*, [0005]-[0006], [0018], [0034]. A POSITA would have understood from Cromer that caching in the hub, allowing the hub to respond to poll requests where possible while low power nodes slept, would be beneficial in other applications as well.

102. A POSITA would have combined the references using known methods to yield predictable results. Cromer teaches a POSITA could implement Cromer’s teachings in software using standard caching and retrieval techniques. EX1022,

[0025]-[0027], claims 7-13. Thus, Cromer's techniques can be implemented by augmenting the software executing on the processor in the combination of Ground 1, where Cromer's techniques would perform the same function as it does separately.

103. Design incentives and market forces would have motivated a POSITA to combine the references, for example, to support the industry standard DMI Specification while still implementing the Bluetooth low power modes. EX1022, [0004]-[0005], [0009], [0019]-[0021].

104. A POSITA would have had a reasonable expectation of success in making the combination of Sugar, Bluetooth, Shin and Cromer through the use of known programming techniques, because a POSITA would have been skilled in working with the standard wireless technologies, as well as the caching and retrieval techniques taught by Cromer.

C. Claim 2

105. The combination discloses the hub of claim 1 (*see e.g.*, Ground 1, claim 1) "comprising a routing module [processor executing algorithm] for receiving a poll request [poll request for asset information] that contains information required to unambiguously identify a station [IP address] that is a node in the second wireless network [node in Bluetooth network], wherein the routing module coordinates retrieval of information from the station [if cached, the hub sends the information, if not cached, the hub coordinates its retrieval by forwarding the request to the node]."

106. Cromer discloses that a remote device, such as a DMI server, may send requests over the internet to a hub (access point) to retrieve information from a mobile system (node in the second network). EX1022, [0018], [0022], [0029], [0031], [0034]. This request is a poll request because it requests information that may or may not exist at the hub (*id.*, [0031]-[0033]) and because it implicitly requests a Bluetooth poll. *Id.*, [0034]. Additionally, it would have been obvious to a POSITA that the server was making the poll request as part of the method for retrieving asset information from its wireless clients, which would be a common reason to make a request under the DMI specification from a client (*Id.*, [0008], [0009]). Indeed, the DMI specification expressly teaches updating privileges that are associated with wireless clients. EX1020, §§10.2.2, 1.5. The request unambiguously identifies the mobile system using its MAC (or IP) address. *Id.*, [0010], [0025], [0027], [0030]-[0032]. Upon receiving the request, the hub determines whether it has the requested information cached and, if so, provides the information. EX1022, [0021], [0027], [0031]-[0032]. If not, the hub coordinates its retrieval from the node when it wakes and polls the hub, or first associates with the hub. *Id.*, Fig. 5, [0010], [0021], [0034]. Bluetooth requires that the master poll the slave once it wakes for the information, thus, the request for information to the hub is a request for a poll. EX1006 §§4.4.1.3, 10.8.4. In the combination, the processor in the hub would execute Cromer's algorithm. EX1022, [0025]-[0027], claims 7-13.

107. The combination includes identical, or at least equivalent, to processing unit 28 executing the algorithms at 7:66-8:7 and 8:11-14 because the processor in the hub executes the same caching and retrieval algorithm. Sections VIII.E. & IX.A-B; EX1001, 7:66-8:7, 8:11-14

X. GROUND 3: CLAIMS 1, 3-4, 7-13 ARE OBVIOUS OVER THE COMBINATION OF GIAIMO AND SINIVAARA

A. Sinivaara

108. Sinivaara discloses enhanced power-saving capabilities for nodes in a multi-network wireless system. EX1007, 1:4-7, 3:12-27. Specifically, Sinivaara discloses enhanced Media Access Control (“MAC”) layer functionality that decreases power consumption for short range ad-hoc networks. *Id.*

B. Giaimo

109. Giaimo discloses the operation and management of multiple mobile devices on different wireless networks, including the routing of data through intermediate hubs. EX1008, [0002], [0014]-[0027], Fig. 1b. Giaimo teaches that these intermediate hubs (i.e., forwarding nodes) can act to route data packets from a first wireless network to nodes on a second wireless network – thereby effectively extending the range of wireless network coverage without negatively affecting battery life of mobile nodes on the second network. *Id.* Specifically, Giaimo discloses the optimization of bandwidth usage across wireless networks by transmitting data across multiple channels and operating a second network as either

an infrastructure or ad-hoc network depending based on need. *Id.*

C. Combination Rationale

110. It would have been obvious for a POSITA to combine Giaimo's techniques for co-existence and data routing across infrastructure and ad-hoc networks with Sinivaara's techniques for enhanced power-saving capabilities of mobile devices on the networks.

111. The '814 patent, Sinivaara, and Giaimo are analogous art because each is directed to the field of wireless networking. Additionally, Giaimo is highly pertinent to the co-existence and data-forwarding problems, and Sinivaara is highly pertinent to the power saving methods, each of which is addressed by the inventor of the '814 patent. EX1001, 2:39-44 (co-existence), 4:1-15 (data forwarding); 12:9-12, 12:26-38, (power saving). *See* EX1007, 5:18-24, 7:31-8:7, Fig. 1; EX1008, [0014]-[0027] (co-existence and data forwarding).

112. A POSITA would have been motivated to combine the teachings of Sinivaara and Giaimo to have an improved infrastructure and ad-hoc network system. A POSITA implementing the infrastructure/ad-hoc hub disclosed in Giaimo would have been motivated by the express teaching of Sinivaara's techniques to reduce power consumption of devices connected to a hub via an ad-hoc network. EX1008, [0014]-[0027]; EX1007, 7:31-8:7.

113. Giaimo teaches that a wireless network hub can interface with two

distinct wireless networks while maintaining a connection to both networks simultaneously. EX1008, [0014]-[0027]. Giaimo teaches that the hub can be programmed to operate in two distinct modes, a first mode for transmission of data across the first wireless network, and a second mode for transmission of data across the second wireless network. *Id.* 4:10-20.

114. In light of their disclosures, and that both are directed to the improvement of wireless networks, it would have been obvious for a POSITA to combine Giaimo's technique's for co-existence and data routing across infrastructure and ad-hoc networks with each of Sinivaara's various techniques for enhanced power-saving capabilities of mobile devices on the networks. The enhanced power-saving capability would be particularly useful in times of reduced or no media streaming between Giaimo's devices.

115. The '814 patent, Sinivaara, and Giaimo are all directed to the field of wireless networks. As stated above Giaimo is directed to the concepts of data-forwarding and co-existence, while Sinivaara is directed to power-saving methods. A POSITA would consider all these references to be analogous art.

116. A POSITA implementing the infrastructure/ad-hoc hub disclosed in Giaimo would have been motivated by the express teaching of Sinivaara's techniques to reduce power consumption of devices connected to a hub via an ad-hoc network. Further, it would have been obvious to combine the teachings of

Sinivaara and Giaimo with either serving as the base reference. (Sinivaara in view of Giaimo and Giaimo in view of Sinivaara.)

117. A POSITA would have understood that in the combination, the co-existence and data-forwarding techniques of Giaimo performs the same function as it does separately, and the power saving methods of Sinivaara performs the same function as it does separately.

118. The techniques of Sinivaara and Giaimo were known and, in the combination, would have improved the hub in similar ways. A hub running software (as disclosed in Sinivaara and Giaimo) is ready for improvement through additional programming using the combination of the techniques taught by Sinivaara and Giaimo to yield the predictable results taught by Sinivaara and Giaimo.

119. Design incentives and market forces would have motivated a POSITA to combine Sinivaara and Giaimo. A hub that supported data forwarding across the networks while enhancing the life-span of battery operated mobile devices would simultaneously extend the effective range of wireless networks to encompass mobile devices outside the coverage area of an infrastructure network access point and reduce downtime of mobile devices due to power shortages. Battery life is always a focus in the market for the mobile devices in Giaimo and Sinivaara. Thus, a POSITA would have been motivated to seek ways to extend that life.

120. Therefore, it is my opinion that a POSITA would have had a reasonable

expectation of success in making the combination through the use of known programming techniques and for the reasons given above.

D. Analysis

1. Claim 1

a. 1.pre

121. In my opinion, a POSITA would have understood that the combination discloses limitation 1.pre “A network-enabled hub [22], usable for facilitating data communications between two or more wireless devices [12, 40] that are configured to communicate indirectly with each other via the network-enabled hub [see 1.e], comprising [see subsequent limitations].” EX1008, [0014]-[0027], Fig. 1b, Figs.5-7.

122. Giaimo discloses a network enabled “hub” that it refers to as media clients, with an example being a PC or laptop. EX1008, [0048], Fig. 5. Giaimo discloses the hub facilitates data communications with an infrastructure network (e.g. 802.11 wireless standards) and an ad-hoc network. *Id.*, [0014]-[0027], Fig. 1b, Figs. 5-7.

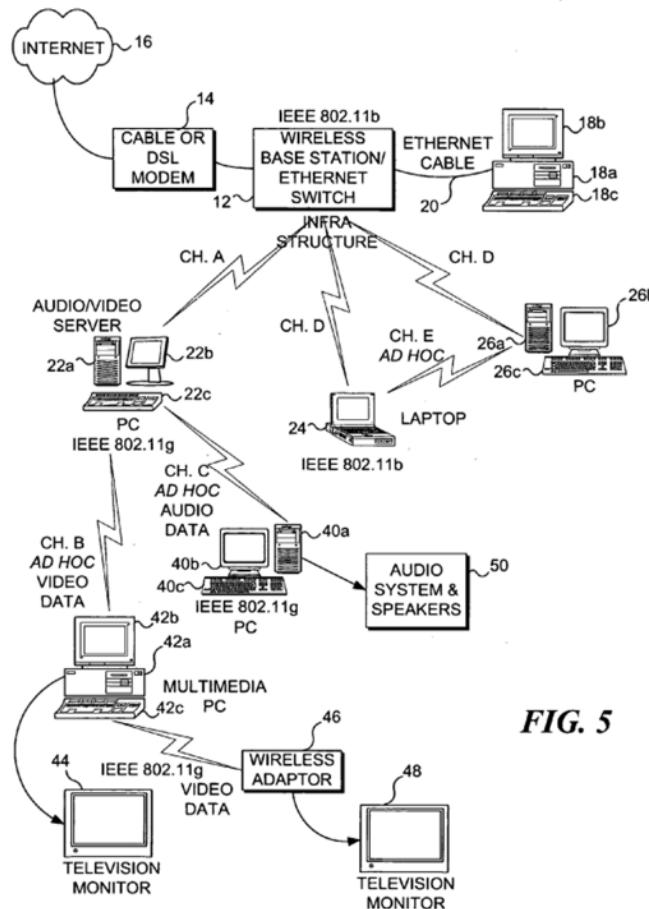


FIG. 5

EX1008, Fig. 5 (hub 22a, 802.11 access point 12, ad hoc network CH. C). Giaimo discloses an infrastructure network wherein computers are connected via an access point (AP). EX1008, [0015]-[0027], Fig. 1b, Fig. 5. In some situations, there are additional wireless devices either out of range of the AP, or which are incapable of directly communicating with the AP at an acceptable data rate. *Id.* [0018]. In this case, the hub is a computer communicating with the AP. *Id.* Giaimo discloses the second wireless connection provides a link to the computer via either an ad-hoc network or distinct infrastructure network. *Id.*, [0015]-[0027], Fig. 5. (“[T]he

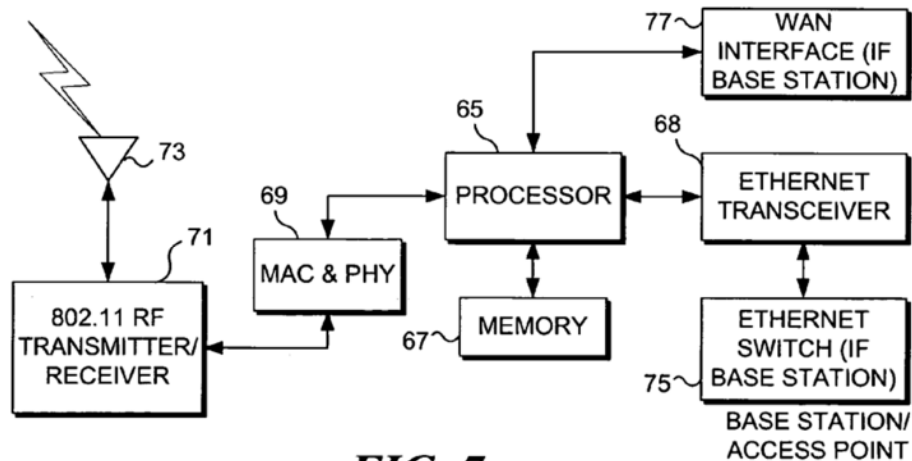
present invention enables the second wireless client device to communicate with the wireless AP indirectly through the first wireless client device.”). Giaimo discloses the identification and recording of MAC addresses to unambiguously identify nodes on the first and second wireless networks. *Id.*, [0058], [0067].

123. Giaimo discloses utilizing multiple wireless networks, including intermediate routing nodes, to increase network coverage and improve data transfer efficiency across multiple wireless devices, and therefore Giaimo discloses this claim limitation.

b. 1.a

124. In my opinion, a POSITA would have understood that the combination of Giaimo and Sinivaara discloses limitation 1.a “an interface [buses/controller 69] to a wireless radio circuit [transceiver 71/controller 69] that can send and receive data wirelessly [infrastructure and ad-hoc], providing the hub with bi-directional wireless data communication capability.”

125. Giaimo discloses in Figure 7 a bus that is an interface to transceiver 71 that is a wireless radio circuit “for transmitting and receiving signals via one or more antenna(e) 73.” EX1008, Fig. 7, [0037], [0054].

**FIG. 7**

126. Additionally, Giaimo discloses a “media access controller (MAC) and physical (PHY) layer transceiver 69” that is also a wireless radio circuit. *Id.*, Figs. 5-7, [0025]-[0027], [0048], [0058]. The hub (e.g., laptop) could have multiple wireless devices (e.g., internal PC cards connected via PCI bus). *Id.*, [0052]-[0054], claim 14. The 1) transceiver 71 and 2) transceiver 69, individually or collectively, (whether or not in a “card”) satisfies the claimed “wireless radio circuit” because they comprise circuitry for bi-directional radio communications. The “interface” for transceiver 71 comprises the bus between transceiver 71 and transceiver 69 (individually or collectively) because they interface transceiver 71 to the rest of the logic in the hub. The “interface” for transceiver 69 is the bus between it and the rest of the logic in the hub (e.g., PCI bus in the case of a “card”). Regardless of whether the hub includes one or more wireless circuits, the hub’s processor executes and stores Giaimo’s smart routing logic to control the radios and forward data between the wireless circuits as described throughout Giaimo. *Id.*, Figs. 6-10, [0058]-[0069].

127. Sinivaara discloses a hub (e.g., “portable computer[.]”) (EX1007, Fig. 1, 6:3-4) that includes a wireless radio circuit (transceiver 801), “at least one antenna” (antenna 802), and an interface to a processor (CPU 803) running the other system functions. *Id.*, Figs. 4 & 9 (interface between system and circuit functions), 6:3-13, 12:10-26. Sinivaara discloses that a hub for data forwarding can be a “portable computer[.]” EX1007, 6:3-4. Sinivaara discloses that the hub can rely on their traditional components without any additional wireless card components. *Id.*, 6:3-13.

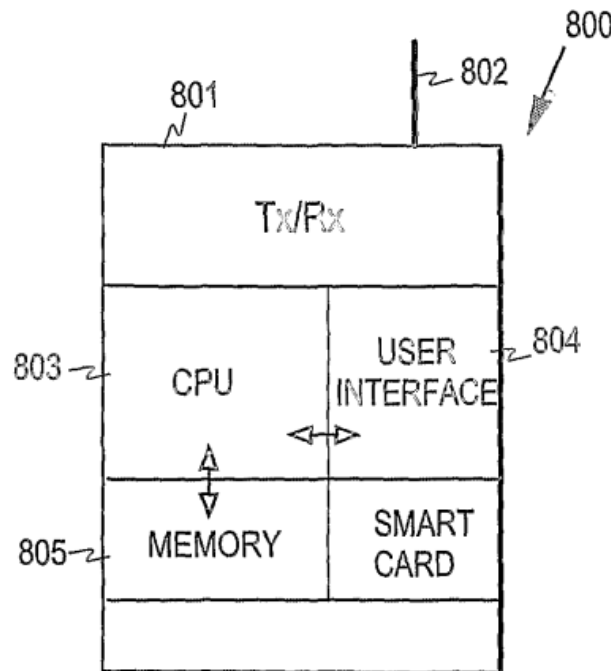


FIG. 8

EX.1007, Fig. 8 (wireless circuit 801, antenna 802, processor 803). A POSITA would be motivated to combine the enhanced data forwarding methodologies

disclosed in Giaimo with decreased power consumption from low power consumption mobile devices as taught by Sinivaara.

128. Therefore, in my opinion, a POSITA would have understood that the combination discloses this limitation.

c. 1.b

129. In my opinion, a POSITA would have understood that Giaimo discloses limitation 1.b “logic [processor] for processing data received via the wireless radio circuit [transmitter].” EX1008, [0024], [0054], [0060], Figs. 5-7.

130. Giaimo discloses a processor (e.g., processor 65) for executing its smart routing logic from memory to control the radios and forward data between the wireless circuits as described throughout Giaimo. *Id.*, Figs. 6-10, [0058]-[0079]. Giaimo discloses the processor executes software stored in memory to perform processing of received data, as well as control the media client’s usage of the infrastructure and ad-hoc networks. *Id.*, [0027], [0054], claims 4-6, 23-24. Giaimo discloses that the processing of data can include, for example, determining the type of data received, the strength of the wireless signal, determine data transfer rate, identify and transmit routing information, as well as utilize data to determine whether to operate the wireless device in an ad-hoc or infrastructure mode. EX1008, [0024], [0054], [0060], Figs. 5-7, claims 4-6, 23-24.

131. Giaimo discloses that the invention may be implemented in code. *Id.*

[0023]-[0024]. Giaimo discloses that the logic for processing data can be stored internally in memory. *Id.*, [0024], [0054], Fig. 7. Giaimo discloses that the hub can be in the form of a variety of wireless devices, including a standard computer, such as a PC or laptop. *Id.*, [0035], [0047]-[0048], Fig. 5. Giaimo's processor is identical to, or at least equivalent to, processing unit 28.

d. 1.c

132. In my opinion, a POSITA would have understood that the combination discloses limitation 1.c "logic for generating data to be transmitted by the wireless radio circuit [transmitter]." EX1008, [0024], [0054], [0060], Figs. 5-7.

133. Giaimo discloses a processor (e.g., processor 65) for executing its smart routing logic from memory to control the radios and forward data between the wireless circuits as described throughout Giaimo. *Id.*, Figs. 6-10, [0058]-[0079]. *See* 1.b. Giaimo discloses the processing includes generating data to be transmitted, for example, in its capacity as a media server, using the appropriate protocols to generate video data for transmission based on a stored video. *Id.*, [0046] (compressing video data before transmission), [0050]-[0053]. Other examples include generating VoIP data packets and TCP/IP headers for transmission. *Id.*, [0046]-[0047]. Giaimo also discloses the hub can be a conventional PC/laptop which renders obvious to a POSITA that the processor could generate data for transmission over the disclosed standard networks (e.g., http GET requests) to, for example, browse the web. *Id.*,

Fig. 5, [0035], [0045]-[0048]. Giaimo's processor is identical to, or at least equivalent to, processing unit 28.

134. Additionally, it is my opinion that a POSITA would have found it obvious in light of Giaimo's disclosure that the hub would generate data to be transmitted by the wireless radio circuit. Further, the purpose of a wireless network is to send data, and therefore it is my opinion that a POSITA would have understood that the media clients contain logic for generating data to be transmitted over the network.

e. 1.d

135. It is my opinion that a POSITA would have understood that Giaimo discloses 1.d.1 "logic for initiating and maintaining wireless network connections with nodes of a wireless network external to the network-enabled hub [media client], maintaining at least a first wireless network connection using a first wireless network protocol [802.11 infrastructure network] and a second wireless network connection using a second wireless network protocol [ad-hoc], that can be maintained, at times, simultaneously with each other in a common wireless space [same time and overlapping space around laptop]." EX1008, [0014]-[0027], [0047]-[0050], Fig. 1b, Fig. 5.

136. Giaimo discloses a processor (e.g., processor 65) for executing its smart routing logic from memory to control the radios and forward data between the

wireless circuits as described throughout Giaimo. *Id.*, Figs. 6-10, [0058]-[0079]. See 1.b. Giaimo discloses the hub facilitates data communications with a first wireless network (e.g., infrastructure network) and a second wireless network (ad-hoc network). *Id.*, [0014]-[0027], [0047]-[0050], Fig. 1b, Fig. 5.

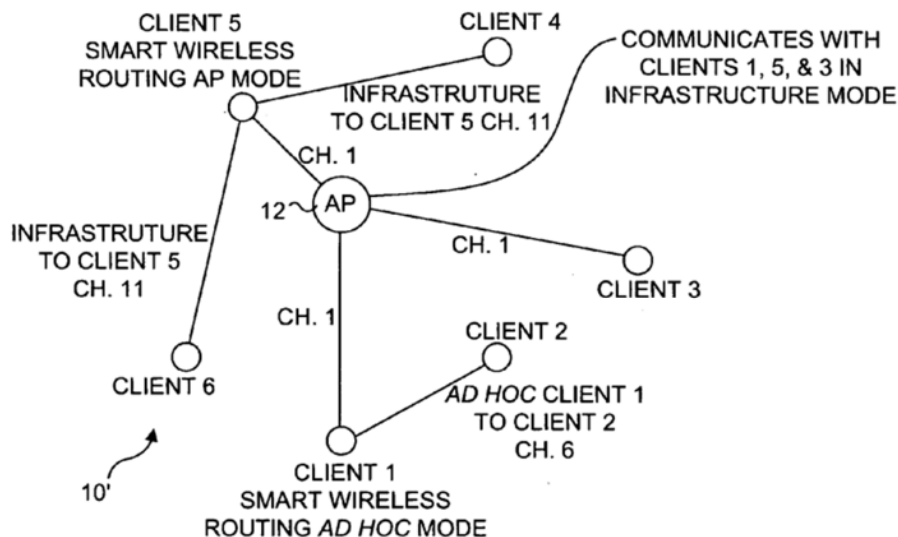


FIG. 1B

EX1008, Fig. 1b. Giaimo discloses that the hub [media client] initiates and maintains the connection to *both* wireless networks at the same time over the same wireless space. *Id.*, [0008], [0016] (“remain associated with the AP ... while creating either a new independent ad-hoc connection...”), [0017] (same), [0052] (“simultaneous maintenance of two wireless connections”). Giaimo’s structure is identical, or at least equivalent to, wireless circuit 27 (see 1.a), processing unit 28 (see 1.b, 1.c), and software platform 36.

137. Additionally, it is my opinion that a POSITA would have found it

obvious in light of Giaimo's disclosure that the hub would generate data to be transmitted by the wireless radio circuit. Further, the purpose of a wireless network is to send data, and therefore it is my opinion that a POSITA would have understood that the media clients contain logic for generating data to be transmitted over the network.

138. Giaimo discloses a processor executing software stored in memory that can manage and control the media client's usage of the infrastructure and ad-hoc networks. *Id.*, [0024], [0054], [0060], Figs. 5-7. Giaimo discloses that the invention may be implemented in software code. *Id.* Giaimo discloses that the logic for managing the network connections can be stored internally in memory. *Id.* Giaimo discloses that the hub can be in the form of a variety of wireless devices, including a standard computer, such as a PC or laptop. *Id.*, [0035], [0047]-[0048], Fig. 5.

139. Sinivaara and Giaimo disclose 1.d.2 "wherein the second wireless network protocol is an overlay protocol with respect to the first wireless protocol in that communications using the second wireless network protocol are partially consistent with the first wireless network protocol and at least some of the communications using the second wireless network protocol impinge on at least some antennae used for the first wireless network."

140. Giaimo discloses a first and second network operating on distinct channels so as to maximize their efficiency. *Id.*, [0045]-[0050]. Giaimo discloses that

these channels can be tailored to operate at different data transfer rates according to the limitations of the devices utilizing the network. *Id.* For example, Giaimo discloses that one channel can be high latency – low throughput for devices accessing webpages (802.11b), and the other can be low latency – high throughput for video file transfer (802.11a/g). *Id.*, [0046]. Giaimo further discloses that ad-hoc and infrastructure networks are not consistent in the manner in which they transmit data between nodes in the network. EX1008, [0009]-[0011], Figs. 1a-1b. Wireless traffic on an infrastructure network must travel first to an access point before being sent back to a different node in the network. *Id.* Direct node-to-node data transfers are not possible. *Id.* Ad-hoc networks on the other hand, are peer-to-peer, and facilitate the transmission of data between nodes without the need for an intermediate access point. *Id.* A POSITA would understand that these wireless networks are therefore operating under different protocols, different transmission methodologies, different coverage ranges, and with different max data transfer rates and are therefore only partially consistent.

141. A POSITA would have known that an ad hoc and infrastructure network operating pursuant to 802.11 would each use 48-bit MAC address defined by 802.11. EX1005, [0037], [0049]; EX1017 (802.11), §§ 5.3.3, 7.1.3.3.1-3. This reduces interference and enhances co-existence by avoiding the overhead associated with dynamically assigning and processing different types of level 2 addresses.

Additionally, the ad hoc and infrastructure networks can use consistent frequencies and common wireless space, which allows both networks to use the same antenna and network interface. EX1008, [0005], [0058]. This component reuse is a purported advantages of the overlay protocol. EX1008, 7:23-29, Fig. 10.

142. Giaimo discloses “smart logic” to reduce interference and permit co-existence. Figs. 6-14, [0058]-[0079]. This includes coordinating use of the common RF spectrum as shown in Tables 1-5 and accompanying text. *Id.* Giaimo uses IEEE 802.11 beacon frames in each network to assign channels and prevent overlapping transmissions. *Id.* Sinivaara similarly uses IEEE 802.11 beacon frames for its ad hoc networks. EX1007, 8:32-9:35.

143. Giaimo further discloses that the first and second wireless network are not entirely consistent because they can operate with different Quality of Service (QoS) properties. EX1008, [0012], [0016], [0019]. QoS provides differentiated handling and capacity allocation to specific flows in network traffic, assigning the order in which packets are handled and the amount of bandwidth afforded to that application or traffic flow. By disclosing the operation of the first and second wireless networks pursuant to different QoS properties, Giaimo discloses at least that the first and second networks operate with different capacity allocations and are therefore not entirely consistent.

144. Sinivaara discloses a modification of the Media Access Control

(“MAC”) layer as it is defined in 802.11. EX1007, 6:21-25. Specifically, Sinivaara discloses modifying the MAC layer to reduce power consumption at the cost of reduced range. *Id.* Sinivaara further discloses modification of the 802.11 standard by transmitting PLCP headers at “higher bit rate mode,” (7:22-30), changing the beacon broadcasts using non-standard assignments and adaptive intervals (Fig. 5, 8:32-9:30), avoiding certain standard headers (Fig. 7, 10:35-11:29), and using non-standard dynamic power control (11:30-12:9). Sinivaara’s disclosures of modifications of the 802.11 standard teach a network protocol that is partially compliant with the 802.11 standard.

145. Giaimo discloses 1.d.3 “and at least some of the communications using the second wireless network protocol impinge on at least some antennae used for the first wireless network.”

146. Giaimo discloses that the wireless transmitters and antennae are 802.11 RF “frequency agile” and can operate on every possible 802.11 RF channel within the utilized frequency bands (e.g. 2.4 Ghz and 5 Ghz). EX1008, [0048], [0054] (“one or more antenna(e)”), [0058], [0068], [0071], [0077]-[0079], Figs. 4-5. A POSITA would have understood that a frequency agile antenna is an antenna that operate across all of the 802.11 RF frequencies and uses channel filters to isolate the desired channel. Giaimo discloses scanning every possible 802.11RF channel and then dynamically assigning different channels in Table 4 and/or Table 5 for the first and

second wireless networks to reduce interference. *Id.*, [0058]-[0079]. As such, it would have been obvious to a POSITA that communications on all 802.11 RF channels, including those sent via the second wireless network protocol, would impinge on at least some frequency agile antennae used for the first wireless network.

147. As stated in further detail above, Bluetooth operates on the same RF frequencies as 802.11b/g and, therefore, those communications would impinge for the same reasons. EX1008, [0047].

f. 1.e

148. In my opinion, a POSITA would have understood that Giaimo discloses 1.e “data forwarding logic, implemented in the network-enabled hub using hardware and/or software [computer], that forwards data between an originating node and a destination node [nodes in infrastructure and ad-hoc networks], wherein the originating node is a node in one of the first and second wireless networks [node in infrastructure or ad-hoc networks] and the destination node is a node in the other of the first and second wireless network [node in infrastructure or ad-hoc networks].” EX1008, [0015]-[0018], Fig. 1b, Fig. 5.

149. Giaimo discloses an infrastructure network wherein computers are connected via an access point (AP). EX1008, [0015]-[0027], Fig. 1b, Fig. 5. In some situations, there are additional wireless devices either out of range of the AP, or

which are incapable of directly communicating with the AP at an acceptable data rate. *Id.* [0018]. In this case, the hub is a computer communicating with the AP. *Id.* Giaimo discloses the second wireless connection provides a link to the computer via either an ad-hoc network or distinct infrastructure network. *Id.*, [0015]-[0027], Fig. 5.

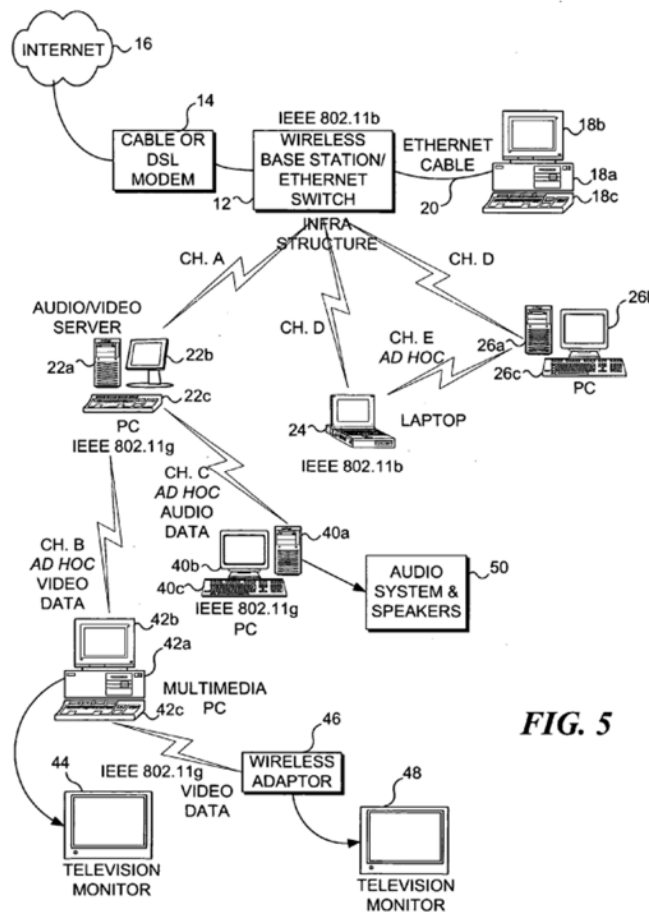


FIG. 5

EX1008, Fig. 5 (hub 22a, infrastructure network access point 12, second wireless device 40a). Giaimo discloses that the computer can route data from one wireless network to the other. EX1008, [0015]-[0018] (“[T]he present invention enables the

second wireless client device to communicate with the wireless AP indirectly through the first wireless client device.”). Giaimo discloses the use of IP addressing for identifying nodes in the first and second network. Giaimo discloses that a channel can be used for conveying “TCP/IP” packets, and envisions nodes on the first and second networks that “communicate[] over the internet using VOIP.” EX1008, [0046]-[0047]. A POSITA would understand that TCP/IP packets and VOIP communication utilize IP addressing for node identification. Giaimo further discloses an embodiment wherein the identification and recording of MAC addresses are used to identify nodes on the first and second wireless networks. *Id.*, [0058], [0067]. Giaimo discloses the use of 802.11 standards for the protocols of the first and second wireless network. *See* X.D.1.e. The 802.11 standards utilize MAC data frames containing multiple address fields to identify origination and destination nodes. *See* IX.E.1.h.

150. As Giaimo discloses utilizing multiple wireless networks, including intermediate routing nodes, to increase network coverage and improve data transfer efficiency, Giaimo discloses this claim limitation.

151. Sinivaara discloses that IP addressing is utilized in situations where data packets are being routed from one network to another. EX1007, 11:12-16. Sinivaara further discloses embodiments wherein node identification for data forwarding is performed with “terminal-specific MAC addresses.” *Id.*, 11:12-13.

152. Therefore, and as explained above in Section X.D., in my opinion a POSITA would have found obvious to combine the teachings of Giaimo and Sinivaara to utilize IP addresses for purposes of identifying nodes in the first and second networks when routing data packets through the hub.

2. Claim 3

153. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood that the combination of Giaimo and Sinivaara renders obvious the hub “wherein the first wireless network connection provides a link via an access point of a wireless local area network (“WLAN”) [e.g., 802.11 infrastructure provides link from hub 22 to AP 12] and the second wireless network connection provides a link to a personal area network (“PAN”) serving PAN devices [e.g., 802.11 ad-hoc network with Sinivaara modifications links hub 22 to PC 40], such that network nodes that have access to the wireless LAN can address packets to PAN devices that are nodes in the PAN [data forwarding based on MAC or IP addressing].”

154. Giaimo discloses an infrastructure network wherein computers are connected via an access point (AP). EX1008, [0015]-[0027], Fig. 1b, Fig. 5. In some situations, there are additional wireless devices either out of range of the AP, or which are incapable of directly communicating with the AP at an acceptable data rate. *Id.* [0018]. In this case, the hub is a computer communicating with the AP. *Id.*

Gaiimo discloses the second wireless connection provides a link to the computer via either an ad-hoc network or distinct infrastructure network. *Id.*, [0015]-[0027], Fig.

5.

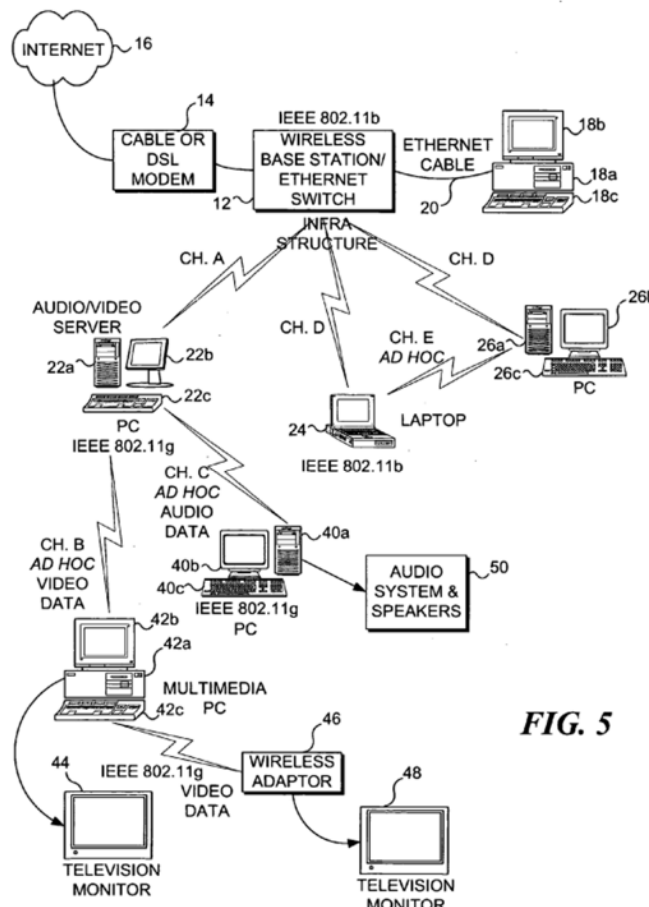


FIG. 5

EX1008, Fig. 5 (hub 22a, infrastructure network access point 12, second wireless device 40a). Gaiimo discloses that the computer can route data from one wireless network to the other. EX1008, [0015]-[0018] (“[T]he present invention enables the second wireless client device to communicate with the wireless AP indirectly through the first wireless client device.”).

155. In addition, the 802.11 ad-hoc network with Sinivaara's modifications renders obvious a PAN because Sinivaara's modifications reduce the coverage range. EX1007, 7:31-34. It would have been obvious to implement the combination such that the ad-hoc coverage range is on the order of 30 feet because Sinivaara teaches such a PAN (*id.*, 1:17-27) and that its modifications are for devices that "are in close proximity" and "close to each other." *Id.*, 6:24-25, 7:31-34, 12:3-4.

156. Therefore, in my opinion, a POSITA would have understood that Giaimo's disclosure of utilizing multiple wireless networks, including intermediate routing nodes, to increase network coverage and improve data transfer efficiency, discloses this claim limitation.

3. Claim 4

157. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood that the combination of Giaimo and Sinivaara discloses claim 4 "wherein the first wireless network protocol is an 802.11x wireless protocol [802.11a/b/g] and the second wireless network protocol is a modification of the 802.11x wireless protocol [Bluetooth] that is not entirely compliant with the 802.11x wireless protocol of the first wireless network but can be maintained in a common wireless space as the 802.11x wireless protocol." See claim 1 & 1.d.

4. Claim 7

158. In addition to my opinions set forth above in claim 1, it is also my opinion a POSITA would understand the combination of Ground 3 discloses claim 7 “wherein the wireless radio circuit [see 1.a] and the logic for processing data [see 1.b] are configured to allow the network-enabled hub to transmit on more than one radio band [see 1.d.3 - any 802.11 RF frequency in Tables 4 and/or 5].”

5. Claim 8

159. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood that Giaimo discloses claim 8 “wherein the wireless radio circuit and the logic for processing data are configured to allow the network-enabled hub to alternate connectivity between the first wireless network connection and the second wireless network connection.” EX1008, [0014], [0021].

160. Giaimo discloses that the hub can alternate between infrastructure and ad-hoc networks automatically. *Id.*, [0014], [0021]. (“The devices are allowed to directly connect to each other in either ad hoc or infrastructure modes...because the present invention automatically facilitates the communication protocol between two wireless devices when needed.”). Therefore, it is my opinion that a POSITA would have understood that Giaimo discloses that the invention may be implemented in code and performed by an internal CPU of the hub. See claim 1.

6. Claim 9

161. In addition to my opinions set forth above in claim 1, it is also my opinion, a POSITA would have understood that the combination of Ground 3 discloses claim 9 “wherein the network-enabled hub is embedded into a personal computer [laptop], a cellular phone, or a home entertainment equipment.” EX1008, [0054], Fig. 5.

162. Giaimo discloses that the hub can “be implemented using existing wireless devices without any hardware modification” (*id.*, [0054]), and Giaimo discloses that the hub can be a computer or laptop. *Id.*, Fig. 5. Giaimo further discloses that “almost any type of electronic device suitable for communication over a wireless network can be included in such a network using the present invention.” *Id.*, [0047]. Given these disclosures, it is my opinion that a POSITA would have understood the hub would be “embedded” in the device.

7. Claim 10

163. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood that Sinivaara discloses “wherein the first wireless network connection is for a wireless network having a first operating range [100 meters] and the second wireless network is for a wireless network having a second operating range [10 meters], where the first operating range is larger than the second operating range [100 > 10].” EX1007, 1:15-16, 1:22-23.

8. Claim 11

164. In addition to my opinions set forth above in claim 1, it is also my opinion that a POSITA would have understood that Giaimo discloses the hub [laptop] “wherein the data forwarding logic further comprises logic for uniquely identifying the destination node from data received from the originating node such that the network enabled hub can use that data to transmit data into the second wireless network [forward packets based on MAC address].” See Ground 3, limitation 1.e.

9. Claim 12

165. In addition to my opinions set forth above in claims 1 and 11, it is also my opinion that a POSITA would have understood that the combination discloses the hub [laptop] “wherein the data identifying the destination node is a network address of the destination node [MAC address].” See Ground 3, limitation 1.e.

10. Claim 13

166. In addition to my opinions set forth above in claims 1 and 11, it is also my opinion that a POSITA would have understood that the combination discloses the hub [laptop] “wherein the data identifying the destination node is an Internet Protocol (IP) address of the destination node [IP address].” See Ground 3, limitation 1.e.

XI. GROUND 4: CLAIMS 1 AND 4 ARE OBVIOUS OVER GUREVICH, HANSEN, AND 802.11/b/g.

A. Hansen (EX1009) Overview

167. Hansen is directed to “wireless communication systems and more particularly to supporting multiple wireless communication protocols within a wireless local area network.” EX1009, [0003]. Hansen teaches a transmitting wireless device compliant with one 802.11 protocol communicating indirectly with a receiving wireless device compliant with a different 802.11 protocol through an access point, wherein the access point reformats the transmitted data to comply with the receiving wireless device’s protocol. EX1009, [0014], [0067]-[0071].

B. Gurevich (EX1010) Overview

168. Gurevich discloses a Generic Client (GC) that “operates multiple virtual network interfaces that communicate simultaneously to different networks” that are in compliance with 802.11. EX1010, Abstract, [0013]. Gurevich’s GC provides the ability for information to be sent to “any type of AP or client” in the various networks (*Id.*, [0012], [0053], [0075]), “including all current and future versions of IEEE 802.11 (also known as WiFi), Bluetooth, and other proprietary wireless protocols.” *Id.*, [0076].

C. IEEE 802.11/b/g Overview

169. In my opinion, a POSITA would have understood that 802.11-1999, 802.11b, and 802.11g—although separately identified and cited in this

Declaration—are considered a single reference (collectively referred to as “802.11/b/g”) as they are “amendments to” the 802.11-1999 standard. To a POSITA, each supplement and/or amendment to the 802.11-1999 standard is not self-contained and cannot be read in isolation. A POSITA would have understood that each supplement and/or amendment to the IEEE 802.11-1999 standard ought to be read in aggregation since the individual supplement/amendment rely on other sections from earlier version and supplement/amendments of 802.11-1999. However, to the extent PO and/or the Board disagrees, I have set forth the rationale for combining these references below.

1. IEEE 802.11-1999 (EX1017) Overview

170. 802.11-1999 generally “defines the protocol and compatible interconnection of data communication equipment via the ‘air,’ radio or infrared, in a local area network” and provides a medium access control (“MAC”) which “supports operation under control of an access point.” EX1017 at iii. In particular, this standard provides wireless connectivity to various devices within a wireless local area network (“WLAN”). EX1017, pp. 1. Clause (“Section”) 15 of 802.11-1999 specifies the protocol for Direct Sequence Spread Spectrum (“DSSS”) systems operating in the 2.4 GHz radio frequency band. *See* EX1017 § 15 *et seq.*

2. IEEE 802.11b-1999 (EX1018) Overview

171. 802.11b is a supplement to the 802.11-1999 standard for WLANs.

EX1018, pp. 1. Specifically, 802.11b (Section 18) discloses a protocol for implementing a higher-speed physical layer extension for Direct Sequence Spread Spectrum (“DSSS”) systems operating in the 2.4 GHz radio frequency band as taught by 802.11-1999. EX1018, Cover, § 18.1. 802.11b is defined to co-exist with Section 15 of 802.11-1999. *Id.* § 18.1.

3. IEEE 802.11g-2003 (EX1019) Overview

172. 802.11g is an amendment to the 802.11-1999 standard as amended by then-existing protocols such as 802.11b. EX1019, pp. 1. Specifically, 802.11g (Section 19) discloses a protocol for implementing a further rate extension for the DSSS systems of 802.11-1999 and 802.11b (NonERP systems) operating in the 2.4 GHz radio frequency band—the Extended Rate PHY (“ERP”). *See* EX1019, Cover, §§ 19.1, 19.1.2. 802.11g further discloses mechanisms to facilitate interoperability and coexistence between ERP stations and NonERP stations. *Id.* §§ 19.1.2, 19.1.4.

D. Rationale for Combining Hansen, Gurevich, and IEEE 802.11-1999, 802.11b and 802.11g.

1. Rationale for Combining IEEE 802.11-1999, 802.11b and 802.11g (collectively, 802.11/b/g).

173. In my opinion, a POSITA would have found it obvious to combine 802.11-1999, 802.11b, and 802.11g based at least on the explicit statements in 802.11g. For example, each is directed to WLAN systems operating in the 2.4GHz band. EX1017 § 15 (2.4Ghz), EX1018, Cover (same); EX1019 (same). In addition, 802.11b is described as a supplement to 802.11-1999, and 802.11g states that it is an

amendment based on 802.11-1999, as amended by, in part, 802.11b. EX1018, pp. 1; EX1019, pp. 1. Further, 802.11g is not self-contained and provides express instructions on how to merge the 802.11-1999, 802.11b, and 802.11g—and other amendments—to form a comprehensive standard and to provide multiple sets of data rates. EX1019, pp. 1.

174. Therefore, it is my opinion, based on the above statements in 802.11/b/g, that a POSITA would have been motivated to combine these protocols, and would have enjoyed a reasonable expectation of success in doing so as it expressly disclosed in 802.11g, and contemplated by the IEEE 802.11 Working Group.

2. Rationale for Combining Hansen, Gurevich, and 802.11/b/g.

175. In my opinion, it would have been obvious for a POSITA to combine Gurevich's techniques for data-forwarding between networks with 802.11/b/g's techniques for generating protocol-specific data frames and coexistence, and 802.11/b/g's coexistence techniques. Indeed, like the 814 patent, Gurevich and Hansen each discloses implementing 802.11 protocols. EX1009, [0009] (disclosing the 802.11b and 802.11g protocols), [0033], [0043], [0067]-[0071] & Fig. 3, 6, 8, 10; EX1010, Abstract, [0003]-[0010] (referencing 802.11 addressing techniques), [0028], [0076] (incorporating the WiFi standards).

176. It is also my opinion that a POSITA would have found it obvious to

implement the details in 802.11/b/g in the combination based on the explicit teachings of implementing 802.11 protocols in Hansen and Gurevich. EX1009, [0009] (disclosing 802.11b and 802.11g), [0033], [0043], [0067]-[0071] & Fig. 3, 6, 8, 10; EX1010, Abstract, [0003]-[0010] (referencing 802.11 addressing techniques), [0028], [0076].

177. Further, it is my opinion that these references are analogous art because each is directed to the field of wireless networks and addresses similar problems as those discussed in the 814 patent. For example, Hansen is highly pertinent to the co-existence problems (EX1001, 2:39-44; EX1009, [0009]-[0013]), Gurevich is reasonably pertinent to IP-addressability and data forwarding problems (EX1001, 4:1-15; EX1010, [0003]-[0010] (data forwarding), [0040] (IP routing), [0063] (same)) and coverage range problems (EX1001, 4:1-20; EX1010 [0054]), and 802.11/b/g is highly pertinent to data forwarding problems (EX1001, 4:1-15; EX1017 §§ 7.2.2, 7.1.3.3.4-6), power management problems (EX1001, 12:19-13:15; EX1017 §§ 7.2.1.4, 9.2.5.2-3, 11.2.1.1), and co-existence problems (EX1001, 2:39-44; EX1017, §§ 9.2-9.2.2 addressed by the inventor.

178. It is also my opinion that a POSITA would have been motivated to combine the teachings of Gurevich, Hansen and 802.11/b/g to design an improved multi-protocol and multi-network wireless device. For example, a POSITA implementing the General Client-Wireless Device (“GC-WD”) disclosed in

Gurevich would have been motivated by the express teachings of Hansen and 802.11/b/g that facilitate coexistence. Indeed, although Gurevich discloses that its GC-WD simultaneously communicates with different wireless devices, which operate according to different protocols in different networks, Gurevich does not expressly teach coexistence techniques. A POSITA, in an effort to address the coexistence issue, would have looked to Hansen and be motivated to combine the teaching of Hansen for supporting multiple wireless communication protocols within a wireless local area network with Gurevich.

179. Moreover, in my opinion, a POSITA would have been motivated to combine the teachings of Gurevich, Hansen, and 802.11/b/g to have an improved GC-WD that is able to facilitate higher data rate communications while maintaining interoperability and coexistence between different protocol devices. For example, as the 814 patent explains, including slower data rate devices in a network of higher data rate devices would have slowed down the entire network. EX1001, 3:7-15. Hansen, understanding this drawback in the art (EX1009, [0009]-[0012]), accordingly teaches transmitting frames comprising “set-up” information to facilitate coexistence and interoperability but also comprising reformatted protocol-specific data portions for higher throughput to capable target devices. EX1009, [0042]-[0046], Therefore, implementing Hansen’s protocol conversion techniques in known 802.11 systems (such as the GC-WD) would ensure interoperability and

coexistence while facilitating higher data rates as discussed in the 814 patent. EX1009, claim 6.

180. In my opinion, a POSITA would have combined the references using known methods to yield predictable results. Gurevich discloses the IP addressing and routing techniques of its GC-WD may be implemented by routing software. EX1010, [0040], [0056], [0063], [0065]-[0070], [0075], Fig. 11. Similarly, Hansen teaches that its co-existence techniques are implemented as operational instructions stored in memory. EX1009, [0042]. Thus, Hansen and Gurevich's techniques may be implemented in any hub running networking software using known programming methods to yield predictable results.

181. Indeed, Gurevich discloses an exemplary that may serve as a platform for implementing its GC techniques (EX1010, [0075], [0077]-[0078]) that is substantially similar to the Hansen's AP. *Compare* EX1010, Fig. 12, with EX1009, Fig. 3. Thus, Hansen's techniques can be implemented in Gurevich's GC-WD using known programming methods to yield predictable results. In the combination, Hansen's co-existence techniques and interoperability, Gurevich's data forwarding and IP routing techniques, and 802.11/b/g's coexistence techniques perform the same functions as they do separately. Notably, Gurevich also provides, without limitation, that its techniques can be implemented with "any current or emerging wireless technology including all current and future versions of IEEE 802.11."

EX1010, [0032]. Moreover, A GC-WD running software is ready for improvement through additional programming using the combination of the techniques taught by these references to yield the predictable results taught by them.

182. Design incentives and market forces would have motivated a POSITA to combine the references to support IP routing, which was a basic networking functionality at the time, and to ensure co-existence and interoperability with different-protocol devices (legacy, then-current, and future protocols), which were known goals in the art.

183. Therefore, it is my opinion that a POSITA would have had a reasonable expectation of success in making the combination of Hansen, Gurevich, and 802.11/b/g through the use of known programming techniques, because a POSITA would have been skilled in working with the standard wireless technologies, and for the reasons given above.

E. Analysis

1. Claim 1

a. 1.pre

184. In my opinion, a POSITA would have understood that the combination of Ground 4 discloses limitation 1.pre “A network-enabled hub [General Client-wireless device (“GC-WD”)], usable for facilitating data communications between two or more wireless devices [devices utilizing one or more of the infrastructure, ad-hoc, 802.11b, 802.11g, and proprietary protocols] that are configured to

communicate indirectly with each other via the network-enabled hub.”

185. For example, Gurevich discloses GC functionalities which, when implemented in a wireless device, facilitate data communications between various devices in different networks. EX1010, Abstract, [0013], [0049], [0075] (transferring data), claims 8-11, 17, 23 (same). For example, Gurevich discloses a situation where a station in a first network communicates with an access point in a second network by way of an intermediary GC-WD (*i.e.*, providing indirect communications). *Id.*, [0053], [0034], [0074]-[0075]. Notably, the first and second networks (and/or additional networks) may utilize the same, partially the same, or different protocols. *Id.*

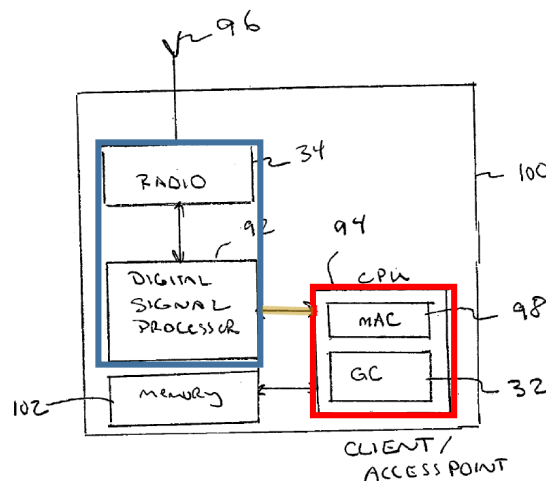
186. Therefore, and in as set forth above in Section V.D, it would have been obvious to combine these teachings.

b. 1.a

187. In my opinion, a POSITA would have understood that the combination discloses limitation 1.a. “an interface to a wireless radio circuit [physical and virtual interfaces to radio transceiver 34 and optional DSP 92] that can send and receive data wirelessly, providing the hub with bi-directional wireless data communication capability [bi-directional infrastructure, ad-hoc, 802.11b, 802.11g, proprietary].” EX1010, Figs. 3, 12, [0013], [0034], [0074]-[0075].

188. To simultaneously receive and transmit data communications between

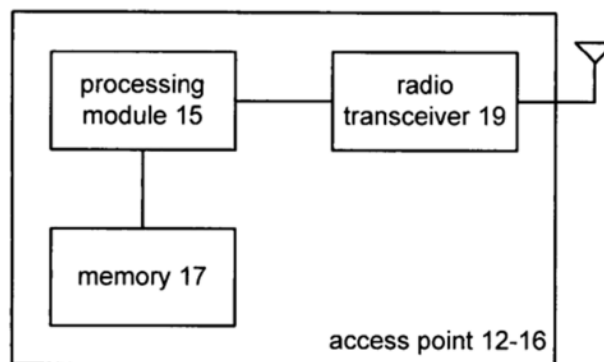
devices in different networks as disclosed by Gurevich (*Id.*, [0053], [0034], [0074]-[0075]), Gurevich teaches that the GC-WD includes a radio transceiver 34. *Id.*, Fig. 12, [0013], [0034] (“803.11 transceiver”), [0037], [0055], [0065], [0073]. Radio transceiver 34 can be coupled to optional DSP 92, which if present would be considered part of the wireless radio circuit. Indeed, Gurevich explains, without limitation, that any of its “various interconnected functional blocks or distinct software modules” may be “aggregated into a single logic device, program, or operation...and can be implemented by themselves, or in combination with other operation in either hardware or software. EX1010, [0078]. Gurevich discloses the radio transceiver 34 (alone or via optional DSP 92) has a physical interface to the CPU 94. *Id.*



Id., Fig. 12 (physical interface (yellow annotation) between a wireless circuit (blue annotation) and CPU (red annotation)); see also *id.*, Fig. 3 (radio 34 without DSP has physical interface to the CPU executing the virtual interfaces).

189. Gurevich also discloses virtual interfaces (36, 38, 40, 47) to radio transceiver 34 (with or without optional DSP 92), which also satisfy this limitation. EX1010, Fig. 3, Fig. 10 (MAC 98), [0034]-[0038], [0063], [0074] (MAC integrated into CPU). The virtual interfaces are implemented as software drivers executing on the CPU and include the layer 2 MAC processing. *Id.* These virtual interfaces provide an interface to the radio circuit 34 which can be used by higher levels of processing, such as IP routing, TCP/IP and Gurevich's smart routing logic.

190. Similarly, Hansen generally discloses the claimed "interface to a wireless radio circuit" as illustrated by the separation of the discrete radio and processor functional blocks. For example, the access point in Figure 3 of Hansen provides:



EX1009, Figs. 3, 6 (same), 8 (same).

191. Hansen also discloses radio transceiver 19 having an interface to processing module 15. EX1009, Fig. 3, [0042]. Radio transceiver 19 has a plurality of antennae and transceiver paths, but is otherwise similar to radio transceiver of

wireless radio 60. *Id.* Radio 60 also has an interface to a host system/processor (i.e., elements 18-32/50). EX1009, Fig. 2, [0007], [0034]-[0038], [0042]. Hansen confirms that “one of average skill” would appreciate that a radio can be implemented as a single IC with an interface to the host system/processor (EX1009, Figs. 2-3, [0034]-[0038], [0041]-[0042]), as also taught by Gurevich (EX1010, [0037], [0077]-[0078]).

192. Thus, in my opinion, a POSITA would have understood that Gurevich alone, or in combination with Hansen’s teachings (*see* Section XI.D (motivation to combine), satisfies this limitation.

c. 1.b

193. In my opinion, a POSITA would have understood that the combination discloses limitation 1.b “logic [CPU] for processing data received via the wireless radio circuit [see 1.a].”

194. Gurevich discloses its CPU executes software that processes data received via the wireless radio circuit 34 (and optional DSP 92). EX1010, Figs. 3, 10, 12, 13, [0034]-[0038], [0063]-[0071], [0073]-[0075]. Gurevich discloses the CPU processes received data to implement the virtual interface mapping and provide layer 2 MAC functionality, including processing the MAC header and then stripping it off. *Id.*, *see also* Fig. 11, [0064]-[0070]. The CPU processes received data to perform layer 3 IP routing, TCP/IP and TBRF routing. *Id.*, Fig. 8, Fig. 10, [0059]-

[0061], [0063]. Gurevich also discloses the GC can be a laptop executing “conventional applications 80.” *Id.*, Figs. 10, 13, [0063], [0075].

195. Thus, it is my opinion that a POSITA would have understood that conventional applications included, but were not limited to, applications which process received data, such as web browsers or media players displaying content.

d. 1.c

196. In my opinion, a POSITA would have understood that the combination discloses limitation 1.c “logic [CPU] for generating data to be transmitted by the wireless radio circuit [see 1.a].”

197. For example, Gurevich discloses CPU 94 generates data to be transmitted by the radio circuit 34 (and optional DSP 92). EX1010, Figs. 3, 10, 12, 13, [0034]-[0038], [0063]-[0071], [0073]-[0075]. In addition, Gurevich teaches that the CPU implements the virtual interface mapping and provides layer 2 MAC functionality, including generating data with new MAC headers for outgoing packets to replace the headers that may have been stripped off during receipt. *Id.*, *see also id.*, Figs. 9-11, [0062]-[0071]. In my opinion, based on Gurevich’s explicit disclosure that the CPU performs the layer 2 MAC processing (e.g., 802.11), a POSITA would have understood that data accompanied with MAC header is generated by the CPU as it is known that the MAC header is an integral and necessary part of MAC processing. Indeed, generated data frames must include the

correct addresses for the GC-WD as the transmitter and the correct management frames, such as those relating to a BSSID (for infrastructure) or IBSSID (for ad-hoc) transmission. *Id.*, [0004]-[0012], [0038] (explaining virtual interfaces use BSSIDs to identify different sessions). In my opinion, a POSTIA would have well understood that a failure to generate data frames with the appropriate MAC header would preclude a successful transmission, such as the disclosed 802.11 transmissions. Thus, generating an appropriate MAC header is required to achieve Gurevich's embodiments, which include, for example, data forwarding/routing. *Id.*, [0034], [0059]-[0061], [0063]-[0071].

198. Alternatively, it is also my opinion that a POSITA would have found it obvious that the CPU would generate data accompanied with the MAC header as part of the MAC processing for all of the reasons given above. Additionally, Gurevich further teaches that traditional networking devices had difficulties communicating simultaneously with different networks since different wireless networks may require distinct frame headers. *Id.*, [0066]. Gurevich discloses the transmission logic was known in the art, which is why it is not explicitly disclosed in more detail. *Id.*, [0071].

199. For at least the reasons stated above, it is my opinion that a POSITA would have understood that the CPU is identical to, or at least equivalent to, processing unit 28.

200. Alternatively, Hansen discloses receiving data frames from a first wireless device compliant with one 802.11 protocol and subsequently generating frames for transmission that are compliant with a different 802.11 standard used by a second wireless device. EX1009, [0007], [0042]-[0047], [0069]-[0071]. As taught by Hansen, this facilitates coexistence and interoperability while providing higher data rates. EX1009, [0009]-[0012], [0042]-[0046]; *see also supra* Section XI.D. Hansen, like Gurevich, teaches that its processing unit includes digital and/or analog logic for generating the appropriate 802.11 protocol frames. EX1009, [0036], [0042], [0046], [0071].

201. Accordingly, Gurevich alone, or in combination with Hansen's teachings (see Section XI.D (Combination Rationale)), satisfies this limitation.

e. 1.d

202. In my opinion, a POSITA would have understood that the combination discloses 1.d.1: "logic [1.a-1.c] for initiating and maintaining wireless network connections [infrastructure, ad-hoc, 802.11b/g, proprietary] with nodes [wireless devices] of a wireless network external to the network-enabled hub [GC-WD], maintaining at least a first wireless network connection using a first wireless network protocol [infrastructure and/or 802.11b] and a second wireless network connection using a second wireless network protocol [ad-hoc and/or 802.11g, or proprietary], that can be maintained, at times, simultaneously with each other in a common

wireless space [same time and common wireless space around the GC-WD].”

203. For example, regarding logic, Gurevich discloses its GC-WD includes a CPU executing software to “simultaneously” initiate and maintain communications on different networks. EX1010, Abstract, [0013] (“simultaneously”), [0016], [0018], [0028], [0032], [0036]- [0037], [0049], [0065] (a “generic client...[can] “simultaneously communicate with ... any other networks.”), [0070]. To that end, Gurevich further discloses the GC functionality is provided by software drivers and other software executing on the CPU with the GC-WD. *See* 1.a-1.c, *see also id.*, [0073]-[0074], [0077]-[0078]. Thus, a POSITA would have understood Gurevich as disclosing “logic for initiating and maintaining wireless network connections with nodes of a wireless network external to the network-enabled hub” which can be “maintained, at times, simultaneously.”

204. Regarding the various network connections that Gurevich’s GC-WD may simultaneously maintain, Gurevich discloses that the networks may be infrastructure, ad-hoc and WDS networks overlapping in a common wireless space around the GC-WD. EX1010, Figs. 4-5, 7A. Further, based on Gurevich’s disclosure that the GC-WD can be a laptop, PC or PDA, a POSITA would have understood that each of the wireless networks would necessarily operate in a common wireless space around that small device. *Id.*, Figs. 3, 13, [0075]. Gurevich discloses the GC-WD is in the common wireless space to be able to forward data to devices in only one space.

Id., [0051]-[0054].

205. This structure is identical, or at least equivalent to, wireless circuit 27, processing unit 28, and software platform 36 under the agreed construction of claim 1.d.1. Transceiver 34 (and optionally DSP 92) corresponds to wireless circuit 27. See 1.a. The CPU corresponds to processing unit 28. See 1.b-1.c. The combination discloses software that supports initiation and maintenance of simultaneous connections between different networks, including virtual MAC interfaces for co-existence and data forwarding, which corresponds to software platform 36. EX1012 (Vleugels I), [0070]-[0074] (a protocol stack that includes a MAC layer to support multiple protocols).

206. In my opinion, a POSITA would have understood that the combination discloses 1.d.2 “wherein the second wireless network protocol [802.11g, proprietary, ad-hoc] is an overlay protocol with respect to the first wireless protocol [802.11b, 802.11, infrastructure] in that communications using the second wireless network protocol are partially consistent with the first wireless network protocol.”

207. In particular, there are two exemplary permutations that disclose this limitation. First, the combination teaches 802.11g (infrastructure or ad-hoc), the second wireless protocol, which is an overlay protocol with respect to 802.11b, the first wireless protocol. Second, Gurevich teaches a proprietary network protocol that is partially consistent with versions of 802.11.

208. With respect to 802.11 networks, Gurevich teaches that its GC-WD can be used with “all current and future versions of IEEE 802.11” and incorporates all of 802.11 by reference which, as of Gurevich’s 2004 filing date, included each of 802.11-1999, 802.11b and 802.11g (collectively, 802.11/b/g). EX1010, [0076]. A POSITA would have therefore understood, for example, that the first network protocol may be 802.11b (infrastructure or ad-hoc) and that the second network protocol may be 802.11g (the other of infrastructure or ad-hoc). It is also my opinion that a POSITA would have understood that 802.11g is partially consistent with 802.11b because 802.11g reuses some, but not all, aspects of 802.11b as explained below. Gurevich teaches this partial consistency allows reuse of the same physical radio 34 for both connections. EX1010, [0032].

209. In the combination, 802.11/b/g teaches that 802.11g is an overlay protocol of 802.11b in that 802.11g is partially, but not entirely, consistent with 802.11b.

210. A first exemplary partial consistency is that the SERVICE field in 802.11g is only partially consistent with the SERVICE field in 802.11b. 802.11b provides a long PPDU to facilitate demodulation and delivery of the PSDU. EX1018, § 18.2.1. The long PPDU (defined in Section 18.2.2.1) contains a Long PLCP header having a “SERVICE field” that supports the High Rate extension of 802.11b. *Id.*, § 18.2.3.4. 802.11b defines the SERVICE field as follows:

Table 97—SERVICE field definitions

b0	b1	b2	b3	b4	b5	b6	b7
Reserved	Reserved	Locked clocks bit 0 = not 1 = locked	Mod. selection bit 0 = CCK 1 = PBCC	Reserved	Reserved	Reserved	Length extension bit

Id. 802.11g also uses the long preamble PPDU but defines its SERVICE field partially inconsistently as follows:

Table 123C—SERVICE field bit definitions

b0	b1	b2	b3	b4	b5	b6	b7
Reserved	Reserved	Locked Clock Bit 0 = not locked 1 = locked	Modulation Selection 0 = Not ERP-PBCC 1 = ERP-PBCC	Reserved	Length Extension Bit (ERP-PBCC)	Length Extension Bit (ERP-PBCC)	Length Extension Bit

EX1019, 19.3.2.1 (red annotations added to show the differences with 802.11b). A POSITA would have understood that 802.11g's specific SERVICE bit b3, b5, and/or b6 are modifications, individually or in combination, of 802.11b's respective SERVICE bits that allow 802.11g devices to signal additional ERP-PBCC options that are absent in 802.11b. EX1019 §§ 19.1.1, 19.3.2.1.

211. A second example is that the 802.11g PPDU is only partially consistent with an 802.11b PPDU. The 802.11b PPDU is defined as follows:

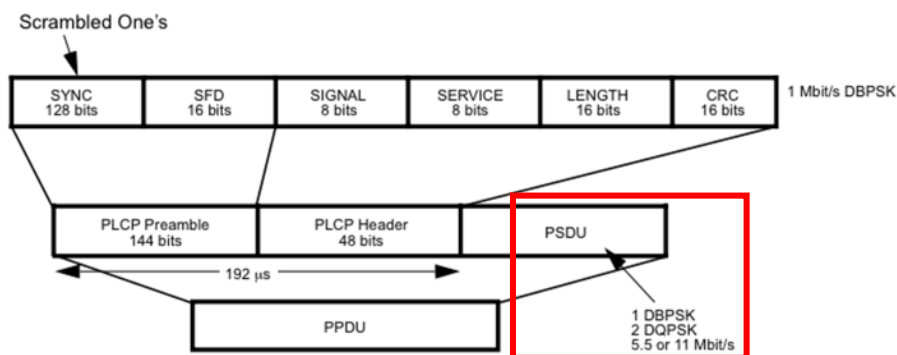


Figure 127—Long PLCP PDU format

EX1018 § 18.2.2.1 (802.11b with red annotation showing inconsistency). The DSSS-OFDM long preamble PDU format in 802.11g uses a DSSS modulated PLCP Preamble and PLCP Header (consistent with 802.11b) but uses an OFDM modulated PSDU payload (inconsistent with 802.11b). EX1019 §§ 19.1.2(d)(1), 19.3.2.4, 19.7.1.

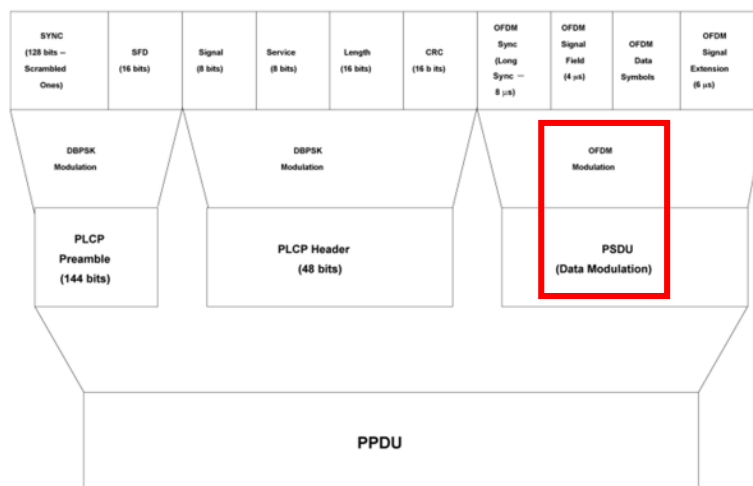


Figure 153A—Long preamble PDU format for DSSS-OFDM

EX1019 § 19.3.2.4.1 (red annotation showing 802.11g inconsistency).

212. As a third example, the 802.11g information element (“g-IE”) is only partially consistent with the 802.11b information element (“b-IE”). The b-IE is

defined as follows:

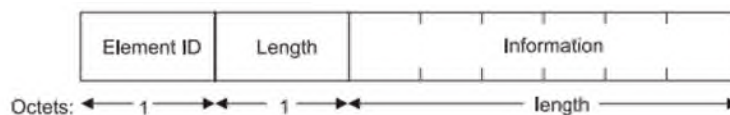
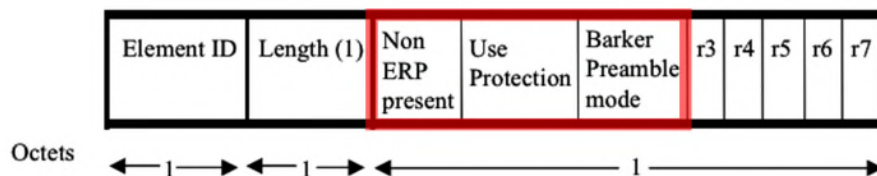


Figure 34—Element format

EX1018 § 7.3.2. The g-IE, however, is defined as follows:



213. EX1019 §7.3.2.13. The g-IE is modified from b-IE to include the “NonERP Present,” “Use Protection,” and “Barker Preamble mode” bits. In addition, the b-IE uses Element ID 3 (the Direct Spread Spectrum Parameter Set Information Element) whereas g-IE may use Element ID 42 (the ERP information element). See EX1017 §7.3.2 (Table 20); EX1019 §7.3.2.

214. The examples provide aspects of 802.11g that are only partially consistent with 802.11b. The common aspects reduce interference and enhance coexistence, for example, by allowing the 802.11b devices to understand the DSSS preamble so they know the network is busy and for how long, even though they cannot decode the OFDM payload. EX1019, 19.3.2.1(c)(3)) (bits in the SERVICE field utilizing 802.11b decoding schemes (Not ERP-PBCC)), 19.1.2(d)(1), 19. 3.2.4, 19.7.1 (DSSS-OFDM format), EX1019 § 9.10 (NonERP and Use Protection bits). This reduces interference and promotes coexistence between the network protocols

by enabling coordination between devices. For example, an 802.11b device that decodes the DSSS preamble will not attempt to transmit a packet during the 802.11g OFDM payload, even though the 802.11b device cannot decode the OFDM payload.

215. In the combination, Hansen also teaches the precise combination of 802.11b and 802.11g, and that 802.11g is a partially consistent overlay of 802.11b. EX1009, [0043]-[0046], [0064], [0071], Fig. 3. the claimed overlay protocol as the frame to be transmitted to a device compliant with one 802.11 protocol (i.e., 802.11g) comprises “set up portions” consistent with one or more aspect of a different 802.11 protocol (i.e., 802.11b preamble or header) and a data portion consistent with the receiving device’s protocol (i.e., 802.11g OFDM). *Id.* Thus, for example, a POSITA would have understood that Hansen teaches that communications with the 802.11g device having 802.11b set up portions and an 802.11g data portion facilitates coexistence with 802.11b devices while advantageously communicating with the 802.11g device at a higher data rate. *Id.*; *see also id.* [0051]-[0054], [0058]. In addition, Hansen teaches that the same hardware/software may be used to communicate with both 802.11b and 802.11g devices. *Id.*, [0042].

216. Finally, the intrinsic record discloses an embodiment wherein the networks are 802.11g and 802.11b. EX1012 (Vleugels I), [0119].

217. As the second example of a partially consistent overlay network,

Gurevich teaches the first network could be 802.11 and the second could be a “proprietary network ... that may ... *partially follow*” 802.11. EX1010, [0048] (emphasis added). The proprietary network may advantageously “include additional security or encryption operations that are not supported in 802.11.” *Id.* Thus, the proprietary network is partially, but not entirely, consistent with 802.11. The partial consistency allows reuse of the same physical radio 34 for both the 802.11 and proprietary connections as taught by Gurevich. Gurevich explains that normally maintaining two 802.11-type communications is impossible, but Gurevich makes it possible by using simultaneous virtual interfaces that use BSSIDs in a non-standard way to identify wireless sessions. *Id.*, [0011]-[0013]. In addition, because Gurevich explains that the proprietary network partially follows the 802.11 standard, it is my opinion that a POSITA would have also understood that the proprietary network may further implement the various techniques to reduce interference and enhance co-existence as taught by 802.11/b/g for the reasons set forth above. EX1019, §§ 19.1.2 (coexistence techniques between 802.11b and g), 19.3.2-19.3.2.1, 9.6, 9.10; EX1017, 9.3.

218. In my opinion, a POSITA would have understood that the combination discloses 1.d.3 “and at least some of the communications using the second wireless network protocol impinge on at least some antennae used for the first wireless network [signals use same antenna].” Gurevich teaches simultaneously

communicating with different devices which operate on the same frequency band (e.g., 802.11b/g) using the same physical interface. EX1010, [0032], [0037]-[0038], [0066]. Thus, the communications on each network will impinge on one or more antenna used for the other network. In the combination, a plurality of antenna elements would have been present and impinged on as taught by Hansen. EX1009, Fig. 2, [0036]-[0039], [0042] (“plurality of antennas”). Further, 802.11/b/g teaches multiple antennas may be supported. EX1019, § 19.8.3 (Tx and Rx antennas); *see also* EX1017 § 14.8.2. In view of the above, and based on my knowledge and experience, a POSITA would have understood that multiple antennae are often illustrated as a single antenna in block diagrams, as is the case in other figures in Hansen.

219. Accordingly, a POSITA would have understood that Gurevich alone, or in combination with the teachings of 802.11/b/g and/or Hansen, satisfies limitation 1.d under any construction. *See* Section XI.D.2 (Combination Rationale).

f. 1.e

220. In my opinion, a POSITA would have understood that the combination discloses limitation 1.e “data forwarding logic, implemented in the network-enabled hub using hardware and/or software [GC-WD], that forwards data between an originating node and a destination node, wherein the originating node is a node in one of the first and second wireless networks and the destination node is a node in

the other of the first and second wireless network.”

221. As I previously discussed, Gurevich discloses forwarding data between, for example, an originating node in a first network and a destination node in a second network. EX1010, Fig. 3, [0048]-[0049], [0051]-[0054] (range extension), [0063]-[0067]. Gurevich teaches the CPU executes layer 3 IP routing between devices on the multiple networks. *Id.*, Fig. 3, [0037], [0056]-[0058], [0062]-[0070] (IP address of the nodes).

222. Additionally, Gurevich teaches that layer 2 forwarding can be used alone or in combination with layer 3. *Id.*, [0057]-[0058]; *see id.*, [0009], [0044]-[0053], [0056]. It would have been obvious to a POSITA to apply the techniques from 802.11/b/g as expressly incorporated in Gurevich for any layer 2 forwarding. *See* Section XI.D.2 (Combination Rationale).

2. Claim 4

223. In addition to my opinions above in claim 1, and for the same reasons set forth limitation 1.d, it is also my opinion that a POSITA would have understood that the combination discloses “wherein the first wireless network protocol is an 802.11x wireless protocol [802.11b or 802.11] and the second wireless network protocol is a modification of the 802.11x wireless protocol [802.11g or proprietary, respectively] that is not entirely compliant with the 802.11x wireless protocol of the first wireless network but can be maintained in a common wireless space as the

802.11x wireless protocol.” *See supra* 1.d.

224. In my opinion, a POSITA would have understood that 802.11g is a modification of 802.11b at least for the reasons explained above with respect to claim 1.d. *See also, e.g.*, EX1019 § 19.3.2.1 (explaining how bit fields of the 802.11b long PPDU frame are modified for the higher data rate-capable 802.11g long PPDU frame). This understanding is further supported by contemporaneous prior art, such as U.S. Patent No. 7,340,015 (EX1023), filed on August 18, 2003, which expressly states that “[t]he 802.11g standard is a modification of the previous 802.11b standard that allows for additional, higher data rates.” EX1023, 4:10-12.

225. In addition, Gurevich explicitly teaches the proprietary protocol is a modification of 802.11. EX1010, [0048].

XII. CONCLUSION

226. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further 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 1101 of Title 18 of the United States Code.



Dr. Zhi Ding
Dated: July 5, 2023.

APPENDIX A

Expert/Consultant Curriculum Vitae

Professor Zhi Ding

Ph.D. and Fellow of IEEE

Expertise

- | | |
|--------------------------------------|--------------------------|
| ▪ Wireless Communication Systems | ▪ WLAN (WiFi, Bluetooth) |
| ▪ Cellular Wireless (2G, 3G, 4G, 5G) | ▪ xDSL Internet Services |
| ▪ Communication Network Protocols | ▪ DOCSIS Modems |
| ▪ Multi-Antenna Technologies | ▪ Optical Networks |
-

Professional Summary

- Professor of major US universities for over 32 years.
- *Consulted for multiple major technology companies*
- Worked as expert on multiple patent infringement cases.
- Conducted research works on Communications and Signal Processing for over 30 years.
- Supervised over 30 PhD students.
- Author of more than 200 journal papers and 2 books on communication technologies.

Dr. Zhi Ding has been a professor of electrical engineering at major US universities for 32 years. Since 1995, he has consulted for both engineering companies such as Nortel, Analog Devices, Intel, and worked as expert for major law firms from US, UK, China, and Canada including Kirkland & Ellis, WilmerHale, Quinn Emanuel, Fish & Richardson, Sheppard Mullin, Sidley Austin, Mayer Brown, Venable, and Finnegan, on multiple technical and patent infringement cases. He has been conducting research works on wireless communications and signal processing since 1984. He has supervised over 30 PhD students. He is an author of 200 journal papers and 2 technical books on communication technologies. He has taught classes that cover the fundamentals of signal detection, communications, and systems.

Dr. Ding currently holds the position of Distinguished Professor at the University of California, where he was also the Child Family Professor of Engineering and Entrepreneurship in 2009-2014. He served as the steering committee chair of the IEEE Transactions on Wireless Communications. He was elevated to Fellow of IEEE in 2002 by the IEEE Signal Processing Society. He also served as the Technical Program Chair of the IEEE Globecom 2006 (the flagship conference of the IEEE Communications Society), Dr. Ding is an eminent scholar and expert of wireless technologies AND signal processing. He received the IEEE Communications Society's 2012 TC Recognition Award and the 2020 Education Award.

Expert/Consultant Curriculum Vitae

Intellectual Property Dispute Consulting:

Past Client	Past Engagement
Kirkland & Ellis LLP	2007 (Intel v. WiLAN)
	2008 (Cisco, Motorola, etc., v. R.),
	2008 (Apple v. N.)
	2009 (Cisco v. WiAV)
	2009 (Apple v. P.)
	2009 (Cisco v. M.)
	2010 (Netgear v. R.)
	2011 (Intel v. E.)
	2011 (Cisco v. M.)
	2011 (Cisco, Motorola v. I.)
	2011 (Netgear v. E.)
	2013 (Alcatel Lucent matter)
	2015 (Intel “project Impala”)
	2020 (Xiaomi global)
	2021 (Samsung v. E.)
Wilmer Cutler Pickering Hale, & Dorr, LLP	2009 (Apple v. N.)
	2011 (Apple v. S.)
	2013 (Apple v. A.)
	2015 (Apple v. E.)
	2018 (Unified matter)
	2019 (Apple v. O.)
Fish and Richardson, LLP	2014 (Marvell v. I.)
	2018 (NEC v. X.)
	2020 (DISH v. T.)
	2020 (Huawei SEP)
	2020 (Samsung v. E.)
	2021 (LG Electronics, Dell v. N.)
	2021 (Quectel v. P.)
	2021 (Apple v. E.)
	2022 (Apple v. S.)
	2022 (Fish v. C.)
Kaye Scholer LLP	2012 (Timer Warner+Ceres+Atlanta Broadband Finance v. K.)
Bridges and Mavrakakis, LLP	2011(Apple matter)
	2014 (Apple v. C.)
	2015 (Marvell “IP evaluation matter”)
Sterne, Kessler, Goldstein & Fox, LLC	2014 (Marvell, MediaTek v. B.)
	2019 (Volkswagen v. C.)
	2020 (Apple v. S.)
Bramson, Plutzik, Mahler & Birkhaeuser	2013 (Karim v. H.)

Expert/Consultant Curriculum Vitae

Gibson, Dunn & Crutcher, LLP	2014 (AT&T v. I)
Quinn Emanuel	2014 (Canon v. I.)
Norton Rose Fulbright US LLP	2015 (<i>Qualcomm v. B.</i>)
	2018 (<i>Qualcomm v. A.</i>)
	2021 (<i>NXP v. Me.</i>)
	2023 (<i>NXP v. MI.</i>)
Sheppard, Mullin, Richter, and Hampton, LLP	2015 (<i>TLC v. E.</i>)
	2017 (<i>ZTE v. H.</i>)
	2018 (<i>HTC v. I.</i>)
	2019 (<i>Motorola v. U.</i>)
	2019 (<i>U-Blox AG v. I.</i>)
	2019 (<i>Continental v. A.</i>)
	2019 (<i>Toyota matter</i>)
	2020 (<i>Opportunity v. S.</i>)
Duane Morris	2021 (<i>HTC v. S.</i>)
	2015 (<i>Comcast, Cox, Time Warner, Verizon v. T.</i>)
Rothwell, Figg, Ernest, & Manbeck, P.C.	2016 (<i>LG Electronics v. O.</i>)
Mayer Brown LLP	2016 (<i>LG Electronics v. N.</i>)
Sidley Austin, LLP	2016 (<i>Huawei v. S.</i>)
	2018 (<i>Huawei v. O.</i>)
Irell & Manella, LLP	2016 (<i>Juniper v. M.</i>)
	2021 (<i>NXP v. M.</i>)
Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.	2017 (<i>LGE v. BLU</i>)
	2017 (<i>Sol IP</i>)
Arnold, Porter, Kaye, and Scholer	2017 (<i>Charter v. S.</i>)
	2021 (<i>Samsung v. X.</i>)
Venable, LLP	2017 (<i>Verizon v. S.</i>)
Pillsbury LLP	2017 (<i>ZTE v. H.</i>)
Alston, Bird, LLP	2018 (<i>ASUSTeK v. H.</i>)
Gibson, Dunn & Crutcher, LLP	2019 (<i>AT&T v. S.</i>)
Jincheng Tongda & Neal (China)	2018 (<i>TCL matter</i>)
Desmaris, LLP	2019 (<i>Cisco matter</i>)
Allen & Overy, LLP, UK	2019 (<i>Huawei v. C.</i>)
Gowling WLG, Canada	2019 (IP matter)
Erise IP	2019 (Apple v. I.)
	2022 (Apple v. L.)
Questel (China)	2020 (ZTE matter)
Xiaomi (China)	2020 (Siemens)
Munger Tolles & Olson, LLP (Tesla)	2021 (Tesla v. O.)
Orrick, Herrington, & Sutcliffe, LLP	2021 (Canon v. W.)
OPPO	2020 (OPPO matters)
	2021 (OPPO matters)
Saikrishna & Associates (India)	2019 (Xiaomi v. E.)
	2021 (Firm matter)

Expert/Consultant Curriculum Vitae

	2022 (vivo v. N.)
Continental	2022 (Continental v. N.)
K&L Gates	2022 (Entropic matter)
Kelley Dryer	2022 (Keep Truckin v. F.)
Collision Communications	2022 (Collision matter)
Haynes Boone	2022 (Apple v. T.)
Vivo	2022 (vivo litigation matters)
Quinsumbing Torres (Philippines)	2022 (vivo v. N.)
Biro Oktroi Roosseno (Indonesia)	2022 (vivo v. N.)
Paul Hastings	2022 (Samsung v. G.)
Unified Patent Inc.	2022 (Unified matter)

Expert Testifying and Depositions (13 Trials and 18 Depositions)

Clients	Deposition/Testifying Experience
Bramson, Plutzik, Mahler & Birkhaeuser LLP	2013: Deposition on Case No. CV 12-05240 PJH Nad Karim v. Hewlett Packard, Co. UNITED STATES NORTHERN DISTRICT COURT OF CALIFORNIA. Settlement ordered Jan. 18, 2017.
Fish and Richardson	2015 (Feb): Deposition for Marvell. US PTAB <i>Inter Partes</i> Review IPR2014-00548 Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC
	2015 (August): Deposition for Marvell. US PTAB <i>Inter Partes</i> Review IPR2014-00548 Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC
Norton, Rose, Fulbright, US, LLP	2016 (April): Deposition for Qualcomm. US PTAB <i>Inter Partes</i> Review cases IPR2015-10577, IPR2015-10580, IPR2015-10581 <i>Qualcomm Inc. v Bandspeed Inc.</i>
Sheppard, Mullin, Richter, and Hampton, LLP	2016 (May): Deposition for in <i>TCL Communication Technology Holdings, LTD., et al. v. Ericsson, et al., Case No. 8:14-cv-341 (C.D. CA).</i>
	2017 (Feb): Testified at C.D. California bench trial.
Sidley Austin, LLP	2016 (December): Testified at trial involving <i>Huawei Technologies, Co. Ltd v. Samsung</i> regarding FRAND licensing disputes in Shenzhen Court, P.R. China.
	2018 (June): Deposition for N.D. CA on IP matter concerning <i>Huawei Technologies, Co. Ltd v. Samsung.</i>
	2018 (December): Testified at trial involving <i>Huawei Technologies, Co. Ltd v. Samsung</i> regarding FRAND licensing disputes in Beijing Court of Intellectual Properties, P.R. China.
Mayer Brown LLP	2017 (January): Testified during tribunal proceeding for <i>LG Electronics, Inc. in standard essential patent (SEP) licensing dispute of Nokia Technologies, Ltd. v. LG Electronics, Inc.</i> During arbitration hearing in Paris, France.

Expert/Consultant Curriculum Vitae

Venable LLP	2017 (October): Deposition as expert witness for Verizon Services Corp. in Case No. 2:16-CV-588-WCB (E. D. TX) on US Patent disputes.
Pillsbury LLP	2018 (Feb): Deposition (E. D. Texas Case No. 5:16-cv-00179-RWS) 2018 (June): Testified at E. D. Texas (Texarkana) jury trial (Case No. 5:16-cv-00179-RWS).
Allen & Overy LLP UK	2019 (April) Testified at trial involving <i>Huawei Technologies, Co. Ltd v. Conversant</i> regarding FRAND licensing disputes in Nanjing Intermediate Court, P.R. China.
Sidley Austin LLP, US	2019 (Sept.) Testified at trial involving <i>Huawei Technologies, Co. Ltd v. PanOptics</i> , regarding FRAND licensing disputes in Shenzhen Intermediate Court, P.R. China.
Sheppard, Mullin, Richter, and Hampton, LLP	2019 (Dec. 3rd): Deposition for HTC and Apple in <i>HTC Corporation, HTC America, Inc., and Apple Inc. v. INVT SPE LLC</i> , Case Nos. IPR2018-01555 and IPR2018-01581.
Sterne, Kessler, Goldstein & Fox, LLC	2020 (Feb.): Deposition for Volkswagen Group of America, In. v. Carucel Investments, L.P. Case Nos. IPR2019-01573 and IPR2019-01101.
Jincheng Tongda & Neal, LLP	2021 (June) Testified at trial involving <i>TCL. v. Ericsoon</i> , regarding FRAND licensing disputes in Shenzhen Intermediate Court, P.R. China.
Orrick, Herrington, & Sutcliffe, LLP	2021 (October): Deposition for Canon, Inc, in <i>Canon, v. WSOU Investments, LLC d/b/a/ Brazos Licensing</i> , W.D. Texas, Case No. 6:20-cv-980.
Fish & Richardson, P.C.	2021 (November) 1 st Deposition for Petitioner IPR 2021-00560 in <i>Quectel v. Koninklijke Philips N.V.</i> 2021 (December) 1 st Deposition for Petitioner on IPR 2021-00563 Proceeding in <i>Quectel v. Koninklijke Philips N.V.</i> 2022 (March 31) 2 nd Deposition for for Petitioner IPR 2021-00560 in <i>Quectel v. Koninklijke Philips N.V.</i> (028) (-) 2022 (April 1) 2 nd Deposition for Petitioner on IPR 2021-00563 Proceeding in <i>Quectel v. Koninklijke Philips N.V.</i> (+) 2022 (Oct. 28) Deposition for Petitioner on IPR 2022-00339 in <i>Apple v. Ericsson</i> .
Jauar Jahja and Partners (Indonesia)	2022 (April 25) Testified at trial involving <i>OPPO v. Nokia</i> regarding one patent disputes at Court in Jakarta, Indonesia. Successful denial of temporary injunction. 2022 (April 26) Testified at trial involving <i>OPPO v. Nokia</i> regarding another patent dispute at Court in Jakarta, Indonesia. Successful denial of temporary injunction.
Quinsambling & Torres (Philippines)	2022 (September) Testified on site at trial involving <i>vivo v. Nokia</i> regarding patent disputes in Regional Trial Court in Manila, the Philippines. Successful denial of temporary injunction.

Expert/Consultant Curriculum Vitae

Orrick, Herrington, & Sutcliffe, LLP	2021 (Oct. 12) Deposition Western D. of Texas cas: 6:20-cv-00980-ADA (Canon)
Arnold, Porter, Kaye, and Scholer	2022 (Dec. 30) Deposition on IPR 2022-00613 Proceeding (Samsung)
Biro Oktroi Roosseno (Indonesia)	2023 (Jan. 4) Testified online at trial involving vivo v. Nokia regarding patent disputes at Court in Jakarta, Indonesia. Successful denial of temporary injunction. 2023 (Feb. 1) Testified on site at trial involving vivo v. Nokia regarding patent disputes at Court in Jakarta, Indonesia. Successful denial of temporary injunction.

Recent IPR Declarations	32 Expert Opinions
	IPR2014-00548 Expert Declaration to the Patent Trial and Appeal Board, Instituted (2014-12-03), with link to Final PTAB Decision, canceling all but 2 claims (2015-11-30). IPR2015-00314 Expert Declaration to the Patent Trial and Appeal Board, Instituted, with link to Final PTAB Decision finding 10 claims (all but 3 claims) unpatentable (2016-09-07). IPR2015-00315 Expert Declaration and Supplemental Expert Declaration to the Patent Trial and Appeal Board, Instituted (2015-11-16), link to final PTAB Trial Decision. Unpatentable (2016-09-07). IPR2015-01580 Expert Declaration to the Patent Trial and Appeal Board, Instituted (2015-11-16), with link to final PTAB Trial Decision. Unpatentable (2016-09-07). IPR2015-00531 Expert Declaration to the Patent Trial and Appeal Board, Instituted (2015-6-11), link to Final PTAB decision finding all but 3 dependent claims unpatentable (2017-08-23). IPR2015-01582 Expert Declaration to the Patent Trial and Appeal Board, Instituted (2015-11-16), link to PTAB Decision on Institution of IPR and Grant of Motion for Joinder with ITR2015-00531. IPR2016-00620 Expert Declaration to the Patent Trial and Appeal Board, Instituted (2016-08-24), link to Final PTAB decision finding all but 2 dependent claims invalid (2017-08-23).

Expert/Consultant Curriculum Vitae

	<u>IPR2016-00623 Expert Declaration</u> to the Patent Trial and Appeal Board, Instituted (2016-08-24), with link to <u>PTAB decision</u> (2017-08-23). <u>IPR2018-01555</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-03-07); Decision (2020-2-28) <u>IPR2018-01581</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-04-01); Decision (2020-2-28) <u>IPR2019-01573</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2020-01-22); Final Decision: Unpatentable (2020-11-20) <u>IPR2019-01105</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-12-02); Final Decision: Unpatentable (2020-11-20) <u>IPR2019-01101</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-12-02); Final Decision: Unpatentable (2020-11-20) <u>IPR2021-00560</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2021-09-13); Final Decision: (2022-09-09) <u>IPR2021-00563</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2021-09-15); Final Decision: Unpatentable (2022-9-13) <u>IPR2021-00587</u> Expert Declaration to the Patent Trial and Appeal Board. Filed (2021-02-26); Withdrawn. <u>IPR2021-00683</u> Expert Declaration to the Patent Trial and Appeal Board. Filed (2021-03-19); Withdrawn. <u>IPR2021-01468</u> Expert Declaration to the Patent Trial and Appeal Board. Filed (2021-09-01). <u>IPR2022-00339</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2022-08-22); Settlement (2022-12-20). <u>IPR2022-00348</u> Expert Declaration to the Patent Trial and Appeal Board, Filed (2022-02-15).
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Expert/Consultant Curriculum Vitae

	<u>IPR2022-00349</u> Expert Declaration to the Patent Trial and Appeal Board, Filed (2022-02-15), Settled. <u>IPR2022-00616</u> Expert Declaration to the Patent Trial and Appeal Board, Filed (2022-02-18), Withdrawn. <u>IPR2022-00619</u> Expert Declaration to the Patent Trial and Appeal Board, Filed (2022-02-25), <u>IPR2022-00613</u> Expert Declaration to the Patent Trial and Appeal Board. Instituted (2022-10-20) <u>IPR2022-01512</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board. Filed (2022-09-09) <u>IPR2022-01598</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board. Filed (2022-10-04) <u>IPR2023-00151</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board. Filed (2022-11-30) <u>IPR2023-00171</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board. Filed (2022-11-08) <u>IPR2023-00441</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board. Filed (2023-01-05) <u>IPR2023-00496</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board, Filed (2023-01-20). <u>IPR2023-00644</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board, Filed (2023-03-07). <u>IPR2023-00720</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board, Filed (2023-03-16). <u>IPR2023-00721</u> <u>Expert Declaration</u> to the Patent Trial and Appeal Board, , Filed (2023-03-16).
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Employment History

From: 2000 **University of California at Davis**
To: Present Davis, CA
Position: *Professor (2000-2020) and Distinguished Professor (2020-), Department of Electrical and Computer Engineering*

Expert/Consultant Curriculum Vitae

From: 01/1999 **University of Iowa**
To: 09/2000 Iowa City, IA
Position: *Assoc. Professor, Department of Electrical and Computer Engineering*

From: 01/1997 **Hong Kong University of Science and Technology**
To: 12/1997 Hong Kong
Position: *Visiting Associate Professor, Department of Electrical and Electronic Engineering*

From: 09/1995 **Auburn University**
To: 12/1998 Auburn, AL
Position: *09/1995-12/1998: Associate Professor, Department of Electrical and Computer Engineering*
09/1990-08/1995: Assistant Professor, Department of Electrical and Computer Engineering

From: 08/1993 **Australian National University**
To: 09/1993 Canberra, Australia
Position: *Visiting Research Fellow, Faculty of Information Technology and Engineering*

From: 06/1993 **US Air Force Wright Laboratory**
To: 08/1993 Eglin AFB, Florida
Position: *Faculty Research Associate, Armament Directorate*

From: 06/1992 **NASA Lewis Research Center**
To: 08/1992 Cleveland, OH
Position: *Visiting Faculty Research Fellow*

From: 08/1987 **Cornell University**
To: 08/1990 Ithaca, NY
Position: *Research Assistant*

From: 09/1984 **University of Toronto**
To: 08/1987 Toronto, Ontario, Canada
Position: *Research Assistant*

Technical Consulting

Professor Zhi Ding, Ph.D.

Printed: 03/21/23

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Expert/Consultant Curriculum Vitae

Consulted for multiple major technology companies, aside from IP litigation related matters.

Patents (Granted and/or Licensed)

<u>Patent Number</u>	<u>Date Issued</u>	<u>Title</u>
US 6,396,885	Mar.28, 2002	Co-channel interference reduction in wireless communications systems (Nortel)
US 6,463,099	Oct.8, 2002	Blind channel equalizers and methods of blind channel equalization (Licensed)
US 7,379,513	Mar. 20, 2008	Channel estimation in CDMA communications systems using both lower power pilot channel and higher power data channel
US 10,623,230	Apr. 14, 2020	Trans-layer robust header-compression technique

Education

1990	Cornell University, Ithaca, NY	Ph.D., Electrical Engineering
1987	University of Toronto, Toronto, Canada	MS, Electrical Engineering
1982	Nanjing Institute of Technology, Nanjing, China	BS, Wireless Engineering

Publications

Books & Book Chapters

- [1] B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, 5th edition, Oxford University Press, 2018.
- [2] Zhi Ding and Ye Li, *Blind Equalization and Identification*, Marcel Dekker, New York, 2001.
- [3] Z. Ding, "Chapter 7: Linear Predictive Algorithms for Blind Multichannel Identification," in *Signal Processing Advances in Wireless and Mobile Communications*, Vol. I: Trends in Channel Estimation and Equalization, G. B. Giannakis, Y. Hua, P. Stoica, and L. Tong (Editors), Prentice Hall, 2000.
- [4] Z. Ding, "Blind Channel Identification and Equalization using Spectral Correlation Measurements: Frequency Domain Analysis," in *Cyclostationarity in Communications and Signal Processing*, William A. Gardner, Ed., pp.417-436, IEEE Press, 1993.
- [5] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, "Chapter 3: Global Convergence Issues with Linear Blind Adaptive Equalizers," in *Blind Deconvolution*, Simon Haykin, Ed., pp.60-120, Prentice-Hall, 1994.
- [6] Z. Ding, "Adaptive Filters for Blind Equalization," in *IEEE DSP Handbook*, Douglas B. Williams, Ed., pp.24.1-24.17, IEEE Press, 1998.

Expert/Consultant Curriculum Vitae

Journal Papers

- [1] M. Del Rosario and Z. Ding, "[Learning-Based MIMO Channel Estimation under Practical Pilot Sparsity and Feedback Compression](#)," in IEEE Transactions on Wireless Communications, 2022, doi: 10.1109/TWC.2022.3202750.
- [2] C. Sun, X. Gao and Z. Ding, "[Optimization of Workload Balancing and Power Allocation for Wireless Distributed Computing](#)," in IEEE Transactions on Wireless Communications, vol. 21, no. 9, pp. 7682-7695, Sept. 2022, doi: 10.1109/TWC.2022.3160493.
- [3] C. -H. Hsu, C. Feres and Z. Ding, "[Wirtinger Flow for Nonconvex Blind Demixing with Optimal Step Size](#)," in IEEE Wireless Communications Letters, 2022, doi: 10.1109/LWC.2022.3203313.
- [4] Zhang, S., Deng, Q. & Ding, Z., "[Multilayer graph spectral analysis for hyperspectral images](#)," EURASIP Journal of Adv. Signal Process, 2022, 92 (2022). doi: <https://doi.org/10.1186/s13634-022-00926-8>;
- [5] C. Feres and Z. Ding, "[An Unsupervised Learning Paradigm for User Scheduling in Large Scale Multi-Antenna Systems](#)," in IEEE Transactions on Wireless Communications, 2022, doi: 10.1109/TWC.2022.3215471.
- [6] L. D. Chamain, S. Qi, and Z. Ding, "[End-to-End Image Classification and COMpression with variational autoencoder](#)" IEEE Internet of Things Journal, vol. 70, 2022, doi: 10.1109/JIOT.2022.3182313.
- [7] C. Feres and Z. Ding, "[A Riemannian Geometric Approach to Blind Signal Recovery for Grant-Free Radio Network Access](#)," IEEE Transactions on Signal Processing, vol. 70, pp. 1734-1748, 2022, doi: 10.1109/TSP.2022.3159988.
- [8] Q. Deng, S. Zhang and Z. Ding, "[An Efficient Hypergraph Approach to Robust Point Cloud Resampling](#)," IEEE Transactions on Image Processing, vol. 31, pp. 1924-1937, 2022, doi: 10.1109/TIP.2022.3149225.
- [9] X. Ling, B. Zhang, H. Xie, J. Wang, Z. Ding, [Hash Access in Blockchain Radio Access Networks: Characterization and Optimization](#) IEEE Internet of Things Journal, 9(11): 8053-8066, 1 June 2022 doi: 10.1109/JIOT.2021.3111915.
- [10] Qi, S.; He, M.; Bai, Z.; Ding, Z.; Sandhu, P.; Zhou, Y.; Namadi, P.; Tom, B.; Hoang, R.; Anderson, J. "[Multi-Location Emulation of a Process-Based Salinity MModel Using Machine Learning](#)," Water , 14(13):2030, 2022, doi: 10.3390/w14132030.
- [11] C. Wang, A. -A. Lu, X. Gao and Z. Ding, "[Robust Precoding for 3D Massive MIMO Configuration With Matrix Manifold Optimization](#)," IEEE Transactions on Wireless Communications, vol. 21, no. 5, pp. 3423-3437, May 2022, doi: 10.1109/TWC.2021.3121734.
- [12] Z. Liu, M. Del Rosario, and Z. Ding, "[A Markovian Model-Driven Deep Learning Framework for Massive MIMO CSI Feedback](#)," in IEEE Transactions on Wireless Communications, vol. 21, no. 2, pp. 1214-1228, Feb. 2022, doi: 10.1109/TWC.2021.3103120.

Expert/Consultant Curriculum Vitae

- [13] L. Teng, G. Zhai, Y. Wu, X. Min, W. Zhang, Z. Ding, and C Xiao, "[QoE Driven VR 360° Video Massive MIMO Transmission](#)," IEEE Transactions on Wireless Communications, vol. 21, no. 1, pp. 18-33, Jan. 2022, doi: 10.1109/TWC.2021.3093305.
- [14] Q. Deng, S. Zhang and Z. Ding, "[Point Cloud Resampling via Hypergraph Signal Processing](#)," IEEE Signal Processing Letters, vol. 28, pp. 2117-2121, 2021, doi: 10.1109/LSP.2021.3119257.
- [15] X. Ling, P. Chen, J. Wang and Z. Ding, "[Data Broker: Dynamic Multi-Hop Routing Protocol in Blockchain Radio Access Network](#)," in IEEE Communications Letters, vol. 25, no. 12, pp. 4000-4004, Dec. 2021, doi: 10.1109/LCOMM.2021.3114218.
- [16] Qi, Siyu, Zhaojun Bai, Zhi Ding, Nimal Jayasundara, Minxue He, Prabhjot Sandhu, Sanjaya Seneviratne, and Tariq Kadir, "[Enhanced Artificial Neural Networks for Salinity Estimation and Forecasting in the Sacramento-San Joaquin Delta of California](#)," Journal of Water Resources Planning and Management 147, no. 10 (2021): 04021069.
- [17] Y. -C. Lin, Z. Liu, T. -S. Lee and Z. Ding, "Deep Learning Phase Compression for MIMO CSI Feedback by Exploiting FDD Channel Reciprocity," in IEEE Wireless Communications Letters, vol. 10, no. 10, pp. 2200-2204, Oct. 2021, doi: 10.1109/LWC.2021.3096808.
- [18] C. J. Feres and Z. Ding, "[Wirtinger Flow Meets Constant Modulus Algorithm: Revisiting Signal Recovery for Grant-Free Access](#)," in IEEE Transactions on Signal Processing, vol 69, pp. 6515-6529, Aug. 2021. doi: 10.1109/TSP.2021.3103038.
- [19] Q. Hu, Y. Liu, Y. Cai, G. Yu and Z. Ding, "[Joint Deep Reinforcement Learning and Unfolding: Beam Selection and Precoding for mmWave Multiuser MIMO With Lens Arrays](#)," in IEEE Journal on Selected Areas in Communications, vol. 39, no. 8, pp. 2289-2304, Aug. 2021, doi: 10.1109/JSAC.2021.3087233.
- [20] C. Sun, J. Wang, X. Gao, Z. Ding and X. Zheng, "[Fiber-Enabled Optical Wireless Communications With Full Beam Coverage](#)," in IEEE Transactions on Communications, vol. 69, no. 5, pp. 3207-3221, May 2021, doi: 10.1109/TCOMM.2021.3059458.
- [21] Y. Ge, Q. Deng, P.C. Ching, Z. Ding "[OTFS Signaling for Uplink NOMA of Heterogeneous Mobility Users](#)," in IEEE Transactions on Communications, 2021, doi: 10.1109/TCOMM.2021.3059456.
- [22] Y. Ge, Q. Deng, P.C. Ching, Z. Ding "[Receiver design for OTFS with fractionally spaced sampling approach](#)," in IEEE Transactions on Wireless Communications, 2021, doi: 10.1109/TWC.2021.3055585.
- [23] S. Zhang, S. Cui and Z. Ding, "[Hypergraph Spectral Analysis and Processing in 3D Point Cloud](#)," in IEEE Transactions on Image Processing, vol. 30, pp. 1193-1206, 2021, doi: 10.1109/TIP.2020.3042088.
- [24] S. Zhang, S. Cui and Z. Ding, "[Hypergraph Spectral Clustering for Point Cloud Segmentation](#)," in IEEE Signal Processing Letters, vol. 27, pp. 1655-1659, 2020, doi: 10.1109/LSP.2020.3023587.

Expert/Consultant Curriculum Vitae

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Professional Services and Achievements

- Steering Committee Chairman, *IEEE Transactions on Wireless Communications*, 1.2008-1-2010
- Canadian National Science and Engineering Research Council Panelist, 2009-2012
- Fellow of IEEE
- Steering Committee Member, *IEEE Transactions on Wireless Communications*, 1.2006-1-2008
- General Chair, IEEE 2016 International Conference on Acoustics, Speech, and Signal Processing, Shanghai, China.
- Technical Program Chair, *IEEE 2006 Globecom*, San Francisco, CA.
- Editorial Board Member, *IEEE Signal Processing Magazine*, 1/2003-1/2007.
- Associate Editor, *IEEE Signal Processing Letters*, 1.2002-1.2005.
- Associate Editor, *IEEE Transactions on Signal Processing*, 1.2001-1.2004.
- Editor, Special Issue on Multiuser Detection and Blind Estimation, *EURASIP Journal on Applied Signal Processing*, Dec. 2002.
- Member, IEEE Statistical Signal and Array Processing Technical Committee, 1993-1998.
- Member, IEEE Signal Processing for Communications Technical Committee, 1998-2004.
- Associate Editor, *IEEE Transactions on Signal Processing*, 1994-1997.
- Technical Program Committee Member, 3rd IEEE Workshop on Signal Processing Advances in Wireless Communications, Taiwan, March 2001.
- Organization Committee Member, 1st IEEE Workshop on Signal Processing Advances in Wireless Communications, Paris, France, April 1997.
- Review Panelist, National Science Foundation, 1997, 2003, 2004, 2005, 2007, 2008, 2010, 2014, 2015, 2016.

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