

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Charter Communications, Inc.,
Petitioner

v.

Adaptive Spectrum and Signal Alignment, Inc.,
Patent Owner

Case No. IPR2025-00013

U.S. Patent No. 11,770,313 B2

Filing Date: November 23, 2020

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Title: METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A
COMMUNICATION UNIT BY A REMOTE SERVER

DECLARATION OF DR. JAMES MARTIN

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I, James Martin, declare as follows:

1. My name is James Martin. I am an independent consultant and a Professor of Computer Science at Clemson University in Clemson, South Carolina.

2. I have prepared this declaration (“Declaration”) as an expert witness retained by Charter Communications, Inc. In this report I give my opinion as to the validity of the claims of U.S. Patent No. 11,770,313 (the “’313 Patent”).

3. This Declaration contains statements of my opinions formed as of the present date and the reasoning for those opinions. As this case progresses, I may offer additional opinions based on my review of materials, opinions, and/or testimony of other expert witnesses. I make this Declaration based upon my personal knowledge and, if called upon to testify, I would competently testify thereto.

I. BACKGROUND AND QUALIFICATIONS

A. Relevant Experience and Qualifications

4. Below, I have summarized my educational background, career history, publications, and other relevant qualifications. My full curriculum vitae is attached as **Appendix A** to this Declaration.

5. I divide my background summary into two parts. The first part summarizes my education and relevant work experiences prior to August 2002 when I left the corporate world and entered the academic world. The second part

summarizes the academic research and consulting engagements which are relevant for this Declaration. Please refer to my CV for further details. I point out that I contributed to the DOCSIS CableLabs standards as well as to the IEEE 802.16 WiMAX standards.

6. I received a B.S. degree in Electrical Engineering from the University of Illinois (Champaign/Urbana) in 1983. My focus was wireless communications. I received an MS in Computer Science from Arizona State University (Tempe, AZ) in 1989. I received a Ph.D. from North Carolina State University (Raleigh, NC) in Electrical Engineering in 1999. My dissertation research involved TCP congestion control. I invented the TCP variant referred to as delay-based TCP congestion control. Aspects of this work, along with aspects of my academic research discussed below, have been foundational to the Cable Industry's relatively recent adoption of delay-based Active Queue Management (AQM) methods such as CoDel and PIE.

7. My industry employment includes 6 years at Motorola, 2 years at a startup (FileNet), 10 years at IBM, and 2 years at Gartner. At Motorola, I worked on chip set design and embedded system design for military satellite communications (the DAMA program to be specific). At IBM, I worked on R&D topics related to Systems Network Architecture (SNA) networking system. While

at IBM, my work generated 3 patents in the 2001-2005 timeframe. At Gartner, I was a telecommunications consultant based out of Raleigh NC. I was also an Adjunct Faculty at NCSU. During this time period, I developed a simulation model of the DOCSIS 1.1 protocols.

8. In August of 2002, I joined Clemson University as an Assistant Professor in the Computer Science Department. Much of my research during the 2002-2015 time period explored resource allocation strategies for DOCSIS-based cable access systems. The 2015 publication in IEEE Communications Magazine “DOCSIS 3.1: Scaling broadband cable to Gigabit Speeds”, which I co-authored with leading Industry technical leaders, identified open problems in DOCSIS. Two that are relevant to this Declaration are: 1) Channel aware packet scheduling taking into account bonded channels and channel profiles; 2) Channel and spectrum analysis/monitoring with Proactive Network Management, and specifically, how it should be used to autonomically adapt the network based on spectrum issues.

9. The DOCSIS lineage originates from the “Aloha with reservations” protocol. Academic and industry research in ATM over wireless, which again cemented the duality between DOCSIS cable and wireless, led to the IEEE 802.16 standards (WiMAX). In the 2012 timeframe, I switched my main research focus to wireless. From 2012 through present, my wireless research evolved from WiMAX,

to 802.11 and now to 3GPP 5G/6G. The majority of my ideas and research in wireless involves methods for monitoring and characterizing channels. I have numerous papers that present ideas I have developed related to wireless system optimization and spectrum sharing.

1. Compensation

10. For my efforts in connection with preparing this Declaration, I am being compensated at my standard rate of \$400 per hour. My compensation is not contingent on the results of this proceeding or any other legal proceeding.

2. Materials and Information Considered

11. I have considered a variety of information from various sources in forming the opinions contained in this Declaration. I have reviewed and considered each of the exhibits listed below in forming my opinions:

Exhibit No.	Description of Document
1001	U.S. Patent No. 11,770,313 B2 to Wonjong Rhee (Application filed November 23, 2020, issued September 26, 2023)
1003	U.S. Patent No. 7,408,907 B2 to Neil Diener (Application filed August 15, 2003, issued August 5, 2008)
1004	U.S. Patent Application Publication No. 2012/0320768 A1 to Shmuel Shaffer, et al. (Application filed June 20, 2011, issued December 20, 2012)

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Exhibit No.	Description of Document
1005	<i>Adaptive Spectrum and Signal Alignment, Inc. v. Charter Communications, Inc.</i> , No. 2:24-cv-00124 (E.D. Tex.), Amended Complaint
1006	'313 Patent File History
1007	<i>Adaptive Spectrum and Signal Alignment, Inc. v. Charter Communications, Inc.</i> , No. 2:24-cv-00124 (E.D. Tex.), Docket Control Order
1008	Docket Navigator – Time to Milestones for the Eastern District of Texas, <i>available at</i> https://search.docketnavigator.com/patent/court/222/14
1009	Docket Navigator – Time to Milestones for the District of Colorado, <i>available at</i> https://search.docketnavigator.com/patent/court/10/14
1010	IEEE Std. 802.11n-2009™ (Amendment to IEEE Std. 802.11™, 1999 Edition (Reaff 2003))
1011	U.S. Patent No. 5,699,365 to Jeffrey T. Klayman, et al. (Application filed March 27, 1996, issued December 16, 1997)
1012	U.S. Patent No. 6,477,669 to Anil K. Agarwal, et al. (PCT Application filed July 15, 1998, issued November 5, 2002)
1013	U.S. Patent No. 7,809,996 to John M. Cioffi (Application filed August 4, 2008, issued October 5, 2010)
1014	F. Peng, J. Zhang, and W. Ryan, “Adaptive Modulation and Coding for IEEE 802.11n”, IEEE (2007)
1015	Y. Song, X. Zhu, Y. Fang, and H. Zhang, “Threshold Optimization for Rate Adaptation Algorithms in IEEE 802.11 WLANs,” IEEE Transactions on Wireless Communications, Vol. 9 No. 1 (Jan. 2010)

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Exhibit No.	Description of Document
1016	H. Jung, K. Cho, Y. Seok, T. Kwon, and Y. Choi, “RARA: Rate Adaptation Using Rate-adaptive Acknowledgment for IEEE 802.11 WLANs,” IEEE (2008)
1017	S. Wong, H. Yang, S. Lu, and V. Bharghavan, “Robust Rate Adaptation for 802.11 Wireless Networks,” ACM (Sept. 23-26, 2006)
1018	Cisco Enterprise Wireless, Intuitive Wi-Fi Starts Here, CISCO E-Book
1019	Cisco Spectrum Expert Users Guide, Software Release 4.0, CISCO Systems, Inc. (Dec. 2010)
1020	Cisco CleanAir Technology: Intelligence in Action, White Paper, CISCO (2010)
1021	’313 Patent Claim Listing
1022	U.S. Patent No. 8,467,369 to L.W. Yonge, et al. (Application filed June 4, 2008, issued June 18, 2013)
1023	ETSI TX 136 300 V9.3.0 Technical Specification (3GPP TS 36.300 Version 9.3.0 Release 9) (April 2010)
1024	IEEE Std. 802.11g TM -2003 (Amendment to IEEE Std. 802.11 TM , 1999 Edition (Reaff 2003))
1025	U.S. Patent No. 10,848,398 to Wonjong Rhee (PCT application filed Nov. 10, 2011, issued Nov. 24, 2020)

II. SUMMARY OF OPINIONS

12. In my opinion, a person of ordinary skill in the art (“POSITA”) would have found the subject matter of claims 1-23 of the ’313 Patent to be obvious upon

review of the teachings of Diener (Ground 1) and/or Diener in view of Shaffer (Ground 2).

III. STATEMENT OF LEGAL PRINCIPLES

13. I am not an attorney. In forming my opinions in this Declaration, I applied relevant legal principles provided and explained to me by counsel, which are summarized below. The below legal principles represent my understanding of the law that I have applied in forming my opinions in this Declaration.

A. Claim Construction

14. I have been informed by counsel that a purpose of claim construction is to determine what a person of ordinary skill in the art would have understood the claim terms to mean. I further understand that claim terms are generally given their ordinary and customary meaning, which is how a person of ordinary skill in the art (a “POSITA”) at the time of invention would have understood the claim terms. The time of the invention is the effective filing date of the patent application. Also, a POSITA is deemed to read a claim term within the context of the claim and within the context of the entire patent, including the specification. I am informed that the patent specification may be highly relevant to the claim construction and has been described as the single best guide to the meaning of a disputed claim term. The patent specification usually provides the best context for understanding the meaning of terms that do have a customary meaning within the art. I understand that the “plain

and ordinary meaning” or the standard from *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313, 75 USPQ2d 1321, 1326 (Fed. Cir. 2005) (*en banc*) is applicable in these proceedings.

15. I am also informed that other claims within the patent can provide information as to a claim term meaning. Claim terms are normally used consistently throughout the patent, thus, the usage of a term in one claim can shed light on the meaning of that same term in other claims. I understand that differences among claims can also provide guidance to determine the meaning of claim terms.

16. I am further informed that the prosecution history of the patent can inform the meaning of claim language. The prosecution history helps explain how the inventors understood their invention and whether the invention was limited during prosecution, narrowing the claim scope. Extrinsic evidence, such as expert testimony, may also be consulted when properly construing claim terms.

17. I discuss issues of claim construction specific to the '313 Patent in Part VIII.

B. Obviousness

18. I have been informed by counsel that under 35 U.S.C. § 103 (pre-AIA – on or before March 15, 2013), a patent claim may be rendered invalid as obvious if, when the invention was made, the subject matter of the claim, considered as a

whole, would have been obvious to a person of ordinary skill in the art before the effective filing date of the invention. I have also been advised by counsel that this pre-AIA rule applies to the claims of the '313 Patent because it claims priority to a patent which was filed before March 15, 2013.

19. Counsel has advised me that the following factors should be considered when analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; and (3) the level of ordinary skill in the pertinent art. I understand further factors (“secondary considerations”) may indicate non-obviousness. These factors include: commercial success, unexpected results, long felt but unresolved need, industry acclaim, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others. I also understand that these secondary considerations should share a nexus with the claimed invention.

20. I understand that a POSITA is assumed to have knowledge of all prior art. A POSITA can combine different prior art references based on the teachings of those references, the general knowledge present in the art, or their common sense. I further understand that a motivation to combine references may be implicit in the prior art, and there is no requirement that there be an actual or explicit teaching to combine two references. Counsel has explained that one may take into account

inferences and creative steps that a person of ordinary skill in the art would employ to combine the known elements in the prior art in the manner claimed by the challenged patent. I understand that one should avoid hindsight bias and *ex post* reasoning when performing an obviousness analysis; however, this does not mean a POSITA must ignore common sense.

21. I am informed that neither the particular motivation for the patent nor the stated purpose of the patentee is controlling when determining obviousness. The main inquiry relates to the objective reach of the claims and if those claims extend to something obvious. If so, the entire patent claim is invalid.

22. I understand a patent may be found invalid by obviousness if, at the time of invention, there was a known problem for which there was an obvious solution encompassed by the patent's claims. I further understand a motivation to combine various prior art references to solve such a problem may come from a variety of sources, including market demand, academic papers, or scientific literature. I am informed that a need or problem within the field at the time of invention may also provide a reason to combine prior art references and render a patent claim obvious. Familiar items may have obvious uses beyond their primary purpose and a POSITA would be able to fit the teachings of multiple prior art references together like the pieces of a puzzle. I understand that a POSITA is also a

person of at least ordinary creativity. Additionally, when there is a design need or market pressure to solve a problem with a finite number of identified, predictable solutions, a POSITA has good reason to pursue the known options within his or her technical abilities. If these finite number of predictable solutions lead to the anticipated success, I understand that the invention is likely the product of ordinary skill and common sense, and not any sort of innovation. I am informed that the fact that a combination was obvious to try may also show that it was obvious and invalid. I understand that if a patent claims a combination of familiar elements according to known methods, that combination is likely to be obvious when it does nothing more than yield predictable results. Thus, if a POSITA can implement a predictable variation, a claimed invention is likely obvious. I understand that combining embodiments disclosed near each other within a prior art reference would not ordinarily require a great leap of inventiveness.

23. Counsel has also advised me that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. I understand obviousness may be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I have been advised by counsel that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that

would have led a person of ordinary skill in the art to combine the invalidating references. Additionally, I am informed that this suggestion or motivation may come from within the knowledge of a POSITA, or from sources such as explicit statements in the prior art, but such explicit statements are not required. Alternatively, any need or problem known in the field at the time and addressed by the patent may provide a reason for combining elements of the prior art. I am advised by counsel that when there is a design need or market pressure, and there are a finite number of predictable solutions, a person of ordinary skill may be motivated to apply common sense and his or her skill to combine the known options to solve the problem.

24. Counsel has advised me that the following are examples of approaches and rationales that may be considered in determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art:

- some teaching, motivation, or suggestion in the prior art that would have led a person of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- known work in one field of endeavor may prompt variations of it for use in the same, or different, field based on design incentives or other

market forces if the variations would have been predictable to a POSITA;

- combining prior art elements according to known methods to yield predictable results;
- applying a known technique to a known device, method, or product ready for improvement to yield predictable results;
- applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions with a reasonable expectation of success);
- simple substitution of one known element for another to obtain predictable results; or
- use of a known technique to improve similar products, devices, or methods in the same way.

IV. RELEVANT TIME FRAME FOR DETERMINING OBVIOUSNESS

25. I understand that obviousness must be evaluated “at the time of the invention.” From the cover pages of the ’313 Patent, I can see that the first application to which the ’313 Patent claims priority was filed on November 10, 2011. Ex. 1001.

26. For the purpose of this Declaration, I have been asked to provide my analysis based on the time frame immediately prior to November 10, 2011, but I have not formed an opinion as to the propriety of that date.

V. RELEVANT TECHNOLOGICAL BACKGROUND

27. The '313 Patent discloses broad concepts centered on broad areas of data and networking systems which are capable of adapting, improving, or optimizing communications performance across networks. The scope of the patent includes two primary components.

28. First, a system model involves a centralized communications system (802.11 Wi-Fi, DSL broadband access), communications units (Wi-Fi equipped devices, DSL home modems), and a remote server (network management station) that acquires communications performance information from the communications system at various interfaces. The communications system includes a method for system adaptation, based in part on a policy provided by the system developers. The communications units themselves, along with the other communications components within the network, monitor and collect communications performance information. This performance information is sent periodically to the remote server which analyzes the information and, if needed, identifies and disseminates a policy to the appropriate system nodes.

29. Second, the '313 Patent discloses generic adaptation algorithms to illustrate the function and scope of the remote server's possible approaches for adaptation. Specifically, the patent defines the "Adaptation Algorithm" as "a time-varying and environment-change-dependent transmission or control strategies for a communications system". Ex. 1001 at 1:45-48.

30. This section of my disclosure provides relevant background information that is content and time-adjusted to reflect the understanding of a POSITA in the 2011 timeframe. The level of detail is only sufficient to help the reader of this Declaration understand the arguments I make as to why the '313 Patent is obvious to a POSITA and thus invalid.

31. By 2011, network-access systems based on standards, such as IEEE 802.11 Wi-Fi, 3GPP 3G/4G, ISO DSL, and CableLabs DOCSIS 3.0, all reflected mature, widely deployed technologies. These standards had, at the time, adopted adaptation algorithms. Adaptation is fundamental to any large-scale communications system that serves dozens, hundreds, or thousands of end users. One can classify "adaptation" across multiple dimensions. It requires the collection of raw performance data which is input into an algorithm. The algorithm uses the data input to arrive at an actionable output which drives modifications to transmission and control strategies, i.e., the adaptation. In many instances, a front-

end algorithm analyzes and reduces the input data into an abstract input required by a decision algorithm. The actionable output can then be communicated to the relevant communication units and/or the relevant components within the communication units to implement.

32. The '313 Patent refers to the IEEE 802.11g “rate adaptation algorithm” as an exemplar to the “Adaptation Algorithm” that is the basis of the patent. Ex. 1001 at 1:52-62. I will also use Wi-Fi as the base access technology example. To provide helpful context, I’ll describe the evolution of relevant Wi-Fi technology using three synergistic perspectives: standards, academic, and industry. The U.S. Federal Government has well-established policies designed to create economic growth where Federal policy targets and directs advanced technology standards, steers federal academic funding agencies to incentivize supportive academic research, and determines appropriate incentives for industry to innovate and participate in a healthy competitive market that leverages the advanced technology. Standards bodies identify areas within the specific standards that are viewed as “open issues” by researchers and product differentiators by industry. Putting this in the context of my background for the '313 Patent, the standards provide a common framework, the academic research explores the “open issues” and develops many algorithmic solutions, and industry leverages its scale to pull the many pieces

together into large scale Enterprise or Telecom solutions. The remainder of my background summarizes the evolution of Wi-Fi “adaptation” from 1999 through 2010 from a standards context, from an academic research context, and finally from an industry context.

33. ***STANDARDS: A Common Framework:*** The IEEE released the first Wi-Fi standard in 1997 followed in 1999 with the 802.11b update. All releases of the Wi-Fi standards included an ability for adapting transmission properties to meet channel conditions. Wi-Fi allows client Stations (“STAs”) and/or Access Points (“APs”) to select the most appropriate modulation and coding setting for each frame transmission based on current channel conditions. The IEEE 802.11 standards specify the Modulation and Coding Schemes (“MCS”) and provide tables that map channel conditions, such as RSSI, to a MCS table entry providing the best choice of modulation and coding parameters. Each new update to the standard increased the degrees of freedom available for adapting communications over wireless channels. By the 2009 release of the amended standard, referred to as 802.11n, the MCS tables provide dozens of choices to support a broad range of advanced modulation and coding options, frequency diversity options such as frequency spectrum location and bandwidth, and space diversity options involving the use of multiple spatial streams. Ex. 1010. The objective of the IEEE was to ensure a sufficient and validated set of

profiles were not only defined but also specified as being required in all implementations. Notably, the standard does not specify a specific approach to dynamically adapt the modulation and coding other than providing the MCS tables. *See generally id.* The IEEE followed normal standards conventions by not specifying a precise description as to what types of channel information should be used to make adaptations that improve performance. The standards also do not address Telecom or Enterprise level performance management techniques. The standards simply provide a sufficient set of common protocols and control knobs such that all standards compliant products should be able to interoperate.

34. ***ACADEMIA: The Algorithmic Solutions:*** According to the '313 Patent, the Wi-Fi “rate adaptation algorithm” (RAA) is an already well-known process that, based on observed channel conditions, adapts the transmission modulation and coding details to an optimal setting such that transmissions are set at the highest bit rate permitted by current channel conditions. Ex. 1001 at 1:44-62. The background discussion in the patent suggests that any RAA involves real-time data collected by the AP which in turn adjusts its transmission properties based on conditions. As of the priority date of the '313 Patent, RAA was well known and disclosed in the prior art such as by U.S. Patent Nos. 5,699,365, 6,477,669, and 7,809,996. Exs. 1011-1013.

35. The IEEE 802.11 WLAN rate adaptation involves the dynamic selection of data rates used by a Wi-Fi transmitter. *See* Ex. 1015 at 1. The problem of optimal rate adaptation is one of the most widely researched topics in the related academic literature in the time between 2000-2011. *See, e.g.*, Exs. 1014-1017. The objective is a method for optimizing Wi-Fi communications systems where a centralized controller and the associated communications units match the unknown state of the channel optimally such that the network throughput is maximized. All approaches fall into one of two categories: closed-loop or open-loop. *See* Ex. 1015 at 1.

36. Closed-loop rate adaptation has a receiver obtain the channel quality and periodically send this information to the transmitter. Ex. 1015 at 1. A wide range of design choices exist, including piggybacking the channel quality information to RTS (Request to Send) or CTS (Clear to Send) messages, creating new Wi-Fi messages, or using a separate command and control plane interface. *Id.* The former was introduced as early as 2001. *Id.*; *see also id.* at 10 (n. 1-17). The latter is how Adaptive Modulation and Coding (AMC) works in 3GPP 3G/4G. *Id.* at 1-2.

37. Open-loop rate adaptation relies on a transmitter to implicitly deduce channel impairment at a receiver by, as an example, detecting sequences of packet

drops based on the sequence of ACKs (i.e., acknowledgments) from the receiver. Ex. 1015 at 1. The Auto Rate Fallback (ARF) algorithm was developed during the 1990s and early 2000s and represents the baseline algorithm to which researchers compared more advanced algorithms. *Id.*

38. ***INDUSTRY/PRIVATE SECTOR: Enterprise/Telecom Solutions:***

By 2011, the leading vendors, Alcatel-lucent, Cisco, and Aruba, each had sophisticated Enterprise class performance management solutions. For example, Cisco's Aeronet product utilized spectrum monitor devices (based on SAGE) which, along with each AP, monitored the spectrum, periodically sending data characterizing observed WLAN performance and spectrum conditions to central controllers which processed the potentially large amounts of data. This type of monitoring was done across multiple networks. The results of the control decisions resulted in new policies regarding how specific APs and wireless client stations were to operate. The level of control ranged from load balancing of APs (having clients associate with specific APs), frequency channel reallocations, as well as link level adaptations ranging from selecting new AMC algorithms, uploading new MCS tables, or altering 802.11 MAC and PHY communications parameters. Exs. 1018-1020.

VI. THE '313 PATENT

39. I understand that the '313 Patent issued on September 26, 2023. Ex. 1001. I also understand that the '313 Patent claims issued from U.S. Application No. 14/356,581 (“the '581 application”), filed as PCT Application PCT/US2011/060265, which was filed internationally on November 10, 2011, then filed as a U.S. national stage application on May 6, 2014. Ex. 1001. The '581 application was published as U.S. Patent Application Publication 2014/0304408 and issued as U.S. Patent No. 10,848,398. *Id.* In rendering my opinions, I have considered all claims of the '313 Patent, the '313 Patent specification, and the '313 Patent prosecution history.

A. Overview of the '313 Patent

40. The '313 Patent relates to an apparatus, system, and method for optimizing performance of one or more communication units by a remote server. Ex. 1001, Abstract. The '313 Patent describes the invention as a system comprising:

[O]ne or more communication units; and a server operable to communicate with the one or more communication units, wherein the server comprises: a memory; and a processor, coupled to the memory, and operable to perform the method discussed....

Ex. 1001, Abstract.

41. The '313 Patent discloses that these types of communication systems were well-known as of the priority date of the '313 Patent. The specification itself

discloses, in Figure 1, an “exemplary prior art communication system (CS) **100** with an access point (AP) **101** and one or more wireless stations **102_{1-N}**.” Ex. 1001 at 1:34-35. “The AP **101** exchanges user data with the one or more stations **102_{1-N}** over wireless channels indicated by the arrows.” Ex. 1001 at 1:35-37. According to the ’313 Patent, to adapt to noise and interference over wireless channels, prior art communication systems would adapt transmission strategies to enhance performance. Ex. 1001 at 1:37-51. This prior art system is depicted in Figure 1.

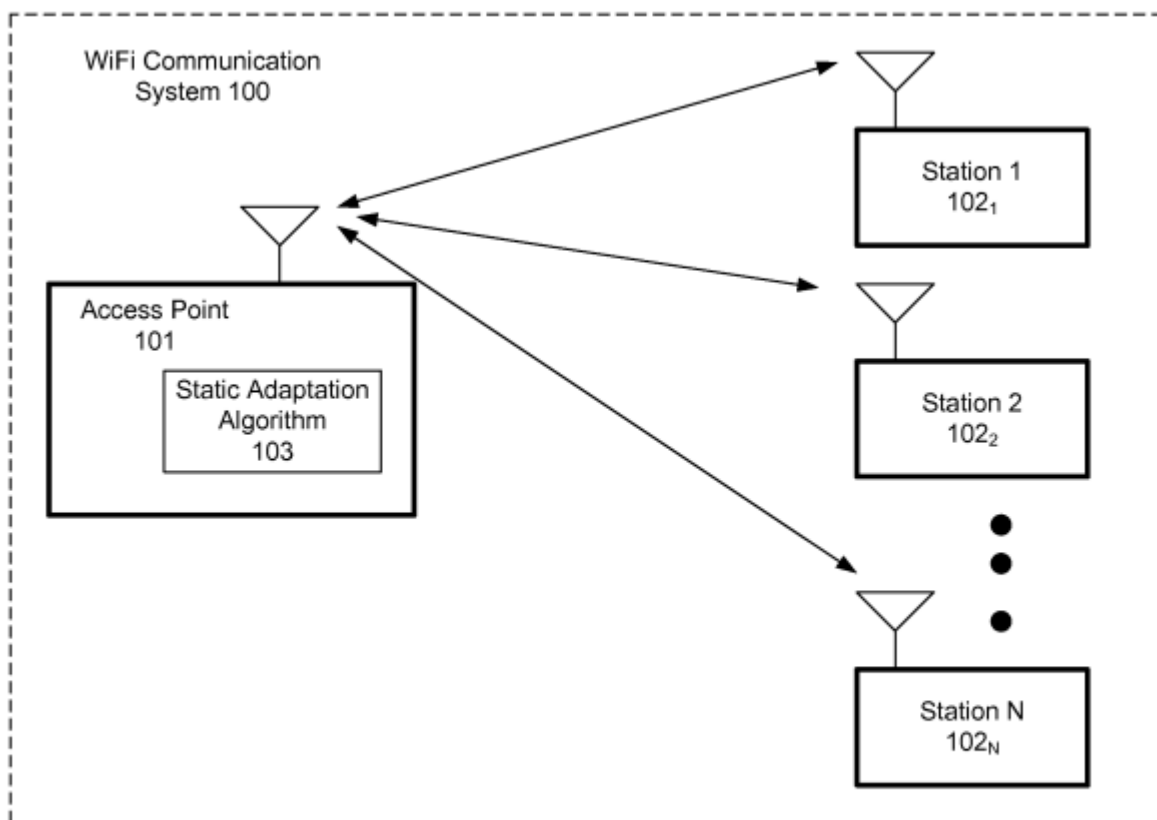


FIG. 1 (prior Art)

42. The '313 Patent noted alleged deficiencies in prior art systems, such as adaptation algorithms that were static in nature, because they were included in the firmware and loaded to WiFi communication systems (Ex. 1001 at 2:5-12); and rules and thresholds for the adaption algorithms that were based on the assumptions made by the system designer of the communication system, which could be quite different from actual operational environments (Ex. 1001 at 1:63-2:21).

43. The '313 Patent thus purports to improve on prior art communication systems by providing a “method, system and apparatus that analyzes real-time and history of operational data related to a communication system and provides rules and conditions for the communication system to improve its performance.” Ex. 1001 at 4:66-5:2. According to the '313 Patent, the technical effect of its disclosed embodiments “is the improvement of performance of a communication system ... by providing the communication system with rules and conditions that were previously not conceivable by the communication system due to lack of information and processing power needed to generate the rules and conditions.” Ex. 1001 at 5:25-31.

44. Accordingly, the '313 Patent discloses a communication system that is “similar to the communication system of FIG. 1, but is operable to communicate with [a] remote server 204 (interchangeably referred to as an optimization center).”

Ex. 1001 at 6:37-41. Figure 2 of the '313 Patent depicts this exemplary communication system, as seen below.

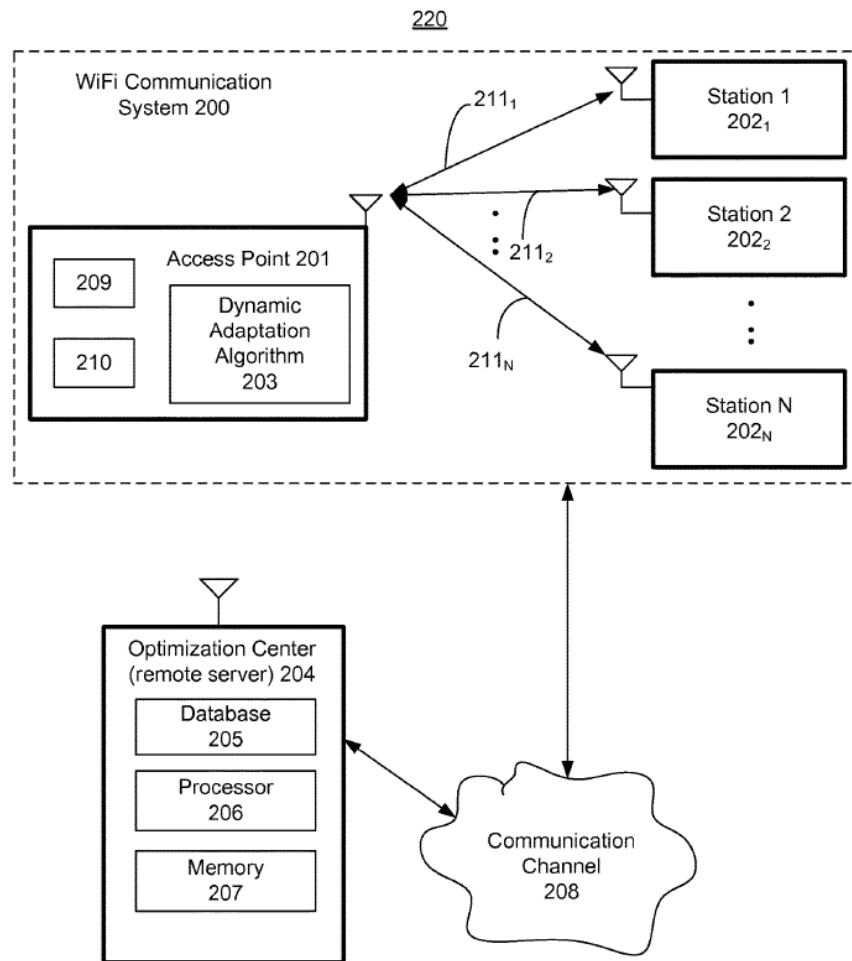


FIG. 2

Ex. 1001 at Fig. 2.

45. The '313 Patent purports to be “not limited to DSL or WiFi communication systems, but appl[ies] to any communication system that needs to run/execute adaptation algorithms (also called algorithms) to cope with real-time

variations in link channel, noise, interference, and other factors that affect communication performance.” Ex. 1001 at 11:37-42.

46. According to the ’313 Patent, prior art communication units allegedly “do not have the capability in terms of processing resources, access to historical operational data, [and] access to operational data of other similarly situated communication units.” Ex. 1001 at 8:36-39. Therefore, prior art communication units cannot allegedly use such information for improving their performance according to the ’398 Patent. *Id.* Hence the ’313 Patent uses “a dedicated server (also referred as ‘remote server’ or ‘optimization center’) [that] may be used to collect operational data related to the communication system, where the operational data may not be accessible or storable by the communication system itself (e.g., data from other communication units or old data that cannot be stored due to memory limitations).” *Id.* at 5:31-38.

47. The ’313 Patent thus purports to improve on the prior art by providing such operational data to a central location such as a remote server, which “has the capability in terms of processing resources, access to historical operational data, [and] access to operational data of other similarly situated communication units, etc., so that it may use such information [to] generate rules and conditions for operating the communication units with enhanced performance.” *Id.* at 8:43-48. After

computing the rules and conditions, the remote server of the '398 Patent “provides the rules and conditions to the processors of the communication units, wherein the processors executes [sic] their respective policies by implementing one of first and second algorithms based on the rules and/or conditions and time-varying data.” *Id.* at 8:53-57.

48. Figure 4 depicts the method performed by the remote server for optimizing performance of a communication system, which can be seen below.

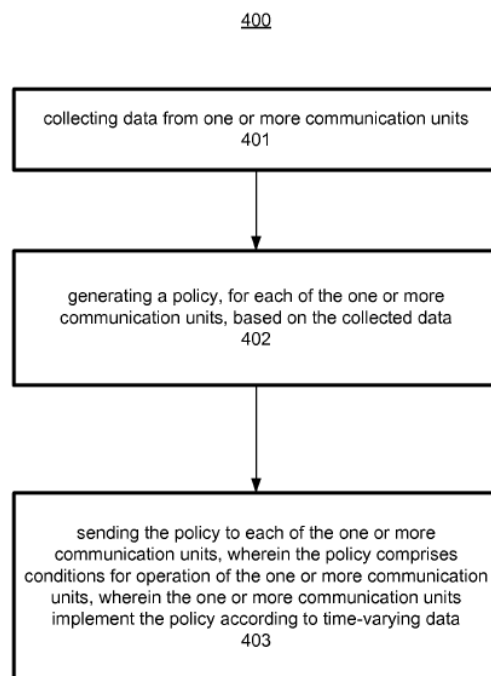


FIG. 4

49. “At block **401**, the remote server **204** collects data (operational and/or performance data) from the one or more communication units.” Ex. 1001 at 14:63-

65. “At block **402**, the remote server **204** generates a policy, for each of the one or more communication units based on the collected data.” *Id.* at 15:19-21. “At block **403**, the remote server **204** sends the policy to each of the one or more communication units, wherein the one or more communication units implement the policy according to time-varying data (data collected by the communication units of the communication systems).” *Id.* at 15:43-47.

50. In one exemplary embodiment showing the process of determining an algorithm the “remote server **204** determines the presence of intermittent high-power interference from other near-by WiFi systems.” Ex. 1001 at 10:42-44. According to the ’313 Patent, “[w]hen other WiFi’s high-power packets collide with the communication system **200**’s packet, the packet is lost regardless of the rate selection.” *Id.* at 10:44-46. If “other noise or interference is never observed” the system may “conclude[] that it is best to adapt rates for the communication units ... as a function of channel strength, or RSSI, only.” *Id.* at 10:49-51. Accordingly, the “remote server **204** sends a control signal ... asking the communication units ... to use the first algorithm all the time instead of the second algorithm.” *Id.* at 10:52-56.

51. The ’313 Patent also refers to a “Network Interface 602”. *Id.* at Fig. 6. “In one embodiment, the processor-based system includes a network interface 602 to communicate with other devices.” *Id.* at 16:38-40.

B. '313 Patent Prosecution History

52. I understand that the '313 Patent issued from U.S. Patent Application No. 17/102,099 (the "'099 Application"). For purposes of this Declaration, I have been asked to assume a priority date of November 10, 2011, but I make no opinion as to the propriety of that priority date regarding the '313 Patent.

53. Based on the file history, I understand the '099 Application was filed on November 23, 2020. The Examiner issued a Non-Final Rejection of the '099 Application on June 25, 2021. Ex. 1006-2 at 441-454. The Examiner rejected all claims of the '099 Application under 35 U.S.C § 112(b) and specifically identified that the term "remote server" was relative, undefined, and rendered the claim indefinite. *Id.* The Examiner also rejected claims 1-4, 7-10, and 18 as anticipated by Clark et al. (U.S. Patent No. 5,970,064) because Clark disclosed a remote server with three interfaces including the functionalities as claimed. *Id.* at 444-448. The Examiner rejected the remaining claims under 35 U.S.C. § 103 as obvious over Clark in view of various references including Jaszewski et al. (U.S. Patent No. 5,933,420), Malik et al. (U.S. Patent Pub. No. 2009/0059872 A1), Roy et al. (U.S. Patent Pub. No. 2006/0187885 A1), and Rahoathan et al. (U.S. Patent Pub. No. 2010/0167771 A1). *Id.* at 448-453.

54. The Applicant then filed an amendment and request for reconsideration on September 15, 2021. *Id.* at 355-364. Applicant amended the claims, removing “remote” from “remote server” and argued that its claim amendments overcame the § 112 rejection. *Id.* Applicant also argued that the prior art references identified by the examiner did not disclose each claim limitation, and, specifically, that Clark failed to disclose multiple interfaces as required by independent claim 1. *Id.* A final rejection followed on October 15, 2021, allowing claims 19-23, but finding Applicant’s arguments regarding the 35 U.S.C. §§ 102 and 103 rejections unpersuasive. *Id.* at 299-314. The examiner noted that the claimed “interfaces” did not need to be separate devices but could refer to the same device that operated as a first and second interface at different times (i.e., when receiving first and second sets of data). *Id.* at 301-303. And, the examiner noted that Clark disclosed a communications network comprising switches which connected multiple LAN segments which are separate networks. *Id.* at 303-304.

55. Applicant filed a response on November 9, 2021, arguing that the claimed three interfaces must be three separate interfaces and that Clark failed to disclose LAN segments as distinct networks. *Id.* at 288-296. The examiner rejected Applicant’s arguments on November 29, 2021 in an Advisory Action, stating that the specification makes clear that the three interfaces could be the same. *Id.* at 268-

270. On December 16, 2021, in a Request for Continued Examination, Applicant re-argued that the claims must be read to recite three separate interfaces and argued that dependent claim 18 is narrower referring to the same interface. *Id.* at 259-267.

56. The examiner issued a Non-Final Rejection on September 29, 2022, pointing out that Applicant contradictorily argued independent claim 1 requires three separate interfaces, while at the same time arguing it is broad enough to encompass three separate interfaces or all three being the same interface (as recited in dependent claim 18). *Id.* at 1-16. In response, on December 28, 2022, the Applicant explained that claim 1 leaves open a possibility that the three interfaces are the same, but claim 18 requires that two of the three interfaces be the same. Ex. 1006-1 at 209-215. In another Final Rejection, the examiner agreed with this understanding and explained that the prior art, therefore, disclosed the claims because claim 1 is broad enough to encompass the possibility where the three interfaces are one and the same (i.e., like Clark). *Id.* at 170-185.

57. In response, Applicant amended claim 1 to recite a communication system comprising three separate interfaces:

Petition for *Inter Partes* Review of
U.S. Patent No. 11,770,313 B2
Exhibit 1002

1. (Currently amended) A server communication system comprising:
- a first interface coupled to a first communication unit, the first interface receives a first set of collected data associated with a first network managed by the first communication unit;
 - a second interface coupled to a second communication unit, the second interface receives a second set of collected data associated with a second network managed by the second communication unit, the second network being a different network than the first network;
 - a memory coupled to the first and second interfaces, the memory stores the first and second sets of collected data;
 - a processor coupled to the memory, the processor generates at least one policy based at least in part on an analysis of the first and second sets of collected data; and
 - a third interface coupled to the processor, the third interface transmits the at least one policy to the first communication unit that makes a performance-related adjustment within the first network based on the at least one policy, the first, second, and third interfaces being different from each other.

Id. at 145. This amendment was rejected in an Advisory Action which noted that the communication units cannot have their own interfaces because they are coupled to the memory that stores the collected data and that the third interface could be the same as, at least, the first interface which both have the same communication capabilities. *Id.* at 128-130. Moreover, the examiner explained that Clark disclosed multiple switches which, under Applicant's reading, would each have their own interface. *Id.*

58. Applicant further amended the claims in response, with amendments to independent claim 1 shown below:

Petition for *Inter Partes* Review of
U.S. Patent No. 11,770,313 B2
Exhibit 1002

1. (Currently amended) A ~~server~~ communication system comprising:

a first interface coupled to a first communication unit, the first interface receives a first set of collected data associated with a first network managed by the first communication unit;

a second interface coupled to a second communication unit, the second interface receives a second set of collected data associated with a second network managed by the second communication unit, the second network being a different network than the first network;

a memory coupled to the first and second interfaces, the memory stores the first and second sets of collected data;

a processor coupled to the memory, the processor generates at least one policy based at least in part on an analysis of the first and second sets of collected data; and

a third interface coupled to the processor, the third interface transmits, in response to the processor determining a change in performance in at least one of the first network or the second network, the at least one policy to the first communication unit that makes a performance-related adjustment within the first network based on the at least one policy.

Id. at 119. Regarding the Clark rejection, Applicant argued that this claim amendment brought claim 1 within the scope of claim 19, which was already allowed by examiner, and thus Clark was not prior art to claim 1 for the same reasons. *Id.* at 124.

59. Following this amendment, a Notice of Allowance was issued on May 2, 2023. *Id.* at 70. The '313 Patent issued on September 26, 2023.

C. The Challenged Claims

60. This Declaration addresses claims 1-23 (the “Challenged Claims”). There are two independent claims within the Challenged Claims. Independent claim 1 recites a communication system and independent claim 19 recites a method of managing a plurality of networks. Independent claim 1 recites:

1. A communication system comprising:

a first interface coupled to a first communication unit, the first interface receives a first set of collected data associated with a first network managed by a first communication unit;

a second interface coupled to a second communication unit, the second interface receives a second set of collected data associated with a second network managed by the second communication unit, the second network being a different network than the first network;

a memory coupled to the first and second interfaces, the memory stores the first and second sets of collected data;

a processor coupled to the memory, the processor generates at least one policy based at least in part on an analysis of the first and second sets of collected data; and

a third interface coupled to the processor, the third interface transmits, in response to the processor determining a change in performance in at least one of the first network or the second network, the at least one policy to the first communication unit that makes a performance-related adjustment within the first network based on the at least one policy.

61. Independent claim 19 recites:

19. A method for managing a plurality of networks, the method comprising:

receiving, by a server, from network monitoring devices that monitor data associated with an operation of two or more communication units, located in at least two networks within the plurality of networks, the data comprising a parameter;

processing, by the server, the received data;

based on the processed data, determining a policy for at least one of the two or more communication units; and

in response to the server detecting a degradation of network performance in at least one network within the plurality of networks, communicating the policy to at least one or more communication units that implement one or more algorithms that use the parameter and at least one rule or one condition for the one or more communication units to improve a performance of the one or more communication units.

62. I address each of the claims further in my detailed analysis in Part X below.

VII. LEVEL OF ORDINARY SKILL IN THE ART

63. In determining the characteristics of a person of ordinary skill in the art of the field of the '313 Patent at the time of the claimed invention¹, I considered several factors, including various prior art communication systems and methods, the

¹ I considered the level of ordinary skill in the art as of November 10, 2011, which is the date I was told to apply to my analysis here, as explained more fully above in Part IV.

sophistication of the technologies involved, educational background of those in the field, and experience of those in the field at the time of invention. I also considered the level of education necessary to understand the '313 Patent and its claimed invention. Finally, I considered the relevant time period along with engineers in the field of transmission and communication systems, including DSL, cable, and internet fields.

64. Based on the above, I have concluded that a POSITA in the field of art of the '313 Patent would have had a bachelor's degree in electrical engineering, or an equivalent subject, with at least two years of experience with transmission optimization techniques in the field of DSL, cable, or wireless communication systems. A person with less formal education, but more relevant practical experience, may also meet this standard, as may a person with more formal education but less relevant practical experience. Such a person would have been capable of understanding the '313 Patent and the prior art references discussed below. Based on my own education, training, and professional experience in the field of the claimed invention, I am familiar with the level and abilities of a POSITA at the time of the claimed invention.

VIII. CLAIM CONSTRUCTION FOR THE '313 PATENT

65. In my analysis of the '313 Patent's claim terms and the prior art in this Declaration, unless otherwise indicated, I have applied the plain and ordinary meaning of the claim terms in light of the specification and '313 Patent prosecution history to a person of ordinary skill in the art.

66. I understand that the Board may decide to construe certain terms of the Challenged Claims. Regardless of any likely construction that is ultimately applied, however, the Grounds included in the Petition are sufficient to invalidate the claims.

67. I understand that the Petitioner may take a different approach to claim construction in other proceedings, but for purposes of the Petition I understand that the Petitioner believes no construction is necessary.

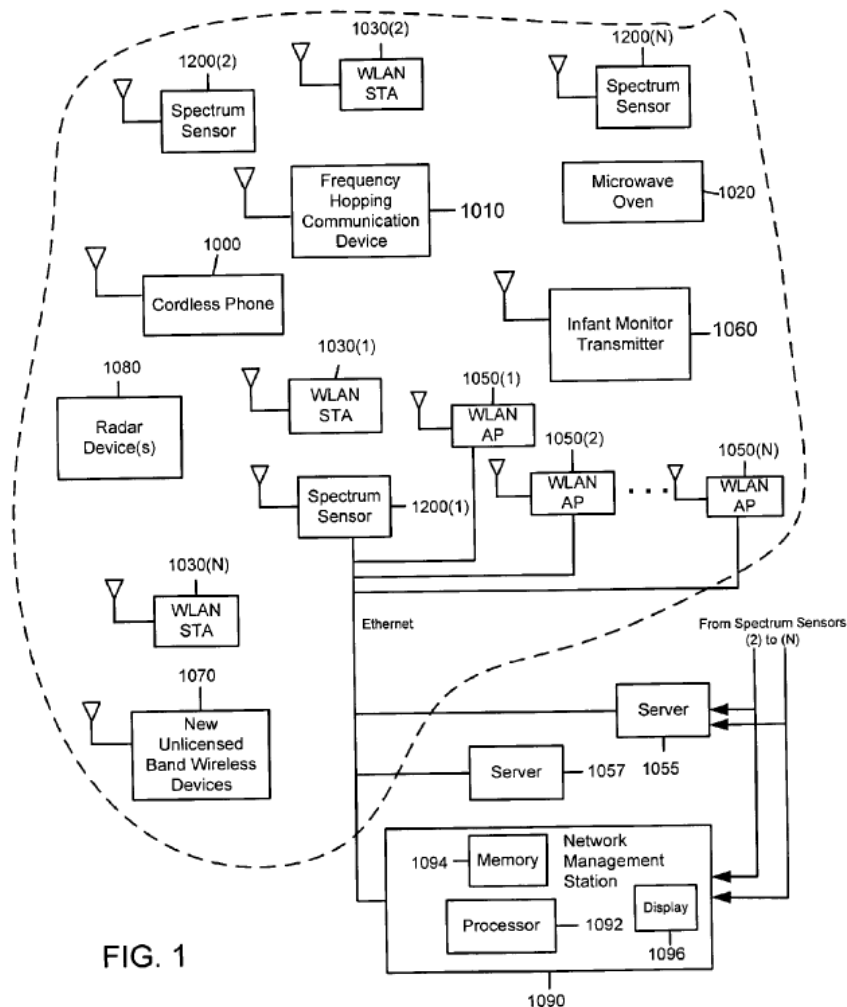
68. I have not yet formed, and do not offer, any opinion on the indefiniteness of any claims of the '313 Patent.

IX. SUMMARY OF THE PRIOR ART

A. Diener (Ex. 1003)

69. U.S. Patent No. 7,408,907 to Neil R. Diener is an issued patent entitled "System and Method for Management of a Shared Frequency Band using Client-Specific Management Techniques" ("Diener"). Ex. 1003. It was filed on August 15, 2003 and issued on August 5, 2008. Diener qualifies as prior art to the '313 Patent under 35 U.S.C. §§ 102(a), (b), and (e).

70. Diener teaches a communication management system, like the one described in the '313 Patent. Diener's communication system involves devices that utilize radio communication parameters. Ex. 1003 at Abstract, Fig. 1. Figure 1 depicts an exemplary system:



Id. at Fig. 1.

71. In Diener, communication units such as access points (“APs”), sensors or other communication devices monitor the network and gather spectrum

intelligence and send that data to a management device (i.e., network management station). *Id.* at 6:58-63; 8:40-45. “Any device that receives radio frequency energy in the frequency band of interest may be equipped with a SAGE to generate spectrum activity information.” *Id.* at 24:16-18. The spectrum intelligence gathered from these communication units can then be used by the network management station to manage the network based on current interference conditions. *Id.*

72. The management devices disclosed by Diener (i.e., network management station or other remote servers) receive spectrum intelligence gathered by, for example, spectrum sensors and cognitive radio devices. *Id.* at 6:45-61. These management devices receive spectrum intelligence via one or more interfaces located on the management devices (*id.*) and process the information received for use in management one or more networks. *Id.* at 9:8-11, 20:64-66, Fig. 1. Once the spectrum activity information is obtained, it “can be accumulated and stored on a short-term basis (seconds or minutes) or a long-term basis (minutes to hours) for subsequent analysis.” *Id.* at 9:15-18. The spectrum activity information may also be processed, for example, through a signal classification step. *See id.* at 9:25-33. The management device can then make policy decisions and generate controls for the communication units within the system. *Id.* at 6:58-63. For example, “controls may

be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band.” *Id.* at 9:57-59.

73. The controls generated by the network management station or server may include:

[A]ssigning a device to a different frequency sub-band or channel in the frequency band (dynamic frequency selection DFS), network load balancing (on the basis of channel frequencies or time), adjusting the transmit power (transmit power control—TPC), adjusting the communication data rate, adjusting a parameter of the transmitted data packet, executing interference mitigation or co-existence algorithms, executing spectrum etiquette procedures, executing spectrum priority schemes, or re-assigning STAs [client devices] to APs [access points] in a WLAN.

Id. at 9:60-10:3.

74. Some other examples of parameters that may be controlled include packet fragmentation threshold (the length of a data packet), transmission data rate and transmission scheduling (synchronizing a transmission to quiescent intervals of one or more periodic interfering signals). *Id.* at 4:2-7. As such, Diener’s system can react to changing conditions at individual wireless client stations and adjust accordingly how devices communicate with each other. *Id.* at 4:7-10.

75. Diener’s remote management device leverages “spectrum intelligence” received from monitoring devices within its network to make decisions and take actions to improve network communication. *Id.* at 67:64-66.

76. Spectrum activity information also includes other information derived from a component like the SAGE. *Id.* at 59:6-9. As one example, Diener teaches a “spectrum management support tool” whose process “may be performed ... at a processing device remote from the client device.” *Id.* at 58:63-65. The remote device “monitors bit error rate (BER) or PER and other spectrum activity information (derived from a component like the SAGE[]).” *Id.* at 59:6-9.

77. The broad variety of spectrum activity information collected allows Diener to make intelligent decisions about the network. For example, Diener discloses, that spectrum intelligence is used by the system to implement “[s]mart data rate selection.” *Id.* at 63:65-64:3. The implementation of smart data rate selection is possible in Diener because the system can distinguish between problems caused by interference, packet errors and hidden nodes as a result of the spectrum intelligence. *Id.* Accordingly, Diener teaches the use of knowledge of the types of signals occurring in the frequency band and other spectrum activity related statistics to take actions in a device to avoid interference with other signals, and in general to optimize simultaneous use of the frequency band with other signals. *Id.* at 2:14-27.

B. Shaffer (Ex. 1004)

78. U.S. Patent Application Publication No. 2012/0320768 to Shmuel Shaffer, Charles Okwudiafor, and Sandeep J. Shetty is a patent application entitled

“Reducing the Impact of Hidden Nodes in Mesh Networks” (“Shaffer”). Ex. 1004.

Shaffer was filed on June 20, 2011 and published on December 20, 2012. It is prior art to the '313 Patent under 35 U.S.C. § 102(e).

79. Shaffer relates to employing specific techniques that account for hidden nodes within a wireless network by taking into account parameters and traffic patterns. Ex. 1004 at [0056]. According to Shaffer:

The novel techniques described herein thus reduce the impact of hidden nodes in a network. In particular, by applying the techniques herein, the resulting system has a greatly reduced collision rate compared with current systems, and therefore improves network efficiency (effective bandwidth) by reducing the number of packets that need to be retransmitted.

Id. at [0113].

80. The wireless network disclosed in Shaffer includes a head end device and various nodes (devices 200) within a wide area network, as shown in Figure 1:

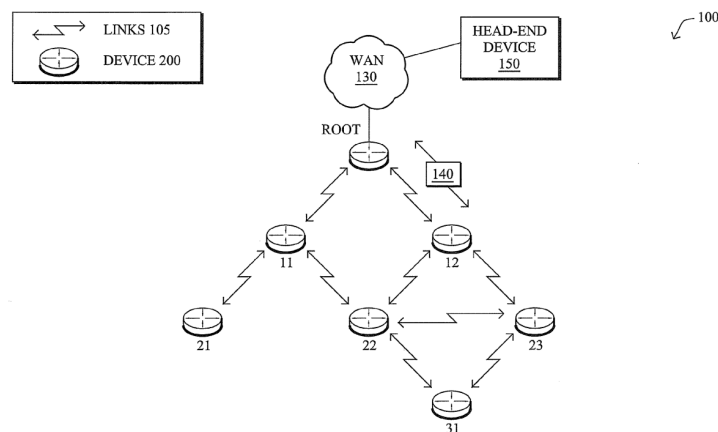


FIG. 1

Id. at Fig. 1. The system may include a network administrator that determines the acceptable level of delay within transmissions across the network and also determines a policy to address issues presented by hidden nodes. *Id.* at [0103].

81. Shaffer discusses different protocols that are known in the art and used in wireless networks—such as Carrier Sense Media Access Control/Collision Avoidance (CSMA/CA) and Request to Send/Clear to Send (RTS/CTS) protocols. *Id.* at [0050]-[0053]. Shaffer further discloses another method to help avoid collisions within a wireless network which are based on hidden nodes. Specifically, Shaffer teaches a method optimizing performance within the system by utilizing “two new, non-exclusive algorithms to mitigate the hidden neighbor issue.” *Id.* at [0058]. The first algorithm relates to a “cost function that is used for optimizing route selection to minimize interference from hidden neighbors.” *Id.* The second algorithm “optimizes the transmission power and/or receiver sensitivity of nodes in the mesh in order to minimize the number of hidden neighbors while attempting to have a minimal impact on the overall delay through the network.” *Id.*

X. APPLICATION OF THE PRIOR ART TO THE CHALLENGED CLAIMS

82. Based on my review and analysis of the materials cited herein, my opinions regarding the understanding of a POSITA, and my training and experience, it is my opinion that the Challenged Claims are rendered obvious by the Grounds

presented in this Declaration. The reasons for my conclusions are explained more fully below.

83. I have reviewed and analyzed the prior art references, including all materials listed in Part I.A.2 above. In my opinion, the claims of the '313 Patent are rendered obvious based on the following prior art:

Ground	'313 Patent Claims	Basis for Challenge	Application of Prior Art
1	1-23	35 U.S.C. § 103	Diener
2	1-23	35 U.S.C. § 103	Diener in view of Shaffer

84. I am informed by counsel that each of the references cited in the above grounds qualifies as prior art to the Challenged Claims because each reference was filed and/or published before the priority date for the '313 Patent.

A. Ground 1: Analysis of Claims 1-23 Based on Diener.

85. In my opinion, claims 1-23 of the '313 Patent are invalid because they are obvious over the teachings of Diener, as detailed below.

1. Claim 1

86. Based on my review and for the reasons that follow, it is my opinion that claim 1 is obvious based on the teachings of Diener.

87. I have reproduced independent claim 1 below and divided up the limitations using bracketed notations to facilitate identification of the limitations in my analysis below.

1[pre] A communication system comprising:

[a] a first interface coupled to a first communication unit, the first interface receives a first set of collected data associated with a first network managed by the first communication unit;

[b] a second interface coupled to a second communication unit, the second interface receives a second set of collected data associated with a second network managed by the second communication unit, the second network being a different network than the first network;

[c] a memory coupled to the first and second interfaces, the memory stores the first and second sets of collected data;

[d] a processor coupled to the memory, the processor generates at least one policy based at least in part on an analysis of the first and second sets of collected data; and

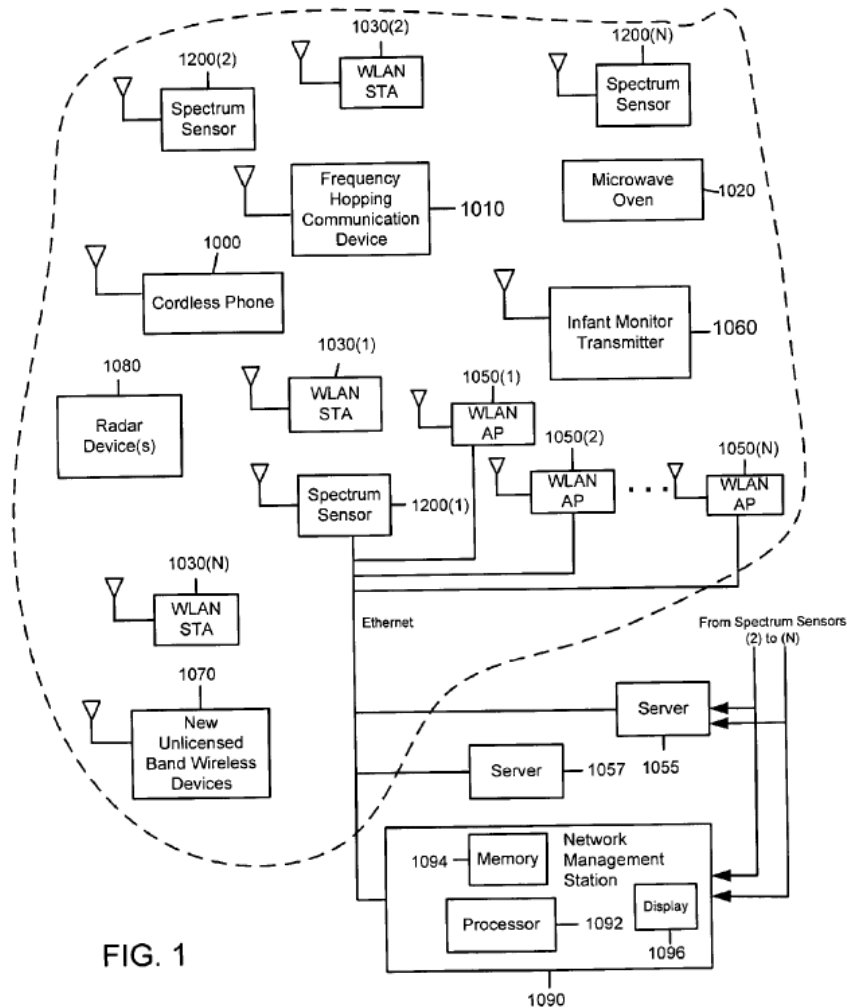
[e] a third interface coupled to the processor, the third interface transmits, in response to the processor determining a change in performance in at least one of the first network or the second network, the at least one policy to the first communication unit that makes a performance-related adjustment within the first network based on the at least one policy.

i. Limitation 1[pre]: A communication system comprising:

88. I understand that a preamble generally does not state a claim limitation. However, to the extent the preamble limits claim 1, it is my opinion that Diener discloses a communication system.

89. Diener teaches “a system . . . for managing communication with a plurality of client devices operating in a radio frequency band”. Ex. 1003 at 3:49-51.

As shown in Figure 1 below, Diener's communication system includes "multiple devices that may be operating simultaneously in an unlicensed or shared frequency band." *Id.* at 4:26-28.



Id. at Fig. 1. Additionally, Diener describes its disclosed invention as "[a] system . . . for managing communication with a plurality of wireless client devices operating in a radio frequency band shared by other types of devices." *Id.* at Abstract. Thus, Diener discloses a communication system.

90. Accordingly, it is my opinion that Diener teaches the preamble of claim 1.

ii. Limitation 1[a]: a first interface coupled to a first communication unit, the first interface receives a first set of collected data associated with a first network managed by the first communication unit;

91. In my opinion, Diener discloses limitation 1[a]. Diener discloses a network management station 1090, which includes a first interface, that is communicatively coupled to a WLAN AP 1050(1). The network management station 1090 receives spectrum intelligence information (i.e., data) associated with the WLAN managed by that AP.

92. As shown in Figure 1 below, Diener discloses a network management station 1090 which is coupled to various WLAN APs, including WLAN AP 1050(1):

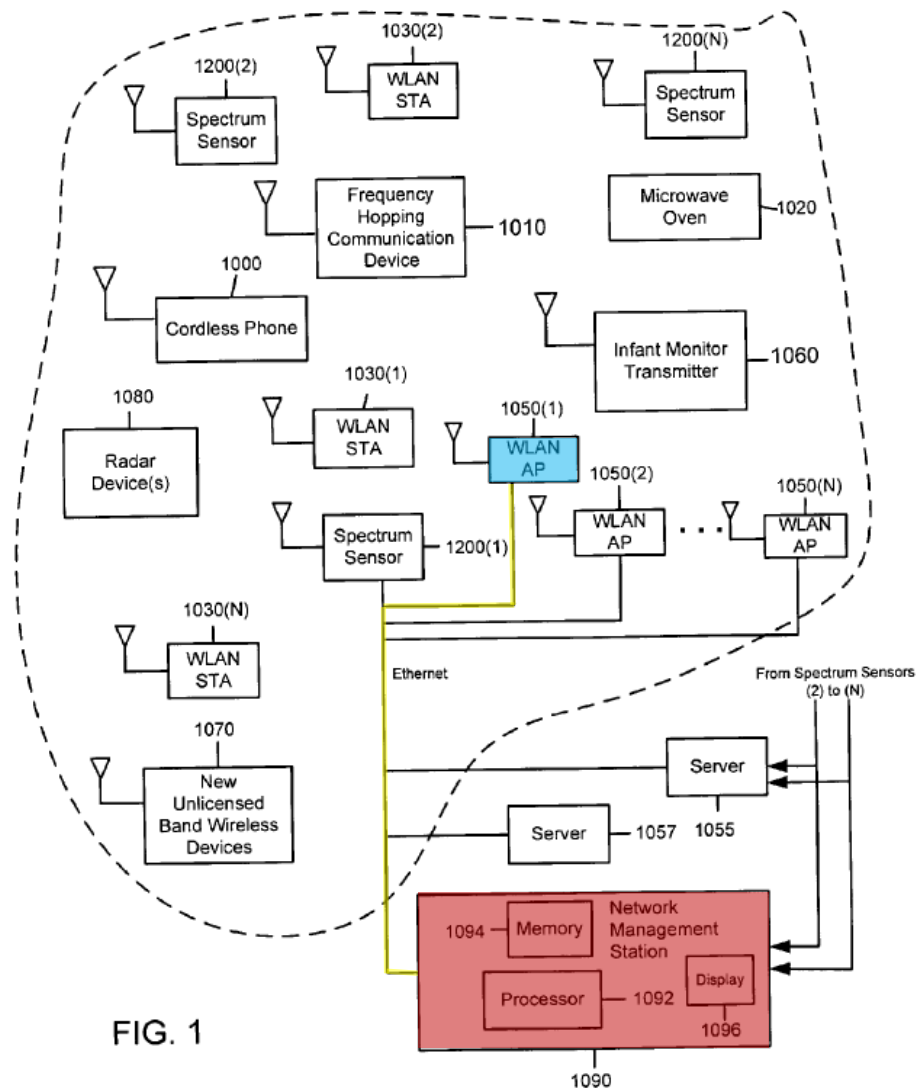


FIG. 1

Ex. 1003 at Fig. 1 (annotated in red to identify network management station 1090, in blue to identify WLAN AP 1050(1), and in yellow to indicate the coupling between network management station 1090 and WLAN AP 1050(1)). Diener also teaches that “the network managing station 1090 [is] . . . coupled to the sensor devices, APs, etc.” *Id.* at 24:7-13; *see also id.*, 65:54-56. Diener also explains:

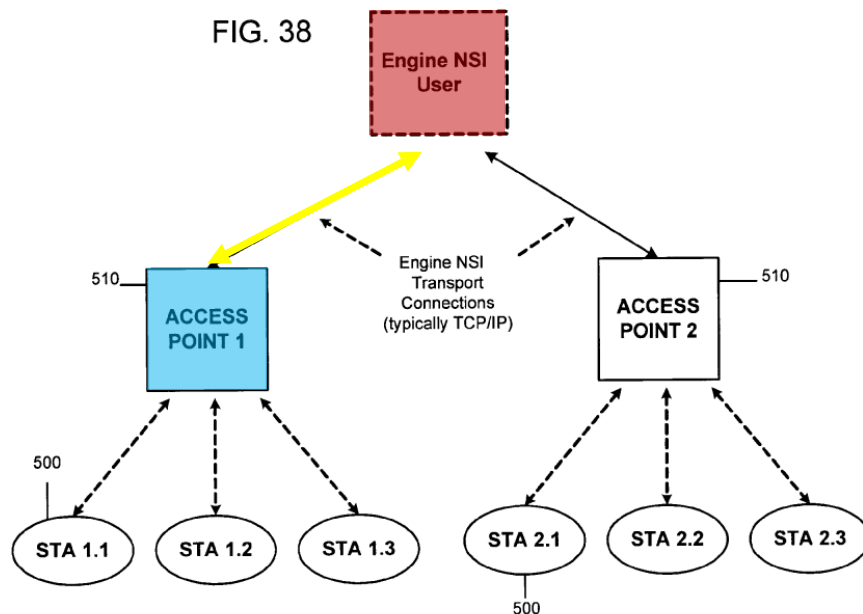
FIG. 1 shows a non-exhaustive exemplary selection of devices that may operate in an unlicensed frequency band, including cordless phones 1000, frequency hopping communication devices 1010, microwave ovens 1020, a wireless local area network (WLAN) comprised of a WLAN access point 1050(1) and its associated client station (STAs) 1030(1) to 1030(N), infant monitor devices 1060 as well as any other existing or new wireless devices 1070. Multiple WLAN APs 1050(1) to 1050(N) may be operating in the region, each of which has one or more associated client STAs 1030(1) to 1030(N).

Id. at 6:8-18 (emphasis added). In my opinion, a POSITA would have understood each WLAN access point (“AP”) to be a communication unit and, thus, WLAN AP 1050(1) corresponds to a first communication unit.

93. Diener also teaches that “network management station 1090 may be connected to the same wired network as the server 1055 and may receive spectrum activity information from one or more WLAN APs 1050(1) to 1050(N) and/or from one or more spectrum sensors 1200(1) to 1200(N).” *Id.* at 7:3-7; *see also id.*, Fig. 1. A POSITA would have recognized that network management station 1090 includes an interface where it receives spectrum activity information from WLAN AP 1050(1) and/or from the spectrum sensors. As shown in Figure 1 above (via the yellow lines), the interface on network management station 1090 is coupled to the first communication unit.

94. A POSITA would have known that an interface may refer to any point of interaction between different communication devices. In Diener, there are a

variety of “Network Spectrum Interfaces” (“NSIs”) at each level of the system. *Id.* at 66:28-40. One such interface is the Engine NSI 270 which “interfaces the L1 engine management services 200 to the L2 manager services 300.” *Id.* at 66:35-37. The “NSI engine services API 272 . . . defines how information is exchanging between the L2 manager services 300 and the L1 engine services 200 executing in APs for that subnet.” *Id.* at 66:64-67. A POSITA would have understood that, in the WLAN environment, the Engine NSI includes a first interface between the WLAN APs and the network management station 1090. This is depicted in Figure 38 where each access point has a transport connection with the Engine NSI User:



Id. at Fig. 38 (annotated). The Engine NSI at the network management station 1090 is just one example of a specific interface at the network management station 1090.

95. The “spectrum activity information” sent from WLAN AP 1050(1) or spectrum sensor 1200(1) is collected data that is received at the first interface of network management station 1090. *Id.* at 7:3-7, 6:58-62 (“The spectrum intelligence gathered by the spectrum sensors is fed to one or several processing platforms such as a network management station 1090 or server 1055, the host processor of an AP, etc., where policy decisions are made and controls may be generated”). For example, Diener explains “[t]he spectrum activity information may comprise information related to the activity in the frequency band as a whole, as well as statistics associated with a wireless network operating in the frequency band, such as IEEE 802.11x WLAN statistics, which may be obtained by an AP or STA operating in the WLAN.” *Id.* at 8:50-64. Additionally, the spectrum intelligence gathered by the spectrum sensors may include data regarding the activity and signals within the frequency band. *Id.* at 3:60-4:7. A POSITA would recognize this spectrum activity information and intelligence to be collected data regarding the frequency band.

96. Additionally, the collected data which is received at the network management station 1090 is associated with a first network in Diener’s system. As previously explained, Diener teaches a first communication device, WLAN AP 1050(1), which is an access point associated with a wireless local area network. Diener teaches “[t]here may be one or more wireless networks each comprising

multiple devices or nodes that operate in the shared frequency band. One example of such a network is a WLAN.” *Id.* at 5:50-52. A POSITA would have understood that the spectrum activity information sent from the WLAN AP 1050(1) (or from spectrum sensor 1200(1) associated with WLAN AP 1050(1)) is data pertaining to that specific WLAN (i.e., network).

97. The WLAN AP 1050(1) in Diener manages the WLAN network with which it is associated. For example, Diener teaches that WLAN AP 1050(1) has associated client stations 1030(1) to 1030(N) which operate within the network and are controlled by WLAN AP 1050(1). *Id.* at 6:11-18, 9:2-6 (describing how an AP advises its associated client stations about spectrum). Diener explains that an access point is a base station that controls “at least one parameter associated with radio communication between the network base station device and each of the plurality of wireless devices based on the radio frequency environment associated with each corresponding one of the plurality of wireless client devices.” *Id.* at 3:54-60. In my opinion, a POSITA would have understood that WLAN AP 1050(1) (i.e., the first communication device) manages the respective WLAN (i.e., first network), and client stations on that network, with which it is associated.

98. Accordingly, it is my opinion that Diener teaches limitation 1[a].

- iii. **Limitation 1[b]: a second interface coupled to a second communication unit, the second interface receives a second set of collected data associated with a second network managed by the second communication unit, the second network being a different network than the first network;**

99. In my opinion, Diener discloses limitation 1[b].

100. As explained immediately above, Diener teaches a network management station 1090, including an interface, that is coupled to WLAN APs 1050(1) to 1050(N) and receives spectrum intelligence information (i.e., data) associated with the network managed by each AP.

101. As shown in Figure 1 below, Diener discloses a network management station 1090 which is coupled to various WLAN APs, including a second communication device WLAN AP 1050(2):

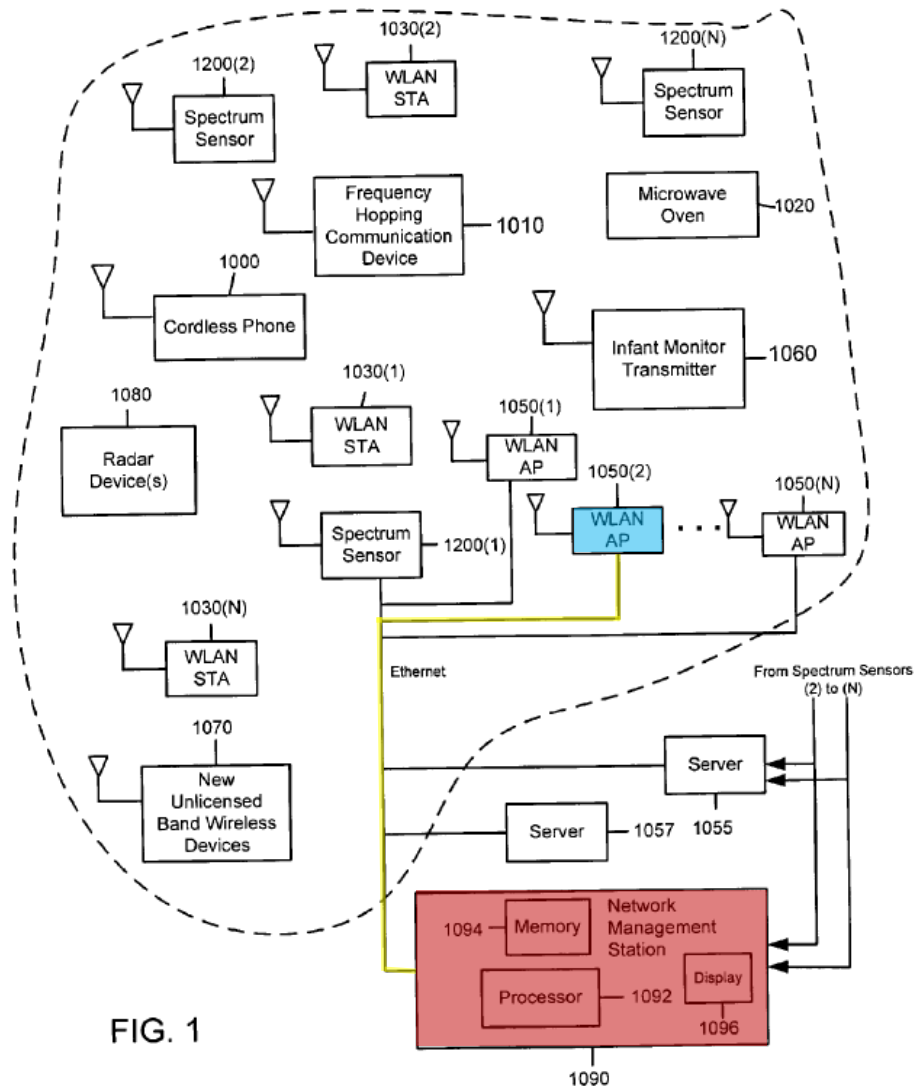
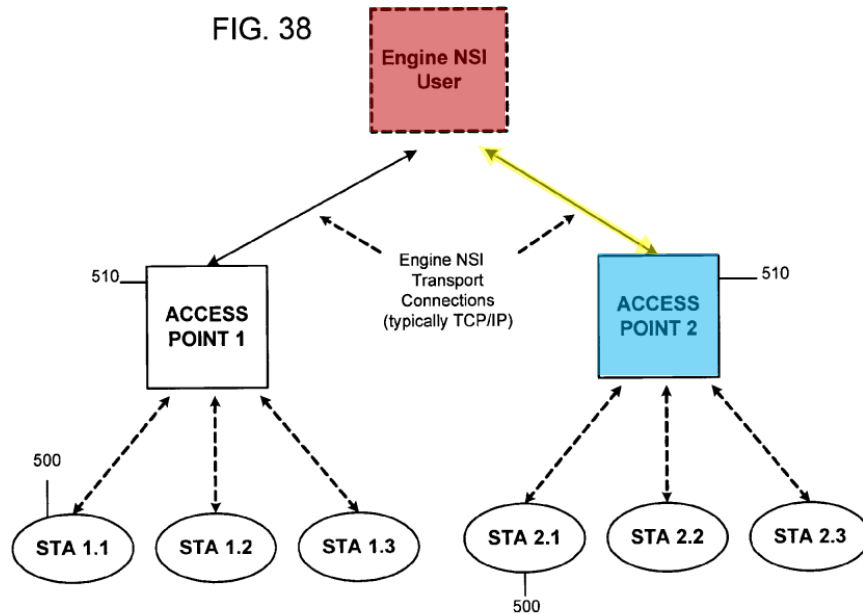


FIG. 1

Ex. 1003 at Fig. 1 (annotated in red to identify network management station 1090, in blue to identify WLAN AP 1050(2), and in yellow to indicate the coupling between network management station 1090 and WLAN AP 1050(2)). As explained above, Diener specifically teaches that network management station 1090 is coupled to the WLAN APs 1050(1) to (N), including WLAN AP 1050(2). *Id.* at 24:7-13, 65:54-56. Diener also explains that “[m]ultiple WLAN APs 1050(1) to 1050(N) may

be operating in the region, each of which has one or more associated client STAs 1030(1) to 1030(N)”. *Id.* at 6:8-18. For the same reasons I discussed above, a POSITA would have understood each WLAN access point to be a communication unit and, thus, WLAN AP 1050(2) corresponds to a second communication unit.

102. Additionally, as I explained above, a POSITA would have understood Diener’s network management station 1090 to have an interface—point of interaction—where spectrum activity information and intelligence (i.e., collected data) is received from the WLAN APs 1050(1) to 1050(N) and/or from spectrum sensors 1200(1) to 1200(N). A POSITA would have also understood the interface at the network management station 1090, where it receives collected data from WLAN AP 1050(2) for example, to be a second interface distinct from the first interface where it received collected data from WLAN AP 1050(1). As shown in Figure 38, Engine NSI is an exemplary interface with a second point of interaction (i.e., a second interface) with a second AP (i.e., second communication device):

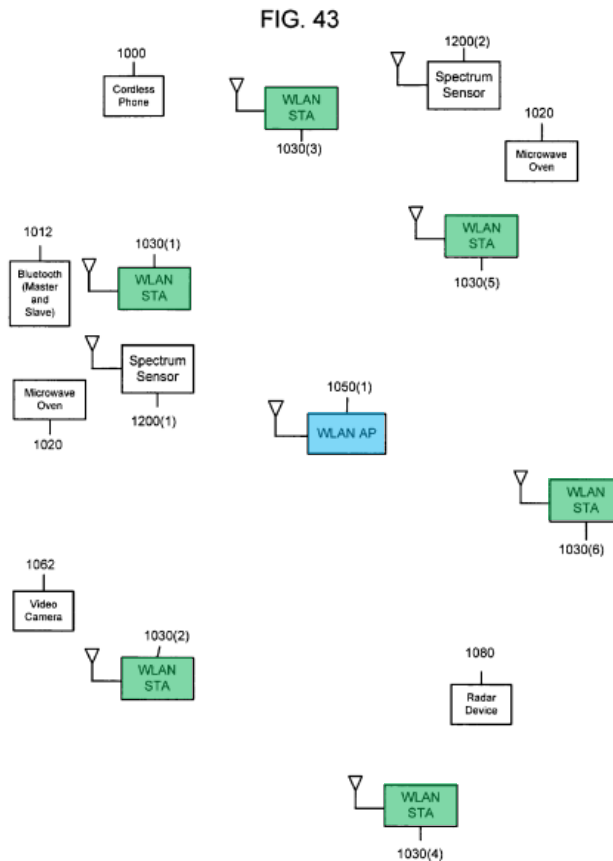


Id. at Fig. 38 (annotated).

103. As explained above, the “spectrum activity information” sent from WLAN AP 1050(2) or spectrum sensor 1200(2) is collected data that is received at the second interface of network management station 1090. *Id.* at 7:3-7, 6:58-62; *id.* at 8:50-64, 3:60-4:7 (explaining the spectrum activity information includes data and statistics regarding the current environment on frequency band).

104. This spectrum activity information and intelligence (i.e., collected data) is associated with a second network in Diener’s system. Diener teaches “[t]here may be one or more wireless networks each comprising multiple devices or nodes that operate in the shared frequency band. One example of such a network is a WLAN.”

Id. at 5:50-52. Figure 43 of Diener shows an exemplary first network with WLAN AP 1050(1) and the various stations on that network:



Id. at Fig. 43 (annotated to identify the WLAN AP in blue and the WLAN stations in green). In my opinion, a POSITA would have recognized this to be an exemplary first network and the second communication device—WLAN AP 1050(2)—may be associated with a second, similarly configured network. Diener further teaches that “[o]ne or more of the WLAN APs 1050(1) to 1050(N) may be connected to a wired network (e.g., Ethernet network).” *Id.* at 6:24-26. The network management station 1090 is configured to “manage wired networks as well as wireless networks” and

make suggestions or “adjust parameters in one or more wireless networks.” *Id.* at 7:11-14, 20:64-66; *see also id.* at 21:20-27 (explaining that a network expert, which is interfaced with the network management station 1090, views activity in the entire region “which may include multiple wireless networks of the same or different varieties”). A POSITA reading Diener would have, therefore, understood that WLAN AP 1050(2) (i.e., a second communication device) may be associated with a second network (e.g., a wired network or a different WLAN) which is different from the first network.

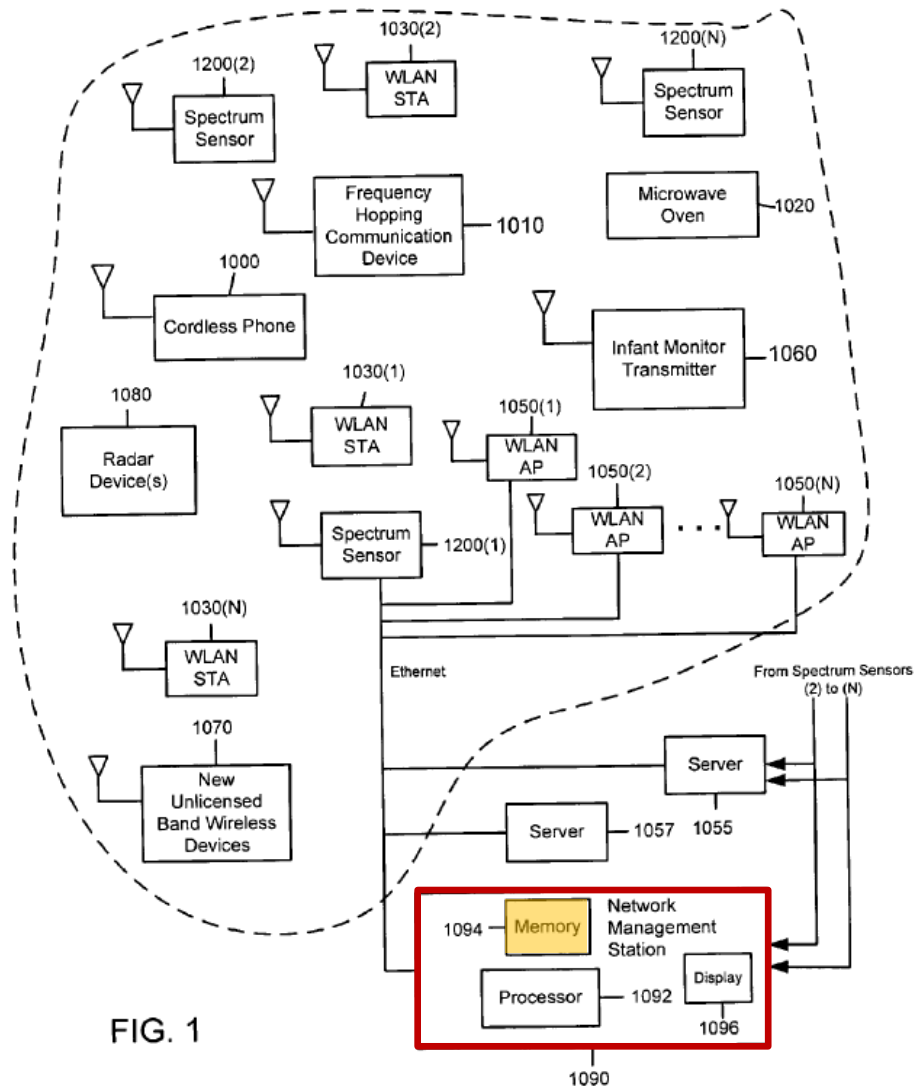
105. As previously explained, a POSITA would have understood that the spectrum activity information sent from the WLAN AP (or from spectrum sensor) is data pertaining to that specific WLAN (i.e., network). Thus, the spectrum activity information and intelligence that is received by second interface of the network management station 1090 from WLAN AP 1050(2) is collected data pertaining to the second network. Like WLAN AP 1050(1), a POSITA would have known that WLAN AP 1050(2) manages the second network which includes its associated client stations. *Id.* at 3:54-60, 6:11-18, 9:2-6 (describing how an AP advises its associated client stations about spectrum).

106. Accordingly, it is my opinion that Diener teaches limitation 1[b].

iv. Limitation 1[c]: a memory coupled to the first and second interfaces, the memory stores the first and second sets of collected data;

107. In my opinion, Diener discloses limitation 1[c].

108. As explained above, Diener discloses a network management station 1090 which a POSITA would have understood to include at least two interfaces which receive collected data associated with the networks of WLAN AP 1050(1) and WLAN AP 1050(2) (i.e., the first and second communication devices). Diener teaches that “[t]he network management station 1090 has, for example, a processor 1092, a memory 1094 that stores one or more software programs executed by the processor and a display monitor 1096.” *Id.* at 7:7-11. The memory of network management station 1090 is depicted in Figure 1:



Id. at Fig. 1 (annotated). A POSITA would have understood that memory 1094 within network management station 1090 is communicatively coupled to the interfaces of network management station where collected data is received and stored within memory 1094.

109. A POSITA would have understood, based on the teachings of Diener, that “the spectrum intelligence gathered” (i.e., collected data) which “is fed to one

or several processing platforms such as a network management station 1090” and stored within memory 1094 of the network management station 1090. *Id.* at 6:58-62, 10:24-25. Diener specifically teaches “the spectrum activity information can be accumulated and stored on a short term basis (seconds or minutes) or a long-term basis (minutes to hours) for subsequent analysis.” *Id.* at 9:12-21 (emphasis added). A POSITA would have understood that this spectrum activity information (i.e., collected data) would be stored in memory 1094 of the network management station 1090. Diener explains that “a server that manages multiple APs will have intelligence for the entire multiple AP network” which a POSITA would have understood to mean that the server (here, network management station 1090 stores data from each AP). *Id.* at 9:6-8. Thus, the network management station 1090 will store both the first and second sets of collected data.

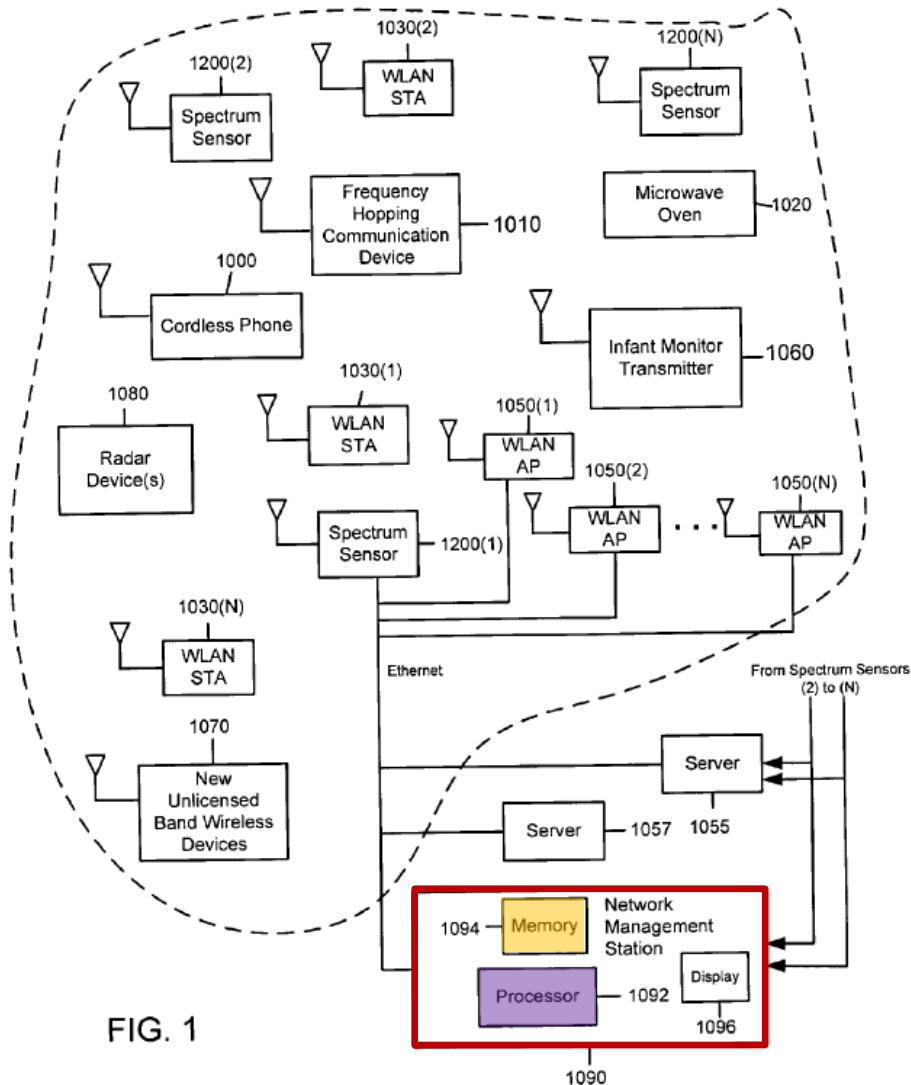
110. Accordingly, it is my opinion Diener discloses limitation 1[c].

- v. **Limitation 1[d]: a processor coupled to the memory, the processor generates at least one policy based at least in part on an analysis of the first and second sets of collected data; and**

111. In my opinion, Diener discloses claim limitation 1[d].

112. Diener teaches that “[t]he network management station 1090 has, for example, a processor 1092, a memory 1094 that stores one or more software programs executed by the processor and a display monitor 1096.” *Id.* at 7:7-11

(emphasis added). The processor 1092 of network management station 1090 is depicted in Figure 1:



Id. at Fig. 1 (annotated). A POSITA would have understood that processor 1092 is coupled to memory 1094 within network management station 1090, especially as Diener teaches that memory stores programs executed by the processor. *Id.* at 7:7-11. A POSITA would have recognized that processor 1092 and memory 1094 are

communicatively coupled such that processor 1092 can carry out programs and use data stored within memory 1094.

113. Diener also teaches that processor 1092 generates a policy based on an analysis of the spectrum activity information and intelligence received (i.e., first and second sets of collected data).

114. Diener discloses that the network management station, through its processor, analyzes the received spectrum information. *Id.* 9:6-11. For example, Diener discloses that “[i]n addition, or separately from the reporting function, the spectrum activity information may be processed in a processor (local to or remote from the source devices of the actual spectrum activity information).” *Id.* at 9:22-25. A POSITA would have considered the “processing” of spectrum activity information to include analysis. A POSITA would recognize that Diener is referring to the network management station, which is remote to the source devices of the actual spectrum activity information. Diener further explains that both of the first and second sets of collected data are analyzed as the network management station “will have intelligence for the entire multiple AP network.” *Id.* at 9:6-8. Therefore, a POSITA would have understood that the analyzed data includes both first and second sets of collected data pertaining to the first and second networks. Additionally, Diener teaches that a network expert 80 interfaces with the network

management station and has a “global view of the spectrum activity of the entire region of unlicensed band operation, which may include multiple wireless networks of the same or different varieties (e.g., IEEE 802.11g WLAN, WPAN, Bluetooth™, etc.).” *Id.* at 21:20-25, 21:51-53. Accordingly, a POSITA would have recognized that the network management station 1090 analyzes data received concerning multiple networks (i.e., the first and second sets of collected data).

115. Diener explains that the analysis of spectrum information (i.e., collected data) is used to generate a policy. For example:

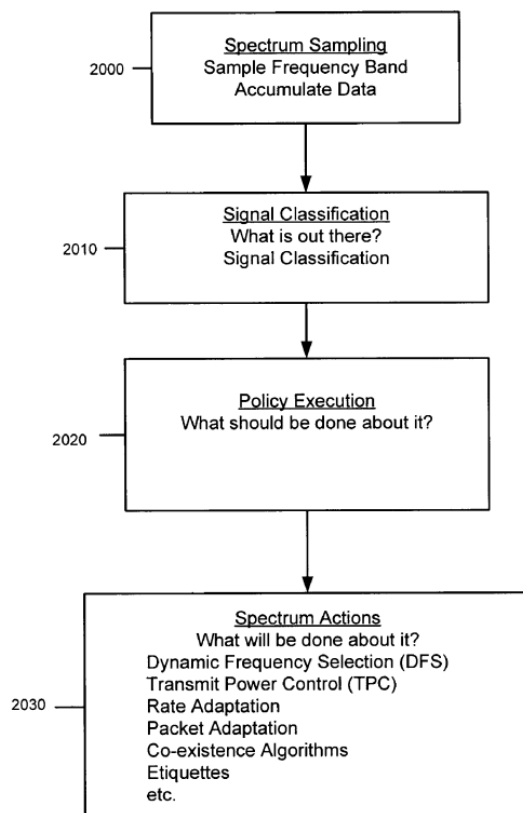
The spectrum intelligence gathered by the spectrum sensors is fed to one or several processing platforms such as a network management station 1090 or server 1055, the host processor of an AP, etc., where policy decisions are made and controls may be generated. For example, there may be another server 1057 that executes a WLAN management application for the APs 1050(1) to 1050(N). The server 1055 or network management station 1090 may generate controls or reports to the server 1057 that affect changes in one or more APs.

Id. at 6:58-67. Similarly, Diener teaches that the data is analyzed in a signal classification step. “Using knowledge of the types of signals occurring in the frequency band and other spectrum activity related statistics (referred to as spectrum intelligence), actions can be taken in a device or network of devices to avoid interfering with other signals, and in general to optimize simultaneous use of the frequency band with the other signals.” *Id.* at 2:18-24. Accordingly, it is my opinion that a POSITA would have understood that Diener teaches the network management

station 1090 generates a policy (via its processor) based on the received spectrum information (i.e., first and second sets of collected data).

116. Diener teaches that “knowledge of the types of signals occurring in the frequency band” is determined during the signal classification step which follows spectrum sampling (where data is collected and transmitted to the network management station 1090). *Id.* at 2:18-24, Fig. 5. As shown in Figure 5 below, this signal classification step is followed by a policy execution step 2020:

FIG. 5



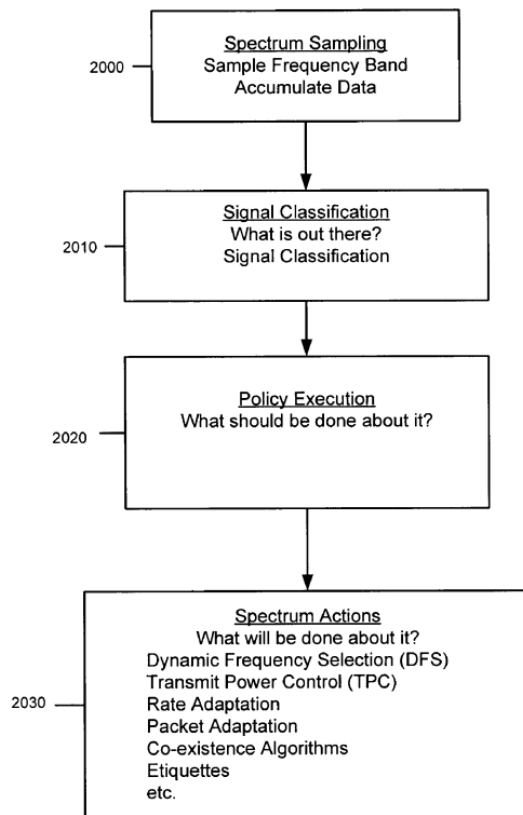
A POSITA would recognize that the policy execution step is performed by the server (i.e., network management station) which generates and determines policies for the communication units. Diener discloses policies are generated by the network management station to suggest or recommend what actions should be taken by the communication device. *See, e.g., id.* at 9:49-52 (“For example, the policies dictate what spectrum actions in or controls of a communication device or network of devices to take on the basis of the output of the signal classification step 2010.”) (emphasis added); *id.* at 9:47-49 (“The policy execution step 2020 involves determining what, if anything, should be done about the information output by the signal classification step 2010.”) For purposes of the ’313 Patent, Diener “generat[es] a policy” when it determines what action should be taken by the communication device. In other words, the claimed “policy” is the network management system’s determination that interference exists (based on signal classification) which needs to be mitigated or avoided and generation of what actions should be taken by the APs to do so.

117. To communicate that policy to the APs, Diener discloses that “in processing the spectrum activity information, controls may be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band.” *Id.* at 9:55-59 (emphasis added). Examples of controls are:

[A]ssigning a device to a different frequency Sub-band or channel in the frequency band (dynamic frequency selection DFS), network load balancing (on the basis of channel frequencies or time), adjusting the transmit power (transmit power control—TPC), adjusting the communication data rate, adjusting a parameter of the transmitted data packet, executing interference mitigation or co-existence algorithms, executing spectrum etiquette procedures, executing spectrum priority schemes, or re-assigning STAs to APs in a WLAN.

Id. at 9:47-10:2. These exemplary “controls” each indicate a different exemplary policy that may be determined in Diener. For example, as shown in Figure 5 below, the policy execution step leads to the spectrum actions step where specific actions (like those discussed immediately above) are taken by the APs in response to the policy:

FIG. 5



118. The generated policies are based on the collected data which is gathered in the spectrum sampling step and classified in the signal classification step. Diener explains “[t]he spectrum intelligence may be used to suggest actions to a device user or network administrator, or to automatically invoke actions in a device or network of devices to maintain desirable performance.” *Id.* at 2:24-27. For example, “when an interference condition (presence of another signal in the frequency band of operation, adjacent frequency channel of operation, etc., of a device or network of devices in the frequency band) is detected, a real-time alert may be generated to

advise a network administrator about the condition.” *Id.* at 9:37-42 (emphasis added). “The alert may include recommendations to a user or to a network administrator to make adjustments to a device or network of devices operating in the frequency band.” *Id.* at 9:42-46 (emphasis added).

119. Diener teaches “us[ing] spectrum activity information” to “make a decision to either interfere with another signal or not to interfere.” *Id.* at 19:41-44. The exemplary policies disclosed by Diener are in the interference context. For example, one specific policy includes: “Detecting in packet sequence statistics indicating a hidden node may call for executing an RTS/CTS sequence. The RTS/CTS sequence is used as a ‘delivery confirmation system’ and is turned off when possible”. *Id.* at 19:53-59. RTS/CTS is a type of algorithm, invoked by an AP, that the spectrum expert at the server instructs the AP to invoke when certain levels of interference, or a hidden node is detected. *Id.*; *see also id.* at 10:3-5 (incorporating by reference U.S. Patent Publication No. 2002/0061031 (published May 23, 2002) which discloses “[e]xamples of interference mitigation algorithms”).

120. As yet another example, Diener teaches an exemplary policy wherein there is noise on a transmission channel (a “background hum”) and “[t]he policy associated with this case may be to use a spatial processing algorithm to improve the link margin between two devices.” *Id.* at 60:60-64; *see also id.* at 60:64-61:6

(incorporating by reference U.S. Patent Application No. 10/174,728 (filed June 19, 2002) which discloses “[e]xamples of spatial processing algorithm[s]”). Diener teaches numerous specific examples of specific interference-mitigation or interference-avoidance policies, including specific actions to be taken by the APs. *Id.* at 54:48-64:18.

121. A POSITA would have understood, based on the teachings of Diener, that these policies would be generated by processor 1092 within the network management station. Additionally, a POSITA would have found it obvious to have processor 1092 generate these policies after analyzing the received data during signal classification.

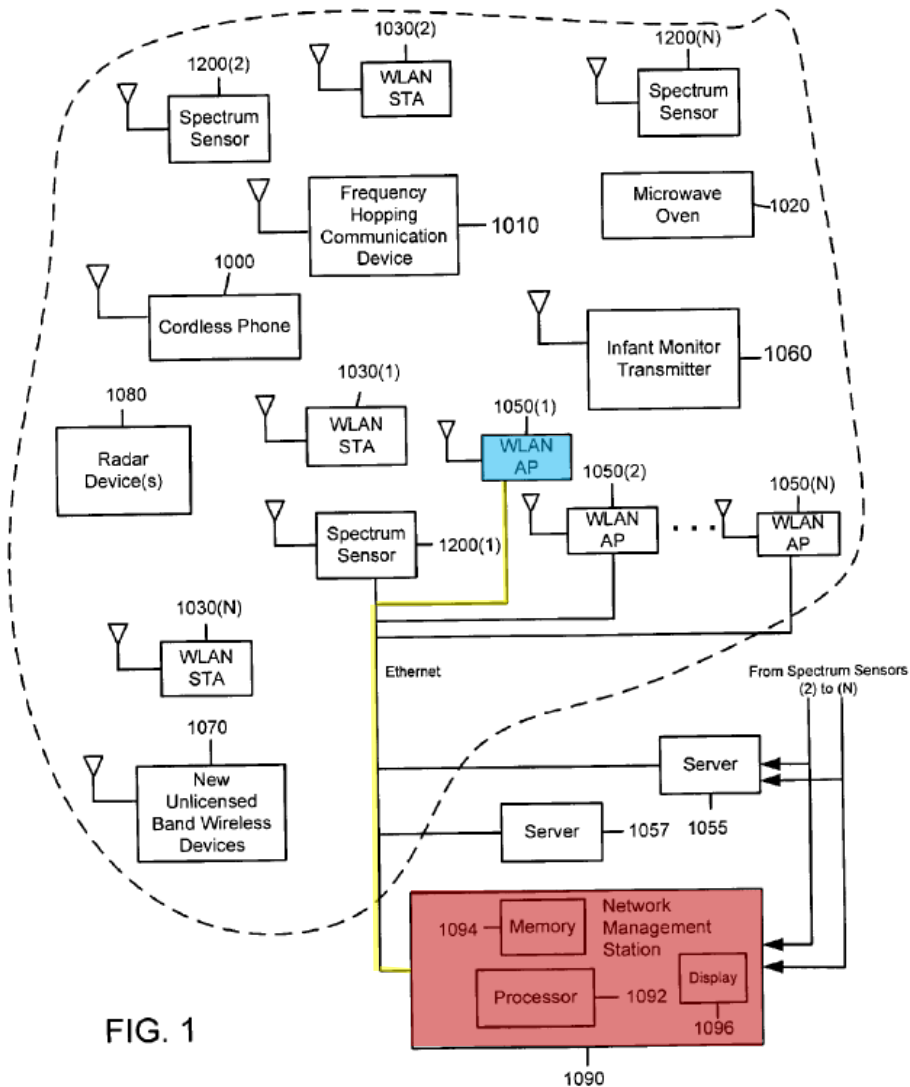
122. Accordingly, it is my opinion Diener teaches and/or renders obvious limitation 1[d].

- vi. **Limitation 1[e]: a third interface coupled to the processor, the third interface transmits, in response to the processor determining a change in performance in at least one of the first network or the second network, the at least one policy to the first communication unit that makes a performance-related adjustment within the first network based on the at least one policy.**

123. In my opinion, Diener discloses claim limitation 1[e].

124. As explained regarding limitation 1[a] above, a POSITA would have understood that the network management station 1090 of Diener includes an

interface where it has a point of contact with WLAN AP 1050(1). For example, as shown in Figure 1, network management station 1090 has an interface where it is coupled to WLAN AP 1050(1):



Id. at Fig. 1 (annotated). In my opinion, a POSITA would have recognized that when this interface is used to transmit controls from network management station 1090 to WLAN AP 1050(1), it is a third interface. This is juxtaposed with the first

interface—also the point of contact between WLAN AP 1050(1) and network management station 1090—which is the interface where data is transmitted from WLAN AP 1050(1) to the network management station.

125. As is shown above in Figure 1, this third interface is coupled to processor 1092 within network management station 1090. A POSITA would have recognized that the third interface and processor 1092 are at least communicatively coupled because the processor generates control signals (as explained more fully below) which are transmitted through the third interface back to WLAN AP 1050(1).

126. Diener teaches that when the received spectrum information (i.e., collected data) is analyzed, a policy is generated based on that information. For example, Diener explains “in processing the spectrum activity information, controls may be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band.” *Id.* at 9:46-59 (emphasis added). These controls are transmitted through the third interface of the network management station 1090 and back to WLAN AP 1050(1) (i.e., the first communication unit) instructing it to adjust an operating parameter respectively. *Id.* at 10:19-36. Specifically, Diener discloses:

For this latter case, the network management station 1090 or the server 1055 (FIG. 1) may receive spectrum activity information and generate the control signals. The control signals are then in turn delivered back to one or more devices operating in the frequency band. For example,

if the control signal pertains to a parameter of a WLAN AP or STA, then the control signal may be delivered by the network management station 1090 or server 1055 via the network connection to one or more APs (e.g., one or more of APs 1050(1) to 1050(N) shown in FIG. 1). The AP will receive the control signal and change one of its operational parameters.

Id. at 10:19-36 (emphasis added). Accordingly, Diener teaches that the policy is transmitted via control signal to the first communication unit.

127. The control signals are generated when, for example, the processor of the network management station 1090 detects a change has occurred affecting the quality of transmission in a frequency band. *Id.* at 9:22 – 10:36. For example, Diener teaches a policy may be determined “when an interference condition (presence of another signal in the frequency band of operation, adjacent frequency channel of operation, etc., of a device or network of devices in the frequency band) is detected.” *Id.* at 9:37-40. A POSITA would have understood that detected interference on a frequency band or channel constitutes a change in performance at a first network.

128. Once the WLAN AP 1050(1) receives the control signal comprising the policy from network management station 1090, the WLAN AP 1050(1) “will receive the control signal and change one of its operational parameters.” *Id.* at 10:31-33. For example, in response to a policy transmitted from the network management station 1090, the WLAN AP may execute a particular RTS/CTS sequence to avoid a hidden node, select a cleaner channel to avoid interference, or adjust its transmit power to

mitigate interference. *Id.* at 19:41-64. Each of these adjustments are performance-related in that they affect the performance on the network, the performance of the specific WLAN AP 1050(1), and/or the performance of the AP's associated client stations. A POSITA would have also known the implementation of the policy by the AP—by making any of the above-described exemplary adjustments—would result in an adjustment to performance within the first network (the WLAN associated with the first AP).

129. Accordingly, in my opinion, Diener discloses claim limitation 1[e].

130. For the foregoing reasons, it is my opinion that Diener teaches and/or renders obvious claim 1.

2. Claim 2: The communication system of claim 1, wherein the adjustment within the first network is an implementation of an algorithm.

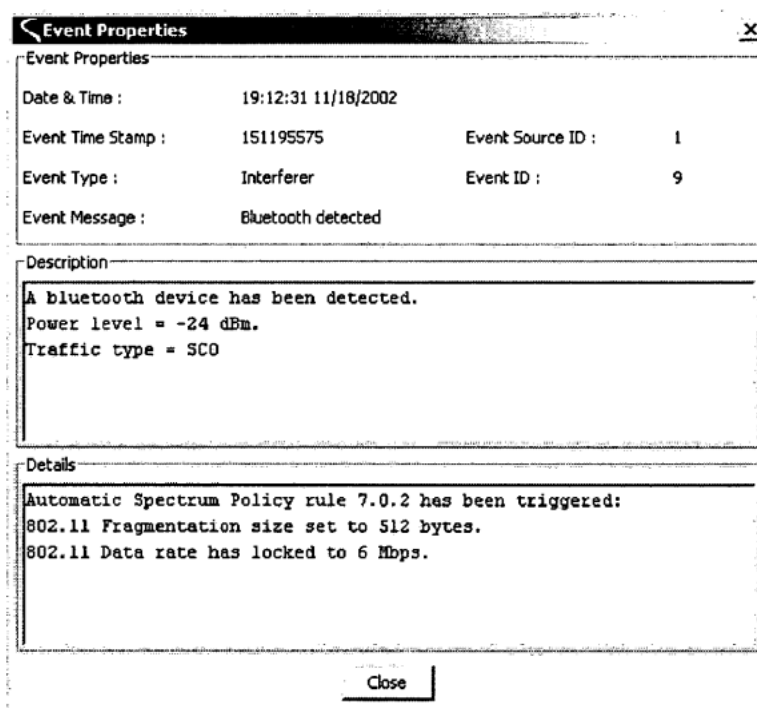
131. In my opinion, Diener discloses claim 2. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, as explained above, Diener teaches generating a policy which instructs the execution of interference mitigation or co-existence algorithms. *Id.* at 9:67 – 10:5 (also incorporating by reference U.S. Patent Publication No. 2002/0061031 which discloses examples of interference mitigation algorithms).

132. Diener teaches that the policy instructing an AP to implement these interference mitigation or co-existence algorithms is transmitted via control signal to the WLAN AP 1050(1) (i.e., first communication unit associated with a first network) which changes its operational parameters accordingly. *Id.* at 10:12-36. As one specific example, Diener teaches that the adjustment in a network may be to execute an RTS/CTS sequence when a hidden node is detected. *Id.* at 19:53-59. In my opinion, a POSITA would have recognized RTS/CTS to be an algorithm that is implemented within a first network (i.e., the wireless network associated with WLAN AP 1050(1)). As a second example, Diener teaches a policy that instructs an AP to “use a spatial processing algorithm” within its network “to improve the link margin between two devices.” *Id.* at 60:60-64. And as a third example, Diener teaches implementing a specific algorithm in a Bluetooth™ network when signal classification indicates interference with an 802.11 network. *Id.* at 62:4-17 (“the Bluetooth network should avoid generating interference with 802.11 by idling slots where the 802.11 data or ACK would occur”).

133. Moreover, as explained above, Diener teaches a policy execution step which results in recommended actions to be taken by an AP. Those actions include: “Dynamic Frequency Selection (DFS), Transmit Power Control (TPC), Rate Adaptation, Packet Adaptation, Co-existence Algorithms, Etiquettes, etc.” *Id.* at Fig.

5. In my opinion, a POSITA would have understood that carrying out each of these specific actions requires the implementation of an appropriate algorithm. In one example in Diener, as shown in Figure 19 below, after detecting interference with a Bluetooth device, the generated policy instructs the AP to adjust fragmentation size to 512 bytes and lock the data rate at 6 Mbps:

FIG. 19



In my opinion, a POSITA would have known that in order to make these adjustments, the AP would implement fragmentation and data rate algorithms. By implementing the algorithms associated with the communicated policy (e.g., Dynamic Frequency Selection (DFS), Transmit Power Control (TPC), Rate

Adaptation, Packet Adaptation, Co-existence Algorithms, Etiquettes), a POSITA would have known that the AP's performance—and performance of its respective WLAN network—would improve in accordance with reduced or minimized interference.

134. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 2.

3. Claim 3: The communication system of claim 1, wherein the adjustment within the first network is a change in parameter value.

135. In my opinion, Diener discloses claim 3. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, Diener teaches that the adjustment made within the first network associated with WLAN AP 1050(1) is “a control . . . of at least one parameter associated with radio communication between the” AP and wireless devices in the environment. *Id.* at 3:54-60.

136. Diener explicitly teaches that “controls may be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band.” *Id.* at 9:55-59; *see also id.* at 11:9-11 (“For example, if the device is an IEEE 802.11 AP, then a change in an operational parameter may affect a change in the operation of the AP as well as the STAs that are associated with that AP.”).

As one example, Diener teaches that an adjustment within the first network includes “adjusting a parameter of the transmitted data packet.” *Id.* at 9:66. Diener also provides several examples of the specific parameter values that may be adjusted in the network:

Parameters that can be adjusted (manually or automatically) based on output of the spectrum expert 56 include frequency channel, transmit power, fragmentation threshold, RTS/CTS, transmit data rate, CCA threshold, interference avoidance, etc.

Id. at 19:13-16.

137. Diener also discloses specific parameters which are adjusted based on the communicated policy. These parameters include: “frequency[] of operation, bandwidth of operation, data rate, transmit power, etc.” *Id.* at 11:20-33. A POSITA would have understood that parameters such as frequency hopping nature, bandwidth, data rate, and transmit power would be adjusted when the AP complies with the received policy. *See also id.* at Fig. 19 (in the specific example of Figure 19, parameter adjustments would be made to the fragmentation size and data rate).

138. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 3.

4. Claim 4: The communication system of claim 1 wherein the first communication unit reduces interference in the second network based on an implementation of the at least one policy within the first network.

139. In my opinion, Diener discloses claim 4. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, Diener teaches a first communication unit reducing interference in a second network based on implementing the policy that is generated by the network management station 1090 in its associated network.

140. For example, Diener discloses a scenario where a Bluetooth™ signal “can cause periodic interference with, for example, an AP for an IEEE 802.11 network”. *Id.* at 61:33 – 62:3. In my opinion, a POSITA would have recognized that WLAN AP 1050(1) (i.e., the first communication unit) is associated with an IEEE 802.11 wireless network (i.e., the first network) and the device(s) causing the Bluetooth™ signal are operating within a second, Bluetooth™ network. In response to this detected interference, Diener teaches generating a few different policies which are implemented by WLAN AP 1050(1) on the first network and result in a reduction of interference on the Bluetooth™ network.

141. First, Diener discloses scheduling 802.11 QoS packets to occur between the Bluetooth™ synchronous traffic (SCO) packets. *Id.* at 61:43-47. Second, Diener discloses implementing a policy wherein packets are not transmitted

during the Bluetooth™ scheduled SCO periods. *Id.* A POSITA would have understood that the implementation of these policies would result in a reduction of interference in the second (Bluetooth™) network.

142. As another example, Diener discloses a scenario where two IEEE 802.11 networks are causing interference on the same channel or an adjacent channel. *Id.* at 59:41 – 60:3. In that situation, Diener teaches employing the disclosed “interference mitigation techniques”, adjusting an AP to a clean or further away channel, or adjusting the location of the AP, as a few examples. *Id.* at 59:45-63. A POSITA would have recognized that any of these techniques, when employed by a first communication unit associated with a first IEEE 802.11 network, reduce interference in the second network.

143. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 4.

5. Claim 5: The communication system of claim 4 wherein the at least one policy adjusts channel transmission characteristics of at least one wireless channel within the first network.

144. In my opinion, Diener discloses claim 5. As explained above, Diener teaches and/or renders obvious the communication system of claim 4. As explained above, Diener discloses situations where more than one network (i.e., IEEE 802.11 networks) operate on the same wireless channel. *Id.* at 59:54-58. In that situation,

one such policy taught by Diener is to have an AP of the first network switch “to a clean/unused channel.” *Id.* Claim 6 of Diener similarly teaches a policy of adjusting a client device’s channel frequency (i.e., switching channels). *Id.* at claim 6. A POSITA would have understood that switching an AP from one wireless channel to another, or inducing a client device to change channels, is indeed equivalent to adjusting the wireless channel’s transmission characteristics as there will be less interference affecting the transmission quality on that channel.

145. Additionally, when two networks cause interference over a wireless channel, Diener alternatively teaches adjusting hops to prevent one network from interfering with another. *Id.* at 62:18-49. For example, in the scenario where a Bluetooth™ network interferes with an IEEE 802.11 network, Diener teaches a policy that “the Bluetooth network should remove hops that enter the 802.11 band.” *Id.* at 62:20-21. A POSITA would have understood this policy to adjust the channel characteristics on the wireless channel comprising the 802.11 band.

146. Diener also teaches adjusting the percentage of a band that may be used by a Dynamic Rate Adapting (DRA) devices which are in the presence of frequency hopping signal(s). *Id.* at 62:31-48. Specifically, Diener discloses:

Policy 1: If a frequency hopping signal is detected, limit the DRA to 50% of the band, so that the frequency hopping network can still operate.

Policy 2: If the frequency hopping network adapts its hop set in response (observed by a measurement), then DRA can be allowed to use 75% of the band.

Id. at 62:43-48. A POSITA reading Diener would have recognized that the above-described policies adjust the channel transmission characteristics (e.g., the percentage allotted to the DRA) associated with the frequency band of a wireless channel.

147. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 5.

6. Claim 6: The communication system of claim 5 wherein the channel transmission characteristics comprise a modification to a transmission band across the at least one wireless channel within the first network.

148. In my opinion, Diener discloses claim 6. As explained above, Diener teaches and/or renders obvious the communication system of claim 5. As explained immediately above, Diener teaches adjusting the percentage of a frequency band of a wireless channel which a DRA may occupy. *Id.* at 62:32-48. I incorporate my analysis above regarding claim 5 by reference. A POSITA would have understood that these policies dictate modifications to the transmission band (i.e., frequency band) across the wireless channel within the first network.

149. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 6.

7. Claim 7: The communication system of claim 1 wherein the first and second sets of collected data comprise historical data.

150. In my opinion, Diener discloses claim 7. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, Diener teaches that the spectrum activity information and intelligence which is received at the network management station 1090 and stored in its associated memory may include historical data.

151. For example, “a server that manages multiple APs will have intelligence for the entire multiple AP network.” *Id.* at 9:6-8. A POSITA would have recognized that network management station 1090 is one such “server” which manages multiple APs across multiple networks. Diener further explains:

The spectrum activity information (or the raw data used to generate it) is reported locally, or remotely, to other devices to display, analyze and/or generate real-time alerts related to activity in the frequency band. Moreover, the spectrum activity information can be accumulated and stored on a short term basis (seconds or minutes) or a long-term basis (minutes to hours) for subsequent analysis.

Id. at 9:12-21 (emphasis added). Thus, the spectrum activity information received regarding the first and second networks (i.e., first and second sets of collected data) is stored and may include historical data that can be analyzed later in time.

152. As explained regarding claim 1, Diener also teaches performing signal classification of the received spectrum activity information. This signal

classification step includes processing historical spectrum data, for example, to “build histograms of signal pulse data that are useful for signal classification.” *Id.* at 14:35-37. In my opinion, a POSITA would have known that these histograms include historical data received from the first and second communication units (i.e., first and second sets of collected data).

153. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 7.

8. Claim 8

i. Limitation 8[pre]: The communication system of claim 1 wherein the processor:

154. I understand that a preamble generally does not state a claim limitation. However, to the extent the preamble limits claim 8, it is my opinion that Diener discloses a communication system with a processor. As I explained regarding claim limitations 1[pre] and 1[d] above, Diener discloses a communication system with a processor.

155. Accordingly, it is my opinion that Diener teaches limitation 8[pre].

ii. Limitation 8[a]: generates a first control signal that is sent to the first communication unit at a first pre-defined time, the first control signal comprising a first policy adjustment to the first network; and

156. In my opinion, Diener renders obvious limitation 8[a]. Diener explicitly teaches generating a control signal: “network management station 1090 . . . may

receive spectrum activity information and generate the control signal.” *Id.* at 10:19-

25. Diener also explains that the controls correspond to specific policies. Diener provides an example:

For example, the policies dictate what spectrum actions in or controls over a communication device or network of devices to take on the basis of the output of the signal classification step 2010. . . . In addition, in processing the spectrum activity information, controls may be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band. . . . Examples of controls are: assigning a device to a different frequency sub-band or channel in the frequency band (dynamic frequency selection—DFS), network load balancing (on the basis of channel frequencies or time), adjusting the transmit power (transmit power control—TPC), adjusting the communication data rate, adjusting a parameter of the transmitted data packet, executing interference mitigation or co-existence algorithms, executing spectrum etiquette procedures, executing spectrum priority schemes, or re-assigning STAs to APs in a WLAN.

Id. at 9:60 – 10:2 (emphasis added); *see also id.* at 10:12-18. A POSITA reading Diener would have therefore recognized that Diener discloses generating a first control signal which is sent to a first communication unit (e.g., WLAN AP 1050(1)) which comprises a policy adjustment to the first network associated with that communication unit.

157. A POSITA would have found it obvious based on the teachings of Diener that a first control signal sent to a first communication unit (e.g., a first WLAN AP 1050(1)) may be sent at a pre-defined time. Diener discloses a spectrum expert that may be executed by network management station 1090 and “may operate

to control or suggest controls for a single WLAN AP” such as WLAN AP 1050(1). *Id.* at 19:10-29. Diener goes on to describe a situation where “a particular AP . . . may be experiencing occasional interference on a particular frequency channel at a certain time of day.” *Id.* at 22:18-21. Diener teaches that the spectrum expert may generate a control—through network management station 1090—which is sent to that AP (e.g., WLAN AP 1050(1)) to “move to another channel during that time of day.” *Id.* at 22:19-23. A POSITA would have understood that this control signal could be sent to the specific AP (e.g., WLAN AP 1050(1)) at a predetermined time (i.e., the time of day when the AP should move to a different channel based on the generated policy). In my opinion a POSITA would have found it obvious, based on the teachings of Diener, to generate a first control signal for this first AP at a pre-defined time.

158. Diener provides a specific example of this scenario where interference occurs between an 802.11 AP on a first WLAN and Bluetooth™ devices on a Bluetooth™ network. Diener teaches that the determined policy, and corresponding generated control signal, adjusts the policy of the 802.11 AP (e.g., first communication device) to schedule its packet deliveries around the timing of the packets transmitted by Bluetooth™. *Id.* at 61:34-49. A POSITA would have understood that the control signal sent to WLAN AP 1050(1), for example, would

be sent at a pre-defined time and comprises a policy adjustment to the first network (i.e., the 802.11 network associated with that AP).

159. Additionally, in my opinion a POSITA would have found it obvious, based on the teachings of Diener, to generate a first control signal for this first AP at a pre-defined time. For example, a POSITA would have been aware that the respective control signal could be sent as soon as the policy is generated and deliver scheduling information to the AP to take future actions in accordance with the schedule. Alternatively, a POSITA would have known that the control signal itself could be timed in accordance with the schedule such that it would be sent instructing the AP to take the appropriate action immediately. In this latter scenario, the control signal would be sent at a predefined time.

160. Scheduling control signals was known by 2011. In one example, contemporaneous art discloses a “central coordinator”—similar to the network management station of Diener—which predetermines time intervals to allow the respective stations use of communication channels and send policy information at the scheduled times. Ex. 1022 at 1:20-31. The schedules (which a POSITA would have understood to be sent via control signals) are sent to stations during pre-determined TDMA Contention Periods. *Id.* at 9:27-39, 10:60-65. Additionally, POSITAs would have known about predefined time slots as discussed in 3GPP

specifications existing prior to 2011. In those specifications, policy updates are transmitted from a central controller to the respective nodes at predefined, periodic intervals. Ex. 1023. Thus, to the extent Diener does not explicitly teach predefined timing of control signals, this would have been obvious to a POSITA based on a POSITA's knowledge in the art at the time of invention.

161. Accordingly, it is my opinion that Diener renders obvious limitation 8[a].

iii. Limitation 8[b]: generates a second control signal that is sent to the second communication unit at a second pre-defined time, the second control signal comprising a second policy adjustment to the second network.

162. In my opinion, Diener renders obvious limitation 8[b]. As explained immediately above, Diener renders obvious generating a first control signal sent to a first communication unit at a pre-defined time and the control signal comprises a first policy adjustment to the first network. A POSITA reading Diener would have similarly understood that, because Diener teaches generating policies and controls for multiple communication units, across multiple networks, Diener discloses a second control signal—similar to the first control signal discussed regarding limitation 8[a]—that adjusts the second network.

163. For example, using first scenario discussed above regarding limitation 8[a], Diener teaches a network expert interfaced with the network management

station 1090 that operates “across multiple WLAN APs, such as APs 1050(1) to 1050(N)” and adjusts “parameters in one or more wireless networks.” *Id.* at 20:59-66. This includes transmitting controls to an AP regarding “AP channel assignments.” *Id.* at 21:1. Thus, a POSITA would have understood that the network expert, which looks at multiple wireless networks, would work with network management station 1090 to transmit a control signal to a second communication unit (e.g., WLAN AP 1050(2)) instructing it to adjust a policy and “move that particular AP to that particular channel”. *Id.* at 22:23-25; *id.* at 22:29-32 (“the network expert 80 may modify its decisions to avoid network or regional behavioral ‘oscillations’”). A POSITA would have recognized that, like the first control signal, this control signal could be based on a predetermined time based on the first network’s channel assignment schedule. In my opinion a POSITA would have found it obvious, based on the teachings of Diener, to generate a second control signal for this second AP at a pre-defined time.

164. As another example, regarding the second scenario discussed above in limitation 8[a], Diener discloses using a control signal to adjust the policies of two different networks—IEEE 802.11 and BluetoothTM—when those networks interfere with one another. In limitation 8[a] above, I described the first policy, sent via control signal to the AP of a first network (i.e., IEEE 802.11). Diener also discloses

a second policy, sent via control signal, to a second communication device within the Bluetooth™ network. *Id.* at 62:4-17. Diener explains that a policy (communicated via a control signal) may involve the Bluetooth™ network “idling slots where the 802.11 data or ACK would occur.” *Id.* at 62:9-12. A POSITA would have recognized that the control signal corresponding to this policy adjustment for the second network could be sent at a predetermined time (i.e., when the network management station 1090 determined the 802.11 data and ACK would occur). Additionally, in my opinion a POSITA would have found it obvious, based on the teachings of Diener, to generate this second control signal at a pre-defined time corresponding to when it wants the Bluetooth™ network to take action.

165. Additionally, for the reasons I explained regarding limitation 8[a] immediately above, a POSITA would have found it obvious to send a second control signal at a second predefined time based on the POSITA’s knowledge in the art at the time of invention.

166. Accordingly, it is my opinion that Diener renders obvious limitation 8[b].

167. For the foregoing reasons, it is my opinion that Diener renders obvious claim 8.

9. Claim 9: The communication system of claim 8 wherein the first pre-defined time and the second pre-defined time are different.

168. In my opinion, Diener renders obvious claim 9. As explained above, Diener renders obvious the communication system of claim 8. Additionally, a POSITA would have understood that first and second pre-defined times to be different. For example, in the scenario discussed regarding claim 8 where the network management station 1090 sends a first and second control signal to WLAN AP 1050(1) and 1050(2), respectively, instructing them to switch channels to avoid interference, a POSITA would have known that those controls signals would be sent at different set times. A POSITA would have recognized that if the policy were to instruct the first WLAN AP to use a specific channel, that control would be transmitted at a first set time. Then, a second control signal would be sent later in time to the second WLAN AP, once the first WLAN AP was no longer using the channel.

169. Similarly, in the scenario where the 802.11 and Bluetooth™ networks experience interference, the first and second pre-defined times would be different. A POSITA would have recognized that the first control signal sent to the WLAN AP on the 802.11 network, instructing it to transmit QoS packets between the timing of the Bluetooth™ packets would be sent at a time when the Bluetooth™ network is

not transmitting. Similarly, a POSITA would have recognized that the second control signal sent to the Bluetooth™ network instructing transmit would be sent at a time different from the time that it is instructing the WLAN AP to transmit. Because a main goal of the policies generated in Diener are to avoid interference, having the controls sent to two potentially interfering networks at different pre-defined would have been obvious to a POSITA.

170. Accordingly, it is my opinion that Diener renders obvious claim 9.

10. Claim 10: The communication system of claim 8 wherein the first policy adjustment and the second policy adjustment are different.

171. In my opinion, Diener renders obvious claim 10. As explained above, Diener renders obvious the communication system of claim 8. Additionally, Diener discloses that the first and second policy adjustments are different. For example, as explained above, the first policy adjustment may include instructing the 802.11 AP to transmit QoS packets between the timing of the Bluetooth's transmitted SCO packets (or not transmitting during the SCO periods at all). *Id.* at 61:42-49. Separately, the second policy adjustment may include instructing the Bluetooth™ network to idle slots where 802.11 data or ACK would occur. *Id.* at 62:9-12. A POSITA would have understood these policy adjustments to be different.

172. Accordingly, it is my opinion that Diener renders obvious claim 10.

11. Claim 11: The communication system of claim 1 wherein the first and second communication units are Wi-Fi access points.

173. In my opinion, Diener discloses claim 11. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, as explained in claim 1, Diener discloses WLAN APs which are wireless local area network access points. *Id.* at 6:11-12. Diener also explains that the referenced WLAN is “an IEEE 802.11 WLAN” which a POSITA would have understood to refer to Wi-Fi. Additionally, Diener specifically notes that the AP may be “an IEEE 802.11 AP”. *Id.* at 11: 8-11. Thus, a POSITA would have understood Diener to disclose that WLAN AP 1050(1) and WLAN AP 1050(2) (i.e., the first and second communication units) may be Wi-Fi access points.

174. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 11.

12. Claim 12: The communication system of claim 1 wherein the first and second communication units are cellular base stations.

175. In my opinion, Diener discloses claim 12. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. As noted immediately above, Diener discloses APs that correspond to the first and second communication units. Additionally, Diener teaches “a network base station device (e.g., wireless network access point device)”. *Id.* at 3:54-55. A POSITA would have

thus recognized that the first and second communication units in Diener are not limited to WLAN AP 1050(1) and WLAN AP 1050(2)—those are examples—and the first and second communication units could be network base stations. Importantly, Diener teaches that “the AP may be any wireless base station device that wireless [sic] communicates with a plurality of client station devices.” *Id.* at 74:29-31.

176. Moreover, Diener teaches that, in its exemplary unlicensed frequency band, cordless phones 1000 and Bluetooth™ wireless devices are present. *Id.* at Fig. 1; 6:27-36. A POSITA would have understood that this would include cellular phones which, much like the STAs associated with the WLAN APs, are associated with cellular base stations. Diener teaches that the network expert (interfaced with the network management station 1090) has a “global view of the spectrum activity of the entire region of the unlicensed band of operation, which may include multiple wireless networks of the same or different varieties.” *Id.* at 21:20-24. In my opinion, a POSITA would have found Diener to disclose (and/or found it obvious) that cellular base stations—associated with the disclosed cordless phones and/or Bluetooth™ devices—would be used as APs in Diener’s system.

177. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 12.

13. Claim 13: The communication system of claim 12 wherein the first communication unit is a small cell base station.

178. In my opinion, Diener teaches and/or renders obvious claim 13. As explained above, Diener teaches and/or renders obvious the communication system of claim 12. As noted immediately above, Diener teaches that the first and second communication units correspond to “a network base station device (e.g., wireless network access point device)” and “the AP may be any wireless base station device that wireless [sic] communicates with a plurality of client station devices.” *Id.* at 3:54-55, 74:29-31.

179. In my opinion, a POSITA would have found it obvious, based on the teachings of Diener, to have a first communication unit as a small cell base station. A POSITA would have known that a small cell base station includes a variety of low-power wireless access points, which may include cellular network access points. As explained above, it is my opinion that Diener discloses and/or renders obvious that the first communication unit is a cellular base station (which would also be a type of small cell base station).

180. Alternatively, Diener explicitly teaches that the network base station may be any wireless access point that “react[s] to changing conditions at individual wireless client station and adjust[s] accordingly how it communicates with corresponding wireless client stations.” *Id.* at 4:7-10. Thus, a POSITA would have

recognized that a network base station which could be “any wireless base station device” would include a small cell base station. Additionally, a POSITA would have known that a small cell base station is often limited to specific areas with a limited range. Diener teaches that its system works with a variety of networks including Personal Area Network applications which are “limited to a few meters”. *Id.* at 3:27-31.

181. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 13.

14. Claim 14: The communication system of claim 1 wherein the first and second sets of collected data comprise RSSI measurements collected within the first and second networks.

182. In my opinion, Diener discloses claim 14. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, Diener explicitly teaches that the collected data comprises measuring a received signal strength indication (RSSI) within the respective network. Diener discloses that client station, sensors and APs collect and send spectrum activity information and spectrum statistics to remote devices like network management station 1090. *Id.* at Fig. 4. These devices have real-time spectrum analysis engines (SAGE). *Id.* at Fig. 6; 72:60-65. “Fig. 8 is a diagram showing how the output of the SAGE can be used to classify signals.” *Id.* at 4:41-42. Although though they are not shown at a

precise scale in Fig. 8, the figure shows that the output of the SAGE includes the “timing, strength and duration” of the received signals. *Id.* at 15:35-42. Regarding spectrum statistics collected at the SAGE, Diener explicitly discloses that “[t]he L1 measurement engine 220 outputs a timestamp and associated received signal strength indicator (RSSI) power values for each of a plurality of Fast Fourier Transform (FFT) bins.” *Id.* at 69:27-29 (emphasis added). Accordingly, Diener explicitly discloses that the monitored data—which, as explained regarding claim 1 includes both first and second sets of data corresponding to first and second networks—includes a received signal strength indication (RSSI).

183. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 14.

15. Claim 15: The communication system of claim 14 wherein the at least one policy adjusts a transmission rate of at least one channel within the first network.

184. In my opinion, Diener discloses claim 15. As explained above, Diener teaches and/or renders obvious the communication system of claim 14. Additionally, Diener teaches that at least one policy includes adjusting a transmission rate of a channel within the first network. As explained regarding claim 1, the policy “adjusts one or more operating parameters of devices or network of devices operating in the frequency band.” *Id.* at 9:55-59. In one specific example, Diener states that the policy

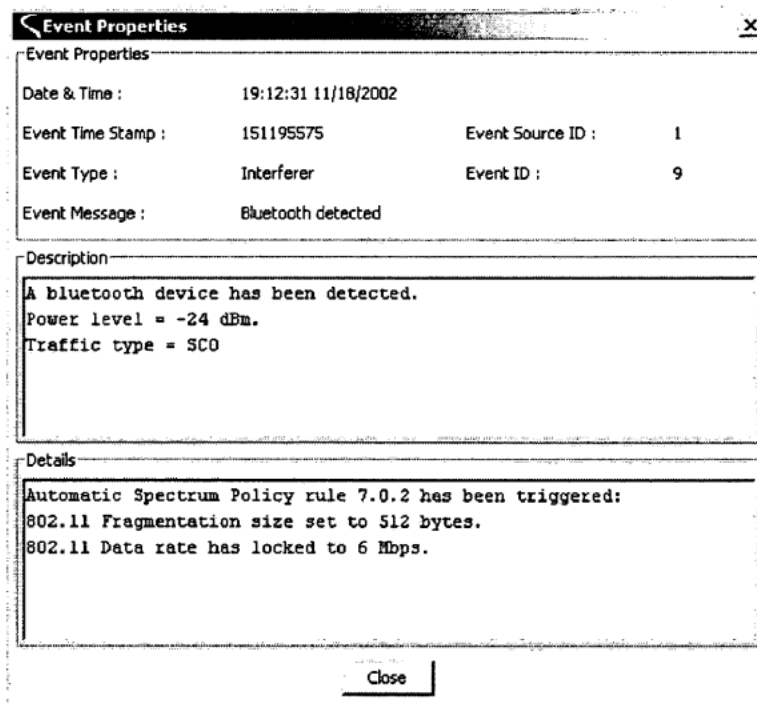
may include “adjusting a transmit data rate of the AP and/or STAs.” *Id.* at 19:48-50; 74:61-64 (“Examples of parameters that may be controlled at the wireless base station device include . . . transmission data rate”). Diener also provides a chart with specific controls (corresponding to policies) that involve adjusting at transmission rate of a channel within the first network:

Client Station	Spectrum Profile (Identified Interferers)		Selected Client Specific Control Therapy(ies)
1	Bluetooth TM piconet	Microwave Oven	1. Hold Data Rate High 2. Dynamic Packet Fragmentation (change fragmentation threshold) 3. Packet Scheduling
2	Video Camera (constant interferer)		Reassign to a different AP (or a different channel on same AP if a multi-channel AP).
3	Cordless Phone		Maintain Data Rate High
4	Radar		Reassign to a different AP (or a different channel on same AP if a multi-channel AP).
5	Microwave Oven		1. Hold Data Rate High 2. Dynamic Packet Fragmentation (change fragmentation threshold) 3. Packet Scheduling
...			
N			

Id. at 73:20-44.

185. In one specific example, Diener teaches a policy that involves adjustments to fragmentation size as well as data rate:

FIG. 19



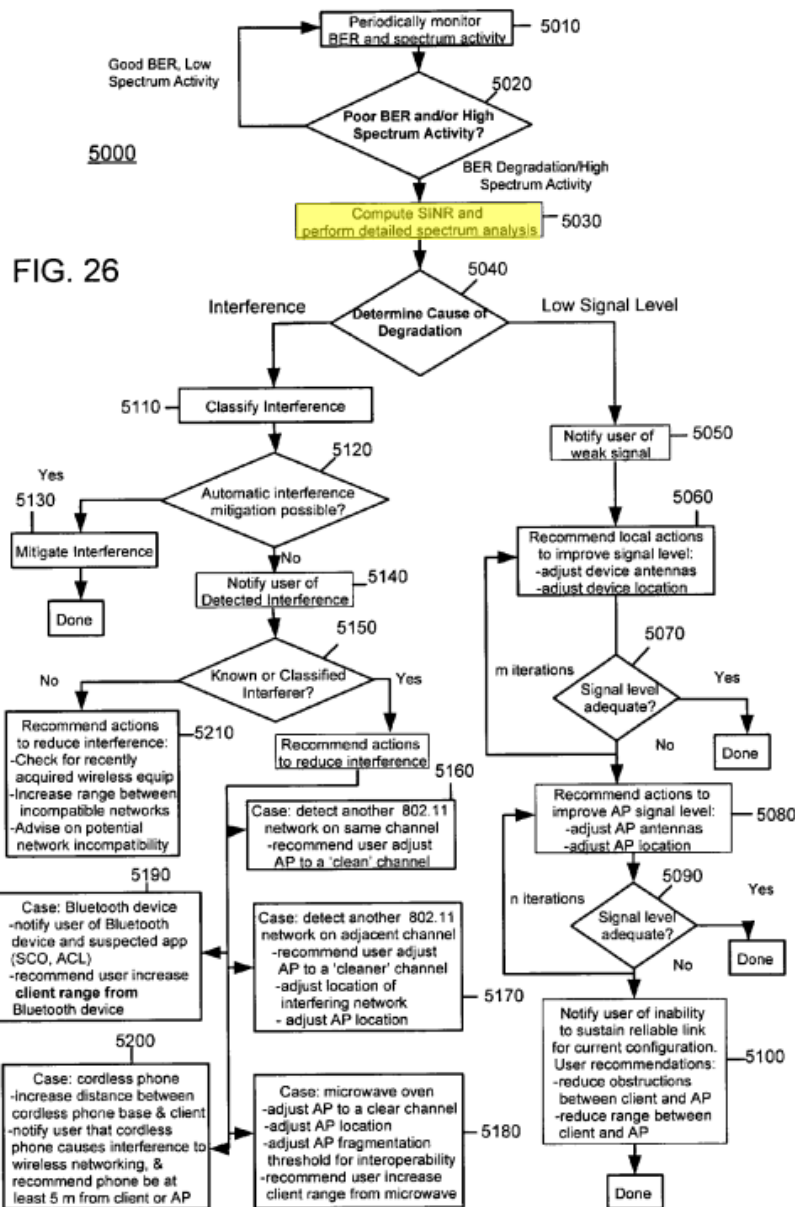
Id. at Fig. 19. As shown in Figure 19, the policy instructs the AP to lock the data rate at 6 Mbps. In my opinion, a POSITA would have understood that adjusting the data rate to 6 Mbps would include an adjustment to the transmission rate of the channel within that AP's network (e.g., the first WLAN network).

186. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 15.

16. Claim 16: The communication system of claim 1 wherein the first and second sets of collected data comprise collected measurements related to SNR across a plurality of wireless channels within the first and second networks.

187. In my opinion, Diener discloses claim 16. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, Diener teaches that the spectrum activity information collected pertaining to the first and second networks associated with WLAN APs include signal to ratio (SNR) measurements across a plurality of wireless channels within those networks.

188. Figure 26 of Diener shows an exemplary flow chart explaining the process of collecting spectrum activity information for each network (i.e., first and second sets of collected network):



Id. at Fig. 26 (highlighted to identify step 5030). At step 5030, Diener teaches “compute SINR and perform detailed spectrum analysis.” *Id.* SINR corresponds to signal to interference and noise ratio, as taught by Diener and would have been known to a POSITA. *Id.* at 59:11-13. Diener explains that this calculation may be

performed at the client device (e.g., an STA) and are transmitted to a server, such as network management station 1090, to make policy decisions based on the received data, including SINR. *Id.* at 59:6 – 60:3.

189. A POSITA would have understood signal to interference and noise ratio to include the claimed SNR (signal to noise ratio). A POSITA would have also understood that these measurements of SINR could be done in both the first and second networks (e.g., two different 802.11 wireless networks) across a plurality of wireless channels within those networks to determine the level of noise present on the channel.

190. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 16.

17. Claim 17: The communication system of claim 16 wherein the at least one policy adjusts a transmission power level across a first wireless channel within the plurality of wireless channels.

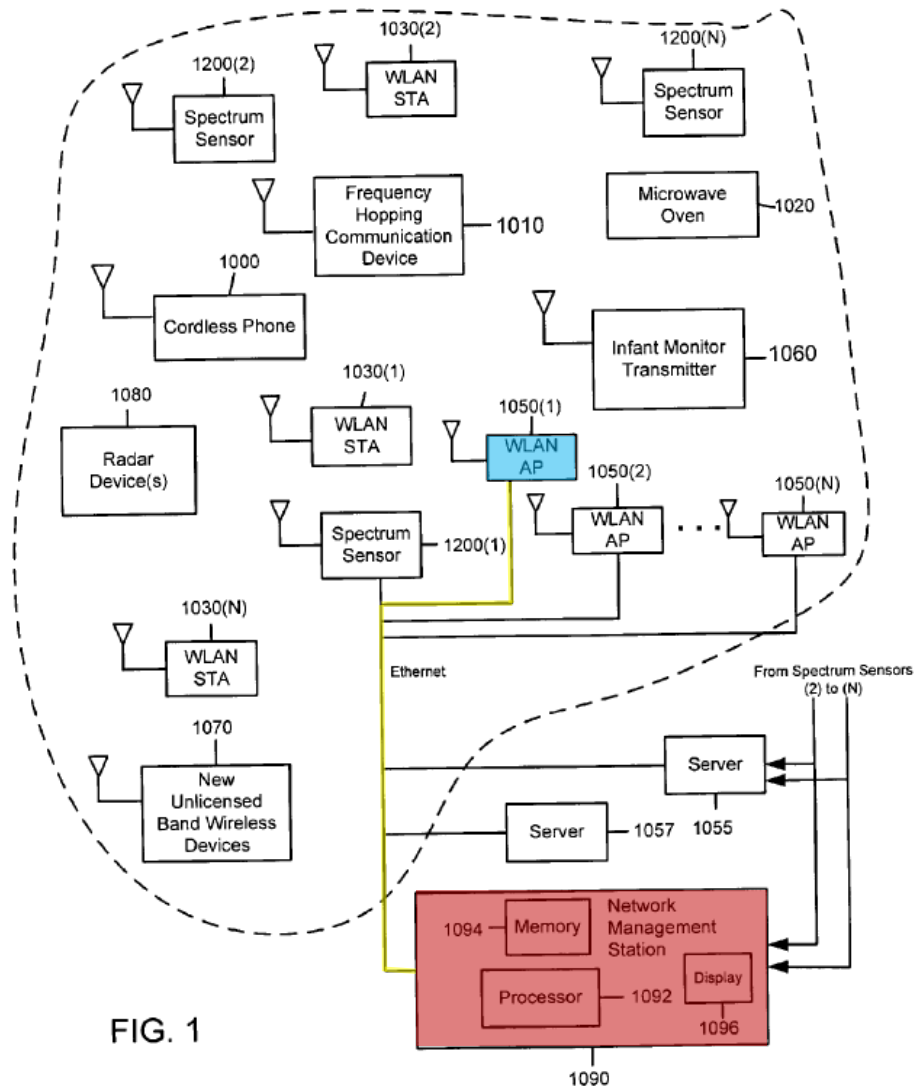
191. In my opinion, Diener discloses claim 17. As explained above, Diener teaches and/or renders obvious the communication system of claim 16. Additionally, Diener discloses that the policy involves adjusting a transmission power level on one of the wireless channels. For example, Diener explicitly teaches that an example of a control associated with a generated policy is “adjusting the transmit power (transmit power control—TPC)”. *Id.* at 9:60-65; *id.* at 19:14-15, 19:62-64

(“adjusting the transmit power of an AP”). A POSITA would have known that this policy of adjusting the transmit power of an AP or device in a frequency band corresponds to adjusting its transmission power on a wireless channel.

192. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 17.

18. Claim 18: The communication system of claim 1 wherein two interfaces within the first, second and third interfaces are the same interface.

193. In my opinion, Diener discloses claim 18. As explained above, Diener teaches and/or renders obvious the communication system of claim 1. Additionally, as explained regarding limitations 1[a] and 1[e], Diener discloses that the first and third interfaces are the same interface. As shown in Figure 1 below, there is an interface at the point of contact between WLAN AP 1050(1) and network management station 1090:



Id. at Fig. 1 (annotated). This interface corresponds to the first interface where collected data is transmitted from WLAN AP 1050(1) to network management station 1090, as explained regarding limitation 1[a]. Additionally, this same interface corresponds to the third interface where control signals are transmitted from network management station 1090 to WLAN AP 1050(1), as explained regarding limitation 1[e]. In my opinion, a POSITA would have understood that while the first and third

interface may serve different functions at different times (i.e., receiving data from the first AP or transmitting a policy to the first AP), the first and third interface are the same interface.

194. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 18.

19. Claim 19

195. Based on my review and for the reasons that follow, it is my opinion that claim 19 is taught and/or obvious based on the teachings of Diener.

196. I have reproduced independent claim 19 below and divided up the limitations using bracketed notations to facilitate identification of the limitations in my analysis below.

19[pre] A method for managing a plurality of networks, the method comprising:

[a] receiving, by a server, from network monitoring devices that monitor data associated with an operation of two or more communication units located in at least two networks within the plurality of networks, the data comprising a parameter;

[b] processing, by the server, the received data;

[c] based on the processed data, determining a policy for at least one of the two or more communication units; and

[d] in response to the server detecting a degradation of network performance in at least one network within the plurality of networks, communicating the policy to at least one or more

communication units that implement one or more algorithms that use the parameter and at least one rule or condition for the one or more communication units to improve a performance of the one or more communication units.

i. Limitation 19[pre]: A method for managing a plurality of networks, the method comprising:

197. I understand that a preamble generally does not state a claim limitation. However, to the extent the preamble limits claim 19, it is my opinion that Diener discloses a method for managing a plurality of networks.

198. Diener explains: “One particular application of this technology is a system and method for managing communication with a plurality of wireless client devices operating in a radio frequency band shared by other types of devices where the radio frequency environment at each wireless client device may be different.” *Id.* at 3:49-53 (emphasis added). Diener also explains that, within its system and method, “[t]here may be one or more wireless networks each comprising multiple devices or nodes that operate in the shared frequency band. One example of such a network is a WLAN.” *Id.* at 5:50-52. Thus, Diener teaches a method for managing multiple wireless networks.

199. Additionally, as explained in Ground 1, Diener explicitly teaches that its communication system includes a network expert that may “automatically adjust parameters in one or more wireless networks.” Ex. 1003 at 20:64-66. Moreover, the network expert which is interfaced with network management station 1090 has “an

even more global view of the spectrum activity of the entire region of unlicensed band operation which may include multiple wireless networks of the same or different varieties (e.g., IEEE 802.11 WLAN, WPAN, Bluetooth™, etc.).” *Id.* at 21:20-25 (emphasis added). Thus, the network expert and network management station 1090 carry out the method of managing the plurality of networks.

200. Accordingly, it is my opinion that Diener teaches the preamble of claim 19.

- ii. **Limitation 19[a]: receiving, by a server, from network monitoring devices that monitor data associated with an operation of two or more communication units located in at least two networks, the data comprising a parameter;**

201. In my opinion, Diener discloses limitation 19[a]. Diener discloses that a network management station can receive real-time data associated with multiple communication units from spectrum sensors (i.e., network monitoring devices). For example, Diener explains that “[t]he spectrum intelligence gathered by the spectrum sensors is fed to one or several processing platforms such as a network management station 1090 or server 1055, the host processor of an AP, etc., where policy decisions are made and controls may be generated.” Ex. 1003 at 6:58-62 (emphasis added). Diener also discloses that “[t]he network management station 1090 may be connected to the same wired network as the server 1055 and may receive spectrum

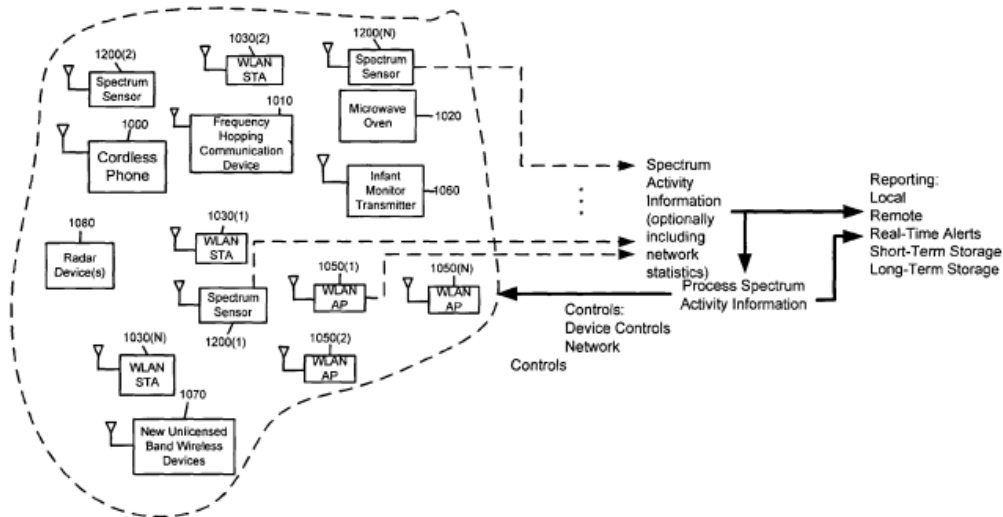
activity information from one or more WLAN APs 1050(1) to 1050(N) and/or from one or more spectrum sensors 1200(1) to 1200(N).” *Id.* at 7:3-7 (emphasis added).

Diener further explains that “the network management station 1090 or the server 1055 (FIG. 1) may receive spectrum activity information and generate the control signals.” *Id.* at 10:24-25.

202. Accordingly, Diener discloses a remote server (i.e., network management station 1090) that receives data associated with an operation of two or more communication units (i.e., WLAN APs 1050(1) to 1050(N)). This data is received from network monitoring devices such as the spectrum sensors mentioned above and other cognitive radio devices. *See id.* at 24:16-19 (“Any device that receives radio frequency energy in the frequency band of interest may be equipped with a SAGE 20 to generate spectrum activity information. FIG. 11 shows an example of such a cognitive radio device.”).

203. These monitoring devices monitor data associated with the operation of two or more communication units located in at least two networks. For example, each communication unit operates on a WLAN, as shown below:

FIG. 4



A POSITA would have known that each WLAN AP correspond to separate networks. Diener also explicitly teaches “adjust[ing] parameters in one or more wireless networks.” *Id.* at 20:65-66. Moreover, Diener discloses that the devices which the server controls (e.g., APs) can be connected “via a wide area network (WAN) connection, e.g., the Internet, a dedicated high speed wired connection, or other longer distance wired or wireless connection.” *Id.* at 24:11-15. Accordingly, a POSITA would recognize that the communication units in Diener are located in at least two networks within the plurality of networks.

204. The collected data includes real-time data such as (1) spectrum activity information and (2) wireless network statistics. *Id.* at 3:60-4:2, 11:40-41. The

collected data is also used to adjust the operational parameters of the communication units. For example, Diener explains that:

Spectrum profile information describing the radio frequency environment (activity in the frequency band) at a wireless client device is sent to the wireless base station device (where the parameter controls are made) from either a wireless client device or another radio device in the proximity of one or more wireless client devices that is capable of generating the spectrum profile information. The spectrum profile information may include information identifying signals that are occurring in the frequency band in the proximity of a wireless client device. Examples of parameters that may be controlled at the wireless base station device include packet fragmentation threshold (the length of a data packet), transmission data rate and transmission scheduling (synchronizing a transmission to quiescent intervals of one or more periodic interfering signals).

Id. at 3:60-4:7 (emphasis added).

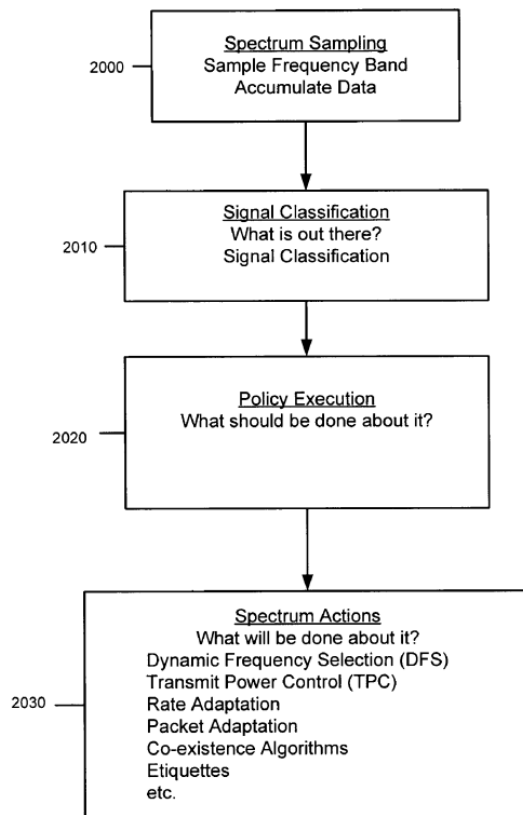
205. “The spectrum activity information may comprise information related to the activity in the frequency band as a whole, as well as statistics associated with a wireless network operating in the frequency band, such as IEEE 802.11x WLAN statistics, which may be obtained by an AP or STA operating in the WLAN.” *Id.* at 8:50-64. All of this monitored information is data associated with the operation of two or more communication units (i.e., WLAN AP 1050(1) and WLAN AP 1050(2)). In my opinion, a POSITA would have known that this data concerning current devices, signals, and statistics on the frequency band would be “monitored”

such that real-time alerts may be generated regarding changing conditions as taught by Diener. *Id.* at 9:37-42.

206. In my opinion, a POSITA would have understood that the spectrum sensors (i.e., network monitoring devices) monitor the data that is collected and sent to the network management station 1090. For example, Diener discloses “spectrum sampling” which involves “sampl[ing] frequency band [to] accumulate data”. *Id.* at Fig. 5. Diener teaches that spectrum sampling includes “scanning sub-bands of the frequency band (on demand or periodically), to determine spectral-based and time-based activity in the frequency band.” *Id.* at 8:27-32. In my opinion, a POSITA would have considered the scanning of sub-bands to include monitoring of conditions on the frequency band.

207. The monitored data in Diener’s system includes a parameter. Diener teaches that spectrum sampling (i.e., monitoring data) is followed by signal classification:

FIG. 5



Signal classification processes the accumulated data from spectrum sampling “to measure and classify signals based on characteristics such as power, duration, bandwidth, frequency hopping nature.” *Id.* at 9:25-29. Based on Diener’s disclosure, a POSITA would have understood these characteristics are included in the “accumulated data” collected as part of the spectrum sampling step. Also, in my opinion, a POSITA would have considered these characteristics (power, duration, bandwidth, frequency hopping nature) to be parameters associated with the

respective communication devices. Examples of these parameters are listed in a pulse data table of Diener. *Id.* at 15:60-16:31.

208. Accordingly, it is my opinion that Diener teaches limitation 19[a].

iii. Limitation 19[b]: processing, by the server, the received data;

209. In my opinion, Diener discloses limitation 19[b]. As explained in Ground 1 regarding limitation 1[d], Diener teaches processor 1092 within network management station 1090 that analyzes that collected data. I incorporate my analysis of limitation 1[d] in Ground 1 by reference.

210. Diener also explicitly discloses the network management station 1090 “processes” received data. Diener teaches that the server has intelligence for the entire multiple AP network and the spectrum activity is sent “upstream” for processing. Ex. 1003 at 9:6-11. For example, Diener discloses that “[i]n addition, or separately from the reporting function, the spectrum activity information may be processed in a processor (local to or remote from the source devices of the actual spectrum activity information).” *Id.* at 9:22-25 (emphasis added). A POSITA would have recognized that Diener is referring to network management station 1090.

211. As another example, Diener’s server performs signal classification, which processes the received data (i.e., spectrum information). Diener discloses that “the spectrum activity information [is] processed at a computing device to generate

reports and/or controls for one or more devices or network of devices (e.g., one or more APs)” and spectrum intelligence “may be used to interface spectrum aware reports or controls to a generalize network management application”. *Id.* at 8:34-45.

212. Diener teaches that the signal classification step “involves processing the output of the spectrum sampling step.” *Id.* at 9:22-30. “The output of the signal classification step 2010 is data classifying the signals/devices detected.” *Id.* Signal classification processes received data, for example, to “build histograms of signal pulse data that are useful for signal classification.” *Id.* at 14:35-37 (emphasis added). As I explained regarding limitation 1(d) above, a POSITA would have considered signal classification and data processing to be an analysis which is part of the processing of this data.

213. Accordingly, it is my opinion that Diener teaches limitation 19[b].

**iv. Limitation 19[c]: based on the processed data,
determining a policy for at least one of the two or
more communication units; and**

214. In my opinion, Diener discloses limitation 19[c]. As explained in Ground 1, Diener discloses generating a policy for at least one of the two or more communication units based on processed data at the network management station 1090. I incorporate my analysis of limitation 1[d] by reference. *See also id.* at 6:58-

62 (“network management station 1090 . . . where policy decisions are made and controls may be generated”).

215. Accordingly, it is my opinion Diener teaches limitation 19[c].

- v. **Limitation 19[d]: in response to the server detecting a degradation of network performance in at least one network within the plurality of networks, communicating the policy to at least one or more communication units that implement one or more algorithms that use the parameter and at least one rule or one condition for the one or more communication units to improve a performance of the one or more communication units.**

216. In my opinion, Diener discloses claim limitation 19[d]. Diener discloses detecting network performance degradation and, in response, communicating the policy to the communication units which implement algorithms associated with the parameter and a rule or condition to improve performance of the communication unit. Diener recognizes that when “devices are sufficiently close in proximity to each other, or transmit signals at sufficiently high power levels, there will inevitably be interference between signals of one or more devices.” *Id.* at 6:2-5.

217. Diener also teaches that “[w]hen interference occurs, a signal from one device to another may not be received properly, causing the sending device to retransmit (and therefore reducing throughput), or possibly entirely destroying the communication link between two communication devices.” *Id.* at 7:33-38 (emphasis

added). A POSITA would recognize that Diener is describing a situation where network performance in at least one network is degraded. Additionally, a POSITA would have found it obvious that Diener's network management station 1090 would detect a degradation based on the received data in one or more networks that it manages.

218. Diener teaches that “[c]ertain actions can be recommended or automatically taken based on a determine[d] cause of the performance degradation.” *Id.* at 14:53-55. In fact, there are two categories of responses to detected interference—or network degradation—one where rate selection can be effective and one where channels are switched to avoid interference:

Generally, the APs responses to interference at a particular client station fall into two categories: (1) retreat from the interference by allowing the client station to switch to a different channel/AP, or (2) stay on that channel but otherwise contend with the interference. There are two types of retreat: switch the AP to a different channel (affecting all associated client station of that AP), or move just a particular client station to another channel/AP.

Id. at 74:1-8. Accordingly, although Diener teaches using rate selection to mitigate certain types of interference, Diener also teaches that rate selection alone would be insufficient for overcoming other types of interference—such as when the device must change channel. *See id.* at 71:1-8. Diener states that “If the interferer is one that cannot be automatically mitigated, then a variety of other actions are recommended

to the user.... If in step 5150 the interference is a type that is known, then several actions to manually deal with the interference are recommended. In step 5150, if the interference is caused by another IEEE 802.11 network on the same channel, then a recommended user action is to adjust the AP of the user's network to a clean/unused channel." *Id.* at 59:49-58. A POSITA would have understood this to mean that Diener detects degradation of network performance in at least one network.

219. More specifically, Diener discloses the server first determining that the cause of degradation of performance is due to interference. *Id.* at 59:41-42. In such a situation, "the interference is classified, by signal type, etc." *Id.* at 59:42-43. Diener then teaches performing signal classification. "The signal classification step 2010 involves processing the output of the spectrum sampling step to measure and classify signals based on characteristics such as power, duration, bandwidth, frequency hopping nature." *Id.* at 9:25-29. Diener's signal classification step classifies the different types of interference or noise from nearby wireless channels:

The classification engine 52 can detect, for example, signals that interfere with the operation of one or more devices (e.g., occupy or occur in the same channel of the unlicensed band as a device operating in the band). The output of the classification engine 52 includes types of signals detected in the frequency band. A classification output may be, for example, "cordless phone", "frequency hopper device", "frequency hopper cordless phone", "microwave oven", "802.11x WLAN device", etc.

Id. at 15:2-10.

220. Once the signal is classified, Diener can determine whether “the interferer is a type that can be mitigated using interference mitigation techniques.” *Id.* at 59:44-45. These mitigation techniques include techniques such as adaptive rate selection. *See, e.g., id.* at 64:10-12 (“the system described above uses signal classification and other interference timing information to make intelligent decisions on data rate.”). If Diener determines that the interference can be automatically mitigated, then Diener communicates the policy by generating control signals to effectuate the policy. For example, “in processing the spectrum activity information, controls may be generated to adjust one or more operating parameters of devices or networks of devices operating in the frequency band.” *Id.* at 9:46-59 (emphasis added). Diener further explains that:

The control signals may be generated in a device that is actually operating in the frequency band (see FIGS. 11 and 12) or in a computing device that is remote from those devices operating in the frequency band. For this latter case, the network management station 1090 or the server 1055 (FIG. 1) may receive spectrum activity information and generate the control signals. The control signals are then in turn delivered back to one or more devices operating in the frequency band. For example, if the control signal pertains to a parameter of a WLAN AP or STA, then the control signal may be delivered by the network management station 1090 or server 1055 via the network connection to one or more APs (e.g., one or more of APs 1050(1) to 1050(N) shown in FIG. 1). The AP will receive the control signal and change one of its operational parameters. In addition, the control signal may be delivered to a particular STA by supplying the appropriate command to that STA’s AP to cause the AP to transmit the parameter change information to the STA.

Id. at 10:19-36 (emphasis added).

221. Accordingly, and as explained regarding claim 1 in Ground 1, Diener discloses communicating the policy to at least one or more communication units (i.e., WLAN APs 1050(1) and 1050(2)). Diener also discloses the system will communicate a different policy depending on the type of interference. Diener discloses a variety of scenarios and examples of different policies that may be communicated. *See id.* at 60:30-64:12; *see also* limitation 1[d] above.

222. Diener also discloses that at least one or more communication units implement one or more algorithms that use the parameter and at least a rule or a condition for the one or more communication units to improve a performance of the one or more communication units. As explained regarding limitation 1[d], the communicated policy includes spectrum actions to be performed by the APs to avoid or mitigate interference. This is shown in the last step of Figure 5 which lists spectrum actions including: “Dynamic Frequency Selection (DFS), Transmit Power Control (TPC), Rate Adaptation, Packet Adaptation, Co-existence Algorithms, Etiquettes, etc.” *Id.* at Fig. 5. In Diener’s taught system, a POSITA would have understood that each of these spectrum actions would be carried out by the AP or, at least, coordinated by the AP and its relevant STAs.

223. In my opinion, a POSITA would have known that each of the above-listed spectrum actions require implementation of appropriate algorithms to carry out those actions. Diener also explicitly discloses “interference mitigation algorithms”, “co-existence algorithms,” and a “spatial processing algorithm” which are included within the policy sent to an AP and pertain to adjusted parameters. *Id.* at 9:67-10:5, 60:60-67. In another example, the policy of Diener includes detecting interference with a Bluetooth™ device and instructing an AP to adjust the fragmentation byte size and data rate. *See id.* at Fig. 19. In this scenario, for example, the AP would implement specific algorithms associated with fragmentation size and adapting the data rate to comply with the communicated policy. Examples of other relevant algorithms include rate adaptation and transmit power control, which a POSITA would have understood to be associated with such operational parameters. As a specific example, a POSITA would have understood that Wi-Fi communication units implement an adaptive modulation and coding (AMC) algorithm that adjusts the data rate that maximizes throughput for the current channel conditions. Closed-loop rate adaptation algorithm, which has the receiver convey back to the transmitter the observed SNR for the most recent transmission, was well established by 2011. This information would be piggy-backed on ACK or CTS frames sent by the receiver to the transmitter. The transmitter uses a threshold-based algorithm that maps the

observed signal quality information to the appropriate modulation and coding to use on the next transmission. This algorithm would rely on the parameter representing the observed channel conditions and at least a rule or a condition, such as the table-driven logic mapping the parameter to an action in order to improve the performance of the one or more communication units.

224. A POSITA would have known that these policies are set, and algorithms are implemented by the APs in response, to improve performance of the system. Diener teaches “maintain[ing] desirable performance” as a stated objective of its system and methods. *Id.* at 2:24-27. The various interference mitigation and avoidance policies taught by Diener thereby improve performance of the system. *See id.* at 60:60-67 (explaining the purpose of implementing spatial processing algorithms is to improve link margin, which in my opinion would constitute an improvement to performance of the AP and system as a whole); *see also id.* at Fig. 19 (adjusting the fragmentation size and data rate to avoid or mitigate Bluetooth interference would improve performance of the device).

225. As explained above, Diener teaches that “spectrum aware drivers **17** may receive commands from interference algorithms at a higher level to adjust a transmit rate, fragmentation threshold, etc.” *Id.* at 11:20-22 (emphasis added). Diener also discloses that “the spectrum aware drivers **17** may receive

commands to change a (center frequency) of operation, bandwidth of operation, data rate, transmit power, etc.” *Id.* at 11:20-33 (emphasis added). A POSITA would have understood each of these adjustments—which are adjusted by implementing an algorithm—to use the parameter that is previously received with collected data at the network management station. Diener discloses controlling a parameter to change the center frequency of operation, data rate and transmit power discloses teaches that the communication unit implements one or more algorithms that use such operational parameters to improve device performance.

226. As another example, Diener discloses that “changes in operational parameters made by the AP can be with respect to parameters that are adjustable within a particular communication protocol standard.” *Id.* at 74:32-34. A POSITA would have understood that this is equivalent to updating an adaptation control policy that would be subsequently disseminated to the communication units to carry the adaptation steps. Diener teaches “[t]he spectrum aware drivers **17** respond to manually generated or automatically generated controls in order to change an operational parameter of a device or network of devices.” *Id.* at 11:1-19. “For example, if the device is an IEEE 802.11 AP, then a change in an operational parameter may affect a change in the operation of the AP as well as the STAs that are associated with that AP.” *Id.* at 11:1-19 (emphasis added). Accordingly, Diener

discloses that the one or more communication units use the parameter to improve a performance of the one or more communication units.

227. The communication of the policy from the network management station to the APS—via a control signal—includes a “rule” as claimed which instructs the AP to implement the requisite algorithm. As explained previously, Diener teaches communicating a policy of interference avoidance or mitigation to the APs which includes “controls” instructing the APs to: “assign[] a device to a different frequency sub-band or channel . . . , adjust[] the transmit power . . . , adjust[] the communication data rate, adjust[] a parameter of the transmitted data packet, execut[e] interference mitigation or co-existence algorithms, execut[e] spectrum etiquette procedures, execut[e] spectrum priority schemes, or re-assign[] STAs to APs in a WLAN.” *Id.* at 9:60-10:2. Each of these controls include a rule (e.g., assign, adjust, execute) telling the AP what specific action to take. A POSITA would have understood these rules to, accordingly, affect a change in the APs.

228. Accordingly, it is my opinion that a POSITA would have understood that Diener teaches and/or renders obvious limitation 19[d].

229. For the foregoing reasons, it is my opinion that Diener teaches and/or renders obvious claim 19.

20. Claim 20: The method of claim 19 wherein determining the policy comprises selecting the policy from a set of policies that are stored on the one or more communication units and wherein the communicated policy updates the one or more algorithms implemented on the one or more communication units.

230. In my opinion, Diener discloses claim 20. As explained above, Diener teaches and/or renders obvious the method of claim 19. And, Diener discloses selecting the policy from a set of policies stored on a communication unit. Diener discloses examples of specific control therapies that the AP may use for the affected client stations. Ex. 1003 at 73:12-17, 73:20-45, Fig. 43. Diener discloses a table (at 73:20-45) which is representative of the type of data that may be stored in a database format and processed by a software program in the computing device associated with the AP. *Id.* at 73:14-73.

231. Diener further explains that the new and updated policies “may be downloaded by the L2 policy manager 340 to the L1 policy engine.” *Id.* at 71:41-44. Diener teaches that “[t]he L1 engine services level 200 is normally performed ‘off-chip,’ that is in a host processor of the communication device.” *Id.* at 65:11-13. A POSITA would have therefore understood that when policies are downloaded “to the L1 policy engine” they are downloaded to the host processor of the AP. Additionally, Diener teaches examples of policies that can be selected by a user. *See, e.g., id.* at Fig. 15 (at step 2017 “User selects spectrum policy/action to be

executed”); *id.* at 55:48-50 (“the user can then select the spectrum policy to be executed, or go to a ‘policy wizard’ to set up a policy and actions to be taken for that type of alert”). In my opinion, a POSITA would have known that policies which could be selected would be stored on the AP. And, in my opinion, a POSITA would have found it obvious to store devices on the AP so that they could be selected for future use.

232. Additionally, Diener discloses updating the policy based on a change in the operation of the communication unit. During the signal classification step, Diener teaches updating the signal classification database with new data for new devices using the frequency band. Ex. 1003 at 15:14-16. Because signal classification is used to determine the policy (*see id.* at Fig. 5), in my opinion a POSITA would have understood that this updated data during signal classification would result in an updated policy based on a change in operation on the band (e.g., a new device causing a different level of interference on the frequency band). *See also id.* at 71:42-44 (“New or updated policies [are] created”). And, because the policies instruct the AP to implement a specific algorithm, updating the policy would result in an updated algorithm.

233. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 20.

21. Claim 21: The method of claim 19 wherein the one or more communication units comprise a Wi-Fi access point.

234. In my opinion, Diener discloses claim 21. As explained above, Diener teaches and/or renders obvious the method of claim 19. Additionally, as explained regarding claim 11 in Ground 1, Diener discloses that the one or more communication units (i.e., WLAN APs 1050(1) and 1050(2)) comprise Wi-Fi access points. I incorporate my analysis from claim 11 in Ground 1 by reference.

235. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 21.

22. Claim 22: The method of claim 19 wherein the one or more communication units comprise a cellular base station.

236. In my opinion, Diener discloses claim 22. As explained above, Diener teaches and/or renders obvious the method of claim 19. Additionally, as explained regarding claim 12, Diener teaches and/or renders obvious that the one or more communication units comprise cellular base stations. I incorporate my analysis from claim 12 in Ground 1 by reference.

237. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 22.

23. Claim 23: The method of claim 19 wherein the at least one rule or one condition comprises an adjustment to a wireless transmission band within the plurality of networks.

238. In my opinion, Diener discloses claim 23. As explained above, Diener teaches and/or renders obvious the method of claim 19. Additionally, Diener discloses and/or renders obvious that at least a rule or condition comprises an adjustment to a wireless transmission band within the plurality of networks taught by Diener.

239. As I explained regarding limitation 19[d], Diener teaches “controls” instructing the APs to take certain actions based on the transmitted policies. A POSITA would have understood these controls to be rules as claimed. One such rule taught by Diener is adjusting a dynamic rate percentage of the band. *Id.* at 62:31-48. In my opinion, a POSITA would have understood that the control (i.e., rule) instructing an AP to adjust a dynamic rate adapting device to 50% or 75% of the band would include an adjustment to the wireless transmission band. *Id.*

240. As another example, Diener teaches that WLAN APs may have specific “rules of a particular communication protocol” with which they operate. *Id.* at 11:11-19. A specific protocol would include IEEE 802.11—which would correspond to the IEEE 802.11 WLAN APs taught by Diener—which “has necessary controls points for adjusting [] parameters”. *Id.* The specific requirements of the IEEE 802.11

protocol (i.e., rules or conditions) are implemented by the WLAN AP (i.e., communication device). A POSITA would have understood that these requirements, which may involve moving a client station to a lower bandwidth, using CTS protection mechanisms, or using a specific delay time correspond to adjustments to the wireless transmission band. Ex. 1010.

241. Accordingly, it is my opinion that Diener teaches and/or renders obvious claim 23.

B. Ground 2: Analysis of Claims 1-23 Based on Diener in view of Shaffer.

1. Overview of the Combination of Diener and Shaffer.

242. In my opinion, claims 1-23 of the '313 Patent are invalid because they are obvious over the teachings of Diener in view of Shaffer, as detailed below.

243. As explained in Ground 1 above, Diener teaches a communication system comprising first and second interfaces which received collected data associated with first and second networks of a first and second communication unit, and those interfaces are coupled to a memory with a processor that generates a policy based on analysis of the received data, and transmits that policy through a third interface to a first communication unit, which makes a performance-related adjustment based on that policy, after determining a change in performance in the first or second networks.

244. In my opinion, a POSITA would have been motivated to combine Diener's disclosed communications system with the teachings of Shaffer which explicitly teaches two algorithms that may be employed by an AP in response to a policy which is set to minimize interference in the presence of hidden nodes. Ex. 1004 at [0058].

245. Prior to 2011, POSITAs were well-aware that communications systems sent policies to the communication units which instructed those units to take certain actions that helped to avoid interference and improve the efficiency of the system. *See, e.g.*, Ex. 1003 at 9:47-10:2; Ex. 1024 at 9, 13; Ex. 1004 at [0058], [0113]. These policies are used to instruct the APs to enable specific algorithms allowing those APs to more efficiently transmit data (or avoid transmitting data) during certain conditions present throughout the entire system. Shaffer provides an example of the algorithms that may be included in a policy sent to an AP, allowing the AP to avoid packet collisions with hidden nodes. Ex. 1004 at [0058], [0073], [0106].

246. As I set forth below, a POSITA would have been motivated to combine Shaffer's teachings of setting a policy to invoke a specific algorithm with the communications system and method disclosed in Diener to more precisely manage the communication units and increase the overall efficiency of the system. For the

reasons set forth below, a POSITA would also have had a reasonable expectation of success in making this well-known combination.

2. Motivation to Combine and Expectation of Success (Diener in view of Shaffer)

247. Diener and Shaffer are analogous art as they both relate to communications systems operating within a WLAN or wireless network. Ex. 1003; Ex. 1004. Both Diener and Shaffer teach using a “network administrator” to make “recommendations” or “adjustments to a device or network of devices operating in the frequency band”. *See* Ex. 1003 at 9:37-46; *compare* Ex. 1004 at [0103]. And both Diener and Shaffer acknowledge transmission problems presented by “hidden nodes” and the need to collect data and parameter information to inform a spectrum manager or network administrator about conditions on the network. *See* Ex. 1003 at 64:1-3, Abstract; Ex. 1004 at [0113].

248. While Diener does not explicitly disclose the details of the algorithms that should be implemented based on the generated policies, Diener does teach “policies [that] dictate what spectrum actions in or controls of a communication device” should take, including “adjusting the transmit power . . . , adjusting the communication data rate, adjusting a parameter of the transmitted data packet, executing interference mitigation or co-existence algorithms” Ex. 1003 at 9:47-10:1. Accordingly, a POSITA would have been motivated to use existing algorithms

or search for algorithms which instruct the AP to make specific adjustments, which would have led a POSITA to find Shaffer, which is related art, or other similar implementations.

249. Shaffer discloses “two new, non-exclusive algorithms to mitigate the hidden neighbor issue.” Ex. 1004 at [0058]. “The first algorithm introduces a new cost function that is used for optimizing route selection to minimize interference from hidden neighbors” which is “derived based on the number of hidden nodes associated with a given node at a given (and selected) transmission power, channel, and receiver sensitivity.” *Id.* “The second algorithm optimizes the transmission power and/or receiver sensitivity of nodes in the mesh in order to minimize the number of hidden neighbors while attempting to have a minimal impact on the overall delay through the network.” *Id.* These algorithms take collected data into account to identify hidden nodes and then determine either an optimized path for packet transmission or the allowable delay. *Id.* at [0069], [0102].

250. A POSITA reading Shaffer would have recognized it to disclose a specific policy implementation—pertaining to hidden nodes in a wireless network—instructing an AP to invoke one of two algorithms. In my opinion, it would have been obvious to a POSITA to implement this policy in a system like Diener’s which discloses a wide array of policies, including those which are in response to detected

hidden nodes and transmission power issues. Accordingly, it would have been obvious to a POSITA to modify Diener based on Shaffer's teachings to enable the AP's to dynamically invoke hidden node avoidance algorithms to improve the efficiency of the system. Additionally, a POSITA would have been motivated to combine Diener with Shaffer for the reasons discussed more fully below.

i. Implementing Shaffer's teachings of specific algorithms in Diener's system is suggested by the teachings of Diener.

251. As noted above, Diener explicitly teaches "adjusting the transmit power (transmit power control—TPC)" as part of the policy and controls that are communicated from the server to the APs. Ex. 1003 at 9:64-65. And, as noted above, Shaffer teaches two specific algorithms, a cost function algorithm associated with transmission power and a transmission power tradeoff algorithm. Ex. 1004 at [0058]. Diener also discloses a spectrum expert at the network management station that makes interference decisions and, after detecting a "hidden node" the spectrum expert "may call for executing an RTS/CTS sequence." Ex. 1003 at 19:41-59. Shaffer acknowledges that RST/CTS "can be utilized to reduce frame collisions introduced by hidden nodes," but discloses "two new, non-exclusive algorithms" which are better able to adapt to hidden nodes to optimize the system. Ex. 1004 at [0052], [0058].

252. Thus, a POSITA reading the teachings of Diener would have been motivated to look to Shaffer which discloses specific algorithms that may be employed to address the hidden node problem and are an improvement over known RTS/CTS techniques.

ii. A POSITA would have expected success because Diener's system and Shaffer's system have similar architectures are operate in similar frequency bands.

253. It is my opinion that a POSITA in the relevant timeframe would have had a reasonable expectation of success in modifying Diener (to the extent needed) to implement the two-algorithm policy of Shaffer. Diener teaches that its disclosed system may include “one or more wireless networks each comprising multiple devices or nodes that operate in the shared frequency band. One example of such a network is a WLAN.” Ex. 1003 at 5:50-52. Shaffer similarly discloses a system operating within a wireless with “a plurality of nodes”. Ex. 1004 at [0024]. Both systems operate within known wireless protocols, including IEEE 802.11. Ex. 1003 at 7:45-62; Ex. 1004 at [0027].

254. Both Diener and Shaffer also teach a “network administrator” which can “make adjustments to a device or network of devices operating in the frequency band.” Ex. 1003 at 9:44-46; Ex. 1004 at [0103] (describing a network administrator that determines the acceptable amount of packet delay and adjusts transmission

power “in accordance with the network policy”). Thus, a POSITA would have expected success in implementing the two-algorithm policy taught by Shaffer within Diener’s system, wherein a network administrator would ensure the correct algorithm is employed at an AP.

255. And, as Diener already teaches that its server is communicatively coupled with APs such that a policy determined at the server may be received by an AP, a POSITA would have seen no technical obstacle to employing Shaffer’s two-algorithm policy in Diener’s system. In the combined system, a POSITA would have recognized that Diener’s network management station 1090 would be able to determine a policy instructing the AP to invoke either a cost function or transmission power algorithm (or both), communicated that policy to an AP, wherein the AP will invoke the particular algorithm to best avoid the hidden node problem within the system.

256. Moreover, Diener’s system explicitly recognizes that hidden nodes may be problematic in the network and anticipates setting a policy to combat that exact issue. Ex. 1003 at 19:54-59. Thus, a POSITA would have seen no obstacle in implementing the two-algorithm policy of Shaffer—picking the appropriate algorithm based on the received parameters indicating the network’s specific conditions—within the system of Diener when hidden nodes are present.

257. Notably, the '313 Patent does not provide any technological advances in the server capabilities, but merely directs the use of the same to store and track data and provide rules and conditions. Thus, it is my opinion that a POSITA would have been able to make any necessary modifications and simple substitutions as indicated in the Ground below. A POSITA would have been motivated to combine Diener and Shaffer and expected success in doing so.

3. Claim 1

258. Based on my review and for the reasons that follow, it is my opinion that claim 1 is obvious based on the teachings of Diener and Shaffer.

i. **Limitation 1[pre]: A communication system comprising:**

259. As I explained in Ground 1, Diener discloses the limitations of the preamble of claim 1. I incorporate my analysis and discussion from Ground 1 by reference.

260. Accordingly, it is my opinion that Diener teaches the preamble of claim 1.

ii. **Limitation 1[a]: a first interface coupled to a first communication unit, the first interface receives a first set of collected data associated with a first network managed by the first communication unit;**

261. As I explained in Ground 1, Diener discloses limitation 1[a]. I incorporate my analysis and discussion from Ground 1 by reference.

262. Accordingly, it is my opinion that Diener teaches limitation 1[a].

- iii. **Limitation 1[b]: a second interface coupled to a second communication unit, the second interface receives a second set of collected data associated with a second network managed by the second communication unit, the second network being a different network than the first network;**

263. As I explained in Ground 1, Diener discloses limitation 1[b]. I incorporate my analysis and discussion from Ground 1 by reference.

264. Accordingly, it is my opinion that Diener teaches limitation 1[b].

- iv. **Limitation 1[c]: a memory coupled to the first and second interfaces, the memory stores the first and second sets of collected data;**

265. As I explained in Ground 1, Diener discloses limitation 1[c]. I incorporate my analysis and discussion from Ground 1 by reference.

266. Accordingly, it is my opinion that Diener discloses limitation 1[c].

- v. **Limitation 1[d]: a processor coupled to the memory, the processor generates at least one policy based at least in part on an analysis of the first and second sets of collected data; and**

267. In my opinion, Diener in view of Shaffer renders obvious claim limitation 1[d]. As explained in Ground 1, Diener teaches a processor coupled to the memory within network management server 1090. Additionally, as explained in Ground 1, Diener teaches determining a policy for the communication units based on an analysis of the first and second sets of collected data. As explained regarding

limitation 1[d] in Ground 1, Diener teaches different types of policies, based on the spectrum intelligence, that instruct a communication unit to take a specific action or make an operational adjustment, such as assigning a device to a different frequency sub-band, adjusting transmit power, or adjusting data rate.

268. Shaffer teaches a policy that includes employing one of two algorithms (or both) to “reduce the impact of hidden nodes in wireless networks by accounting for hidden nodes wireless parameter selection and routing decisions.” Ex. 1004 at [0056]. Regarding the first algorithm, Shaffer discloses “a new cost function that is used for optimizing route selection to minimize interference from hidden neighbors” which is derived from received data pertaining to transmission power, channel, and receiver sensitivity. *Id.* at [0058]. Regarding the second algorithm, Shaffer explains that it “optimizes the transmission power and/or receiver sensitivity of nodes in the mesh in order to minimize the number of hidden neighbors while attempting to have a minimal impact on the overall delay through the network.” *Id.*

269. The cost function algorithm “selects an appropriate set of parameters” and “determines a new optimal routing path as to minimize interference among hidden neighbors.” *Id.* at [0084]. The purpose of utilizing this first algorithm is to determine which parameter combinations and adjustments result in desired performance. *Id.* at [0090]. The transmission power algorithm is selected when the

system “calculates a tradeoff curve” and determines the trade-off between the number of hidden nodes and amount of delay in packets from a particular node. *Id.* at [0092]-[0093]. For example, “[t]he number of nodes which can receive the signal from any specific node can be reduced if that node were to reduce its transmission power.” *Id.* at [0091].

270. Shaffer discloses a “network administrator” which determines the acceptable level of delay and configures a policy based on the appropriately-chosen algorithm. *Id.* at [0103]-[0104]. When generating the policy, the system “take[s] into account the expected traffic flow amounts . . . within the network.” *Id.* at [0106]. The system also considers received parameters from the nodes, including “the physical parameters of the environment and the impact of potential collisions with packets from hidden nodes.” *Id.* at [0113]. Shaffer explains that the choice of which algorithm to employ may vary from node to node, especially based on the congestion and number of hidden nodes within each node’s proximity. *Id.* at [0085]. Additionally, the two algorithms “are not mutually exclusive, and may in fact be complimentary or otherwise overlapping.” *Id.* at [0104].

271. Diener’s network management station 1090 is “where policy decisions are made and controls may be generated” based on the spectrum intelligence gathered by spectrum sensors and processed at the server or network management

station. Ex. 1003 at 6:58-62. As I explained regarding limitation 1[d] in Ground 1, these policies and controls are generated based on an analysis of the first and second sets of collected data. In the combined system of Diener and Shaffer, a POSITA would have understood that the network management station 1090 of Diener generates a policy for the APs based on the analyzed data. That policy, as taught by Shaffer, instructs the communication units to employ the cost function algorithm or transmission power algorithm (or both) when the processed data indicates performance of the system will be optimized by doing so. *See* Ex. 1004 at [0113] (explaining these algorithms “improve[] network efficiency (effective bandwidth) by reducing the number of packets that need to be retransmitted”).

272. Accordingly, it is my opinion Diener in view of Shaffer renders obvious limitation 1[d].

- vi. **Limitation 1[e]: a third interface coupled to the processor, the third interface transmits, in response to the processor determining a change in performance in at least one of the first network or the second network, the at least one policy to the first communication unit that makes a performance-related adjustment within the first network based on the at least one policy.**

273. In my opinion, Diener in view of Shaffer discloses limitation 1[e]. As explained regarding limitation 1[d] above, Diener in view of Shaffer discloses a policy that is communicated to the APs informing that communication unit to

employ either the cost function or transmission power algorithm to minimize interference with hidden nodes. A POSITA would have understood that the AP (e.g., WLAN AP 1050(1)) would implement one of the 2 algorithms disclosed in Shaffer in response to the policy which constitutes a performance-related adjustment within the first network.

274. As explained regarding limitation 1[e] in Ground 1, Diener also discloses a third interface, coupled to the processor of network management station 1090, which transmits this policy in response to a determination of a change in performance in the first or second networks. I incorporate my discussion and analysis of limitation 1[e] from Ground 1 by reference.

275. Accordingly, in my opinion, Diener in view of Shaffer renders obvious claim limitation 1[e].

276. For the foregoing reasons, it is my opinion that Diener in view of Shaffer renders obvious claim 1.

4. Claim 2: The communication system of claim 1, wherein the adjustment within the first network is an implementation of an algorithm.

277. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener

teaches claim 2. I incorporate my analysis and discussion from Ground 1 by reference.

278. Additionally, as explained above regarding claim 1, Shaffer teaches that the specific policy adjustment is an implementation of one of two algorithms (i.e., cost function algorithm or transmission power algorithm). Ex. 1004 at [0058]. Thus, in the combined system of Diener and Shaffer, a POSITA would have recognized that one such policy generated by the system would result in an adjustment within a first WLAN that implements an algorithm.

279. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 2.

5. Claim 3: The communication system of claim 1, where in the adjustment within the first network is a change in parameter value.

280. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener teaches claim 3. I incorporate my analysis and discussion from Ground 1 by reference.

281. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 3.

6. **Claim 4: The communication system of claim 1 wherein the first communication unit reduces interference in the second network based on an implementation of the at least one policy within the first network.**

282. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener teaches claim 4. I incorporate my analysis and discussion from Ground 1 by reference.

283. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 4.

7. **Claim 5: The communication system of claim 4 wherein the at least one policy adjusts channel transmission characteristics of at least one wireless channel within the first network.**

284. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 4. And, as explained above, in Ground 1, Diener discloses claim 5. I incorporate my analysis and discussion from Ground 1 by reference.

285. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 5.

8. Claim 6: The communication system of claim 5 wherein the channel transmission characteristics comprise a modification to a transmission band across the at least one wireless channel within the first network.

286. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 5. And, as explained above, in Ground 1, Diener discloses claim 6. I incorporate my analysis and discussion from Ground 1 by reference.

287. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 6.

9. Claim 7: The communication system of claim 1 wherein the first and second sets of collected data comprise historical data.

288. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener teaches claim 7. I incorporate my analysis and discussion from Ground 1 by reference.

289. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 7.

10. Claim 8

290. In my opinion, Diener in view of Shaffer renders obvious claim 8.

**i. Limitation 8

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[pre]
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: The communication system of claim 1 wherein the processor:**

291. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1 with a processor. And, as explained above, in Ground 1, Diener teaches the preamble of claim 8. I incorporate my analysis and discussion from Ground 1 by reference.

292. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious the preamble of claim 8.

ii. Limitation 8[a]: generates a first control signal that is sent to the first communication unit at a first pre-defined time, the first control signal comprising a first policy adjustment to the first network; and

293. As explained above, in Ground 1, Diener renders obvious limitation 8[a]. I incorporate my analysis and discussion from Ground 1 by reference.

294. Accordingly, it is my opinion that Diener renders obvious limitation 8[a].

iii. Limitation 8[b]: generates a second control signal that is sent to the second communication unit at a second pre-defined time, the second control signal comprising a second policy adjustment to the second network.

295. As explained above, in Ground 1, Diener renders obvious limitation 8[b]. I incorporate my analysis and discussion from Ground 1 by reference.

296. Accordingly, it is my opinion that Diener renders obvious limitation 8[b].

297. In sum, Diener in view of Shaffer renders obvious claim 8,

11. Claim 9: The communication system of claim 8 wherein the first pre-defined time and the second pre-defined time are different.

298. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 8. And, as explained above, in Ground 1, Diener renders obvious claim 9. I incorporate my analysis and discussion from Ground 1 by reference.

299. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 9.

12. Claim 10: The communication system of claim 8 wherein the first policy adjustment and the second policy adjustment are different.

300. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 8. And, as explained above, in Ground 1, Diener discloses claim 10. I incorporate my analysis and discussion from Ground 1 by reference.

301. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 10.

13. Claim 11: The communication system of claim 1 wherein the first and second communication units are Wi-Fi access points.

302. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener discloses claim 11. I incorporate my analysis and discussion from Ground 1 by reference.

303. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 11.

14. Claim 12: The communication system of claim 1 wherein the first and second communication units are cellular base stations.

304. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener teaches and/or renders obvious claim 12. I incorporate my analysis and discussion from Ground 1 by reference.

305. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 12.

15. Claim 13: The communication system of claim 12 wherein the first communication unit is a small cell base station.

306. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 12. And, as explained above, in Ground 1, Diener

teaches and/or renders obvious claim 13. I incorporate my analysis and discussion from Ground 1 by reference.

307. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 13.

16. Claim 14: The communication system of claim 1 wherein the first and second sets of collected data comprise RSSI measurements collected within the first and second networks.

308. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener discloses claim 14. I incorporate my analysis and discussion from Ground 1 by reference.

309. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 14.

17. Claim 15: The communication system of claim 14 wherein the at least one policy adjusts a transmission rate of at least one channel within the first network.

310. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 14. And, as explained above, in Ground 1, Diener discloses claim 15. I incorporate my analysis and discussion from Ground 1 by reference.

311. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 15.

18. Claim 16: The communication system of claim 1 wherein the first and second sets of collected data comprise collected measurements related to SNR across a plurality of wireless channels within the first and second networks.

312. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener discloses claim 16. I incorporate my analysis and discussion from Ground 1 by reference.

313. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 16.

19. Claim 17: The communication system of claim 16 wherein the at least one policy adjusts a transmission power level across a first wireless channel within the plurality of wireless channels.

314. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 16. And, as explained above, in Ground 1, Diener discloses claim 17. I incorporate my analysis and discussion from Ground 1 by reference. Additionally, as taught by Shaffer, the policy may include a cost function algorithm which “optimizes the transmission power” or a transmission power algorithm. Ex. 1004 at [0058]. A POSITA would have recognized that the policy of

Shaffer also adjusts a transmission power level across a wireless channel within a plurality of wireless channels of Diener.

315. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 17.

20. Claim 18: The communication system of claim 1 wherein two interfaces within the first, second and third interfaces are the same interface.

316. As I explained above, Diener in view of Shaffer renders obvious the communication system of claim 1. And, as explained above, in Ground 1, Diener discloses claim 18. I incorporate my analysis and discussion from Ground 1 by reference.

317. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 18.

21. Claim 19

318. Based on my review and for the reasons that follow, it is my opinion that claim 19 is obvious based on the teachings of Diener in view of Shaffer.

i. Limitation 19[pre]: A method for managing a plurality of networks, the method comprising:

319. As I explained in Ground 1, Diener teaches the preamble of claim 19. I incorporate my analysis and discussion from Ground 1 by reference.

320. Accordingly, it is my opinion that Diener teaches the preamble of claim 19.

- ii. **Limitation 19[a]: receiving, by a server, from network monitoring devices that monitor data associated with an operation of two or more communication units located in at least two networks, the data comprising a parameter;**

321. As I explained in Ground 1, Diener teaches limitation 19[a]. I incorporate my analysis and discussion from Ground 1 by reference.

322. Accordingly, it is my opinion that Diener teaches limitation 19[a].

- iii. **Limitation 19[b]: processing, by the server, the received data;**

323. As I explained in Ground 1, Diener teaches limitation 19[b]. I incorporate my analysis and discussion from Ground 1 by reference.

324. Accordingly, it is my opinion that Diener teaches limitation 19[b].

- iv. **Limitation 19[c]: based on the processed data, determining a policy for at least one of the two or more communication units; and**

325. In my opinion, Diener in view of Shaffer renders obvious limitation 19[c]. As explained in Ground 1, Diener teaches generating a policy for the communication units based on the processed data. I incorporate my analysis and discussion from Ground 1 by reference. Additionally, as explained regarding claim 1 above, a POSITA would have understood that the in the combined Diener-Shaffer

system, the network management station would determine a policy for the first communication unit (i.e., WLAN AP 1050(1)) that instructed it to implement one of the algorithms taught by Shaffer. I incorporate my analysis and discussion from claim 1 by reference.

326. Accordingly, it is my opinion Diener in view of Shaffer renders obvious limitation 19[c].

- v. **Limitation 19[d]: in response to the server detecting a degradation of network performance in at least one network within the plurality of networks, communicating the policy to at least one or more communication units that implement one or more algorithms that use the parameter and at least one rule or one condition for the one or more communication units to improve a performance of the one or more communication units.**

327. In my opinion, Diener in view of Shaffer renders obvious claim limitation 19[d]. As explained in Ground 1, Diener discloses this limitation. In the combined Diener-Shaffer system, a POSITA would have understood that the communicated policy instructs the AP to implement one of the two algorithms taught by Shaffer (cost function or transmission power algorithm). I incorporate my analysis and discussion from limitations 1[d]-1[e] by reference.

328. Accordingly, it is my opinion that a POSITA would have understood that Diener in view of Shaffer renders obvious limitation 19[d].

329. For the foregoing reasons, it is my opinion that Diener in view of Shaffer renders obvious claim 19.

22. Claim 20: The method of claim 19 wherein determining the policy comprises selecting the policy from a set of policies that are stored on the one or more communication units and wherein the communicated policy updates the one or more algorithms implemented on the one or more communication units.

330. In my opinion, Diener in view of Shaffer renders obvious claim 20. As explained above, Diener in view of Shaffer renders obvious the method of claim 19. Additionally, as explained in Ground 1, Diener discloses claim 20. I incorporate my analysis and discussion from Ground 1 by reference.

331. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 20.

23. Claim 21: The method of claim 19 wherein the one or more communication units comprise a Wi-Fi access point.

332. In my opinion, Diener in view of Shaffer renders obvious claim 21. As explained above, Diener in view of Shaffer renders obvious the method of claim 19. Additionally, as explained regarding claim 11 in Ground 1, Diener discloses that the one or more communication units (i.e., WLAN APs 1050(1) and 1050(2)) comprise Wi-Fi access points. I incorporate my analysis from claim 11 in Ground 1 by reference.

333. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 21.

24. Claim 22: The method of claim 19 wherein the one or more communication units comprise a cellular base station.

334. In my opinion, Diener in view of Shaffer renders obvious claim 22. As explained above, Diener in view of Shaffer renders obvious the method of claim 19. Additionally, as explained regarding claim 12, Diener teaches and/or renders obvious that the one or more communication units comprise cellular base stations. I incorporate my analysis from claim 12 in Ground 1 by reference.

335. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 22.

25. Claim 23: The method of claim 19 wherein the at least one rule or one condition comprises an adjustment to a wireless transmission band within the plurality of networks.

336. In my opinion, Diener in view of Shaffer renders obvious claim 23. As explained above, Diener in view of Shaffer renders obvious the method of claim 19. Additionally, as explained above in Ground 1, Diener discloses the remainder of claim 23. I incorporate my analysis and discussion from Ground 1 by reference.

337. Accordingly, it is my opinion that Diener in view of Shaffer renders obvious claim 23.

XI. NO SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

338. I am informed by counsel that evidence of secondary considerations of non-obviousness are considered when determining whether a patent is invalid as obvious. I understand that secondary considerations include: (1) an invention's commercial success; (2) a long-felt, but unmet, need; (3) failure of others; (4) professional skepticism; (5) industry praise; (6) copying; (7) unexpected results; and (8) any other relevant consideration. I also understand from counsel that it is Patent Owner's burden to demonstrate the existence of secondary considerations.

339. To the extent that the Patent Owner subsequently identifies any other evidence of non-obviousness, I reserve the right to consider and revise any of my opinions if necessary.

XII. CONCLUSION

340. For at least the preceding reasons, in my opinion, claims 1-23 of the '313 Patent would have been obvious to a person of ordinary skill in the art at the time of invention based on the prior art references that I have cited and analyzed above.

341. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in this proceeding. If required, I will appear for cross-examination

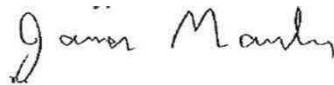
at the appropriate time. I reserve the right to offer opinions relevant to the invalidity of the '313 Patent claims at issue and/or offer testimony in support of this Declaration.

342. I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and belief and believed to be true. Furthermore, these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Dated:

October 25, 2024

Respectfully submitted,

A handwritten signature in cursive script that reads "James Martin".

James Martin, Ph.D.

APPENDIX A

RESUME – James Martin

PERSONAL DATA

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EDUCATION

Ph.D., North Carolina State University, 1999, Electrical Engineering (dissertation topic: end-to-end congestion avoidance for TCP, first to introduce and evaluate delay-based TCP)

M.S., Arizona State University, 1989, Computer Science

B.S., University of Illinois (Champaign/Urbana), 1983, Electrical Engineering

PROFESSIONAL EXPERIENCE

Clemson University, 2023-, Professor Emeritus, Clemson University Emeritus College.

Clemson University, 2020-2023, Professor of Computer Science.

Clemson University, 2008-, Associate Professor of Computer Science.

Clemson University, 2002-2008, Assistant Professor of Computer Science.

Gartner, 2000 to 2002, consultant for Gartner Consulting Group. Office focused on telecommunications strategy and technology assessments. Engagements included network analysis studies, cybersecurity assessments, technical white papers for ISPs.

IBM Corporation, 1991 to 2000, Software Engineer. Contributions include Systems Network Architecture (SNA) architecture extensions: SNA over async, RTP (Rate-based Transport Protocol), Performance study of RTP and delay-based TCP, Device drivers for Unix and OS/2, team leader for the IBM Firewall product (AIX, OS/2).

Filenet Corporation, 1989 to 1991, Unix kernel/application developer, performance study their proprietary hardware/software platform (an image storage work flow product).

Motorola Government Electronics Division, 1983 to 1989, design engineer. Developed hardware and software for military communications systems.

CONSULTING EXPERIENCE

MIT Lincoln Labs, 2019-, Performance analysis of MAC protocols for multibeam directional radios, exploration of emerging content-centric networking systems for future tactical edge environments.

Comcast Corporation, 2022, Technical guidance in areas related to DOCSIS.

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Cox Communications, 2013, Modeling bandwidth/spectrum consumption in emerging DOCSIS 3.0 based cable networks.
CableLabs, 2012, Modeling and analyzing the DASH streaming protocol over cable networks.
Cox Communications, 2010-2011, Network performance analysis.
CableLabs, 2009-2010, analyzing effects of buffer management techniques operating at upstream queues in a cable modem.
The South Carolina Educational Broadband Service Commission, 2008-2010, served as a technical expert to SC's statewide broadband wireless project.
CableLabs, 2006-2008, evaluated the impact of peer-to-peer traffic on Voice-over-IP in broadband cable networks.
South Carolina's Coalition for Mathematics and Science, *South Carolina Department of Education* (Math and Science Unit), 2006, provided technical assistance to select and deploy web collaboration tools.
CableLabs, 2005-2006, cable network traffic modeling and protocol evaluation. First to suggest the concept of two-queue AQM which evolved to the current low latency DOCSIS enhancement to DOCSIS3.1/4.0.
Expert Witness/Consultant to law firms, multiple engagements with different law firms serving as a technology advisor, an expert consultant or an expert witness supporting law teams on Intellectual Property disputes.

OTHER ORGANIZATIONS

SEMPRE, Inc., Advisory Role, 2021-2023.
BitRipple Inc., Advisory Board Member, 2020-2021.
CableLabs Inc, Advisory Role, contributor to DOCSIS 3.0 and 3.1 standards
WiMAX Forum, member and contributor to standards, 2006 – 2009.

MEMBERSHIPS

Member Association for Computing Machinery, ACM, (1989-).
 Member IEEE and IEEE Communications Society, (1989-).
 Member UPE (CS Honor Society), (1989-).

PUBLICATIONS

Book Chapters:

F. Jackson, R. Amin, Y. Fu, J. Gilbert, J. Martin, "A User Study of Netflix Streaming", *SpringerLink Lecture Notes in Computer Science*, vol. 9186, pp. 481-489 (2015).

N. Shah, D. Kouvatsos, J. Martin, S. Moser, "On the Performance Modeling and Optimization of DOCSIS HFC Networks", *Springerlink Lecture Notes in Computer Science*, vol. 5233, pp. 682-715 (2011).

Refereed Journal Publications:

A. Alsuhaimeh, A. Rayamajhi, J. Westall and J. Martin, "Adapting Time Headway in Cooperative Adaptive Cruise Control to Network Reliability," in *IEEE Transactions on Vehicular Technology*, vol. 70, no. 12, pp. 12691-12702, Dec. 2021

K. Chen, X. Xing, M. Palash, J. Liu, J. Martin, "Network-side Multipath Access Management in Wireless Networks with Software-defined Networking" *IEEE Transactions on Vehicular Technology*, 68(10), 10030-10033 (2019).

A. Bhargava, J. Martin, S. Babu, "Comparative Evaluation of User Perceived Quality Assessment of Design Strategies for HTTP-Based Adaptive Streaming", *ACM Transactions of Applied Perception*, 16(4), 22:1-22:20 (2019).

G. Hong, J. Martin, J. Westall, "Adaptive Bandwidth Binning for Bandwidth Management", *Elsevier Computer Networks*, 150 150-169 (2019).

M. Chowdhury, M. Rahman, A. Rayamajhi, S. Khan, M. Islam, Z. Khan, and J. Martin, "Lessons Learned from the Real-World Deployment of a Connected Vehicle Testbed," *Transportation Research Record: Journal of the Transportation Research Board*, 2672(22), 10-23 (2018).

P. Pisu, J. Martin, and Z. Biron, "A Control-Oriented Perspective For Security in Connected and Automated Vehicles", *ASME Dynamic Systems and Control Magazine*, 5(4), 17-20 (2017).

K. Dey, A. Rayamajhi, M. Chowdhury, P. Bhavsar, J. Martin, "Vehicle-to-vehicle (V2) and Vehicle-to-Infrastructure (V2I) Communication in a Heterogeneous Wireless Network – Performance Evaluation", *Elsevier Transportation Research Part C*, 68, 168-184 (2016).

R. Amin, J. Martin, "Assessing Performance Gains Through Global Resource Control of Heterogeneous Wireless Systems", *IEEE Transactions on Mobile Computing*, 15(2), 292-305 (2016).

J. Liu, Y. Fu, J. Martin, "Using Cloud Computing to Support Higher Education in Networks and Systems", *International Journal of Cloud Computing*, 5(1-2), 57-78 (2016).

G. Hong, J. Martin, J. Westall, "On Fairness and Application Performance of Active Queue Management in Broadband Cable Networks", *Elsevier Computer Networks*, 91(C), 390-406 (2015).

K. Xu, K. Wang, R. Amin, J. Martin, R. Izard, "A Fast Cloud-based Network Selection Scheme Using Coalition Formation Games in Vehicular Networks", *IEEE Transactions on Vehicular Technology*, 64(11), 5327-5339 (2015).

M. Toy, J. Martin, M Schmitt, V. Blaked, "Next generation cable networks with DOCSIS 3.1 technology", Guest Editorial, *IEEE Communications Magazine* 53(3), 106-107 (2015).

B. Hamzeh, M. Toy, Y. Fu, J. Martin, "DOCSIS 3.1: Scaling broadband cable to Gigabit speeds", *IEEE Communications Magazine*, 53(3), 108-113 (2015).

A. Hussien, R. Amin, J. Martin, A. Eltawil, "Energy Aware Mapping for Reconfigurable Wireless MPSoCs" *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, 23(2), 392-396 (2015).

R. Amin, J. Martin, J. Deaton, L. DaSilva, A. Hussien, A. Eltawil, "Balancing Spectral Efficiency, Energy Consumption, and Fairness in Future Heterogeneous Wireless Systems with Reconfigurable Devices", *IEEE Journal on Selected Areas In Communications*, 31(5), 969-980 (2013).

J. Deng, R. Brooks, J. Martin, "Assessing the Effect of WiMAX System Parameter Settings on MAC-level Local DoS Vulnerability", *International Journal of Performability Engineering*, 8(2), 806-819 (2012).

J. Westall, J. Martin, "Performance Characteristics of an Operational WiMAX Network", *IEEE Transactions on Mobile Computing*, 10(7), 941-953 (2011).

Zhou, Y., Chowdhury, M., Martin, J., Wang, K.C., Westall, J., Kang, X.Y., "Field Performance Study of a Regional WiMAX Network for Intelligent Transportation System Applications," *Journal of Transportation Research Board*, Transportation Research Board, (2129), 121-128 (2009).

J. Martin, M. Westall, "A Simulation Model of the DOCSIS Protocol", *Simulation: Transactions of the Society for Modeling and Simulation International*, 83(2), 139-155 (2007).

Jiong Gong, David Reed, Terry Shaw, Daniel Vivanco, Jim Martin, "QAM Resource Allocation in Mixed-Format VoD Systems", *Journal of Communications*, 2(1), 1-9 (2007).

J. Martin, A. Nilsson, I. Rhee, "Delay-based Congestion Avoidance for TCP", *IEEE/ACM Transactions on Networking*, 11(3), 356-369 (2003).

Conference Proceedings (Reviewed):

M. Kaur, A.Razi, L. Cheng, R. Amin, J. Martin, “Design and Evaluation of an Application-Oriented Data-Centric Communication Framework for Emerging Cyber-Physical Systems”, *Proceedings of CCNC 2023*, January, 2023.

D. Rice, S. Ozer, J. Martin, “Towards Predictable Low Latency DOCSIS Services”, *Proceedings of the 2022 Fall Technical Forum SCTE Conference*, September, 2022.

J. Martin, M. Kaur, L. Cheng, A. Razzi, “Towards Connecting the Disconnected Internet”, *Proceedings of the International Conference on Computer Communications and Networks (ICCCN)*, July, 2022.

M. Kaur, R. Amin and J. Martin, "The Design and Validation of ICN-Enabled Hybrid Unmanned Aerial System", *Proceeding of the IEEE Military Communications Conference (MILCOM)*, 2021.

M. Kaur, G. Ali, A. Rayamajhi, B. Ayalew, J. Martin, “Network Driven Performance Analysis in Connected Vehicular Networks”, *Proceedings of the IEEE VTC Conference*, September, 2019.

V. Rastogi, R. Merco, M. Kaur, A., Rayamajhi, M. Gavelli, G. Papa, P. Pisu, S. Babu, A. Robb, and J. Martin, “An Immersive Vehicle-in-the-loop VR Platform for Evaluating Human-to-Autonomous Vehicle Interactions,” *Proceedings of WCX: SAE World Congress Experience*, 2019.

K. Chen, Xin Xing, Mijanur Rahaman Palash, Jianwei Liu, and James Martin, “Improving Wireless Network Performance under MPTCP based Multipath Access”, *Proceedings of the 43rd IEEE Conference on Local Computer Networks* (October 2018) **[best paper award: 1 out of 45]**.

K.Chen, J. Liu, J. Martin, K. Wang, H. Hu, “Improving Integrated LTE-WiFi Network Performance with SDN-based Flow Scheduling”, *Proceedings of the 2018 IEEE International Conference on Computer Communications and Networks (ICCCN 2018)*, (July 2018).

A. Rayamajhi, Z. Biron, R. Merco, P. Pisu, J. Westall, J. Martin, “The Impact of Dedicated Short Range Communication on Cooperative Adaptive Cruise Control”, *Proceedings of IEEE International Conference on Communications (ICC 2018)*, (Kansas City, MO, May, 2018).

J. Liu, X. Xing, K. Chen, J. Martin, “On design challenges of an endpoint flow association optimization service in a multi-provider wireless heterogeneous network”, *Proceedings of IEEE International Conference on Communications (ICC 2018)*, (Kansas City, MO, May, 2018).

M. Rahman, M. Chowdhury, A. Rayamajhi, K. Dey, J. Martin, “Adaptive Queue Prediction Algorithm Using Edge-Centric Cyber Physical Platform in a Connected Vehicle Environment”, *Transportation Research board’s 97th Conference*, (Washington DC, January, 2018).

Chowdhury, M., Rahman, M., Rayamajhi, A., Khan, S., Islam, M., Khan, Z., and Martin, J., “Lessons Learned from the Real-World Deployment of a Connected Vehicle Testbed,” *Proceedings of the Transportation Research Board*, (Washington, D.C., January, 2018).

A. Rayamajhi, M. Rahman, M. Kaur, J. Liu, M. Chowdhury, H. Hu, J. McClendon, K. Wang, A. Gosain, J. Martin, “ThinGs In a Fog: System Illustration with Connected Vehicles”, *Proceedings of the IEEE Vehicular Technology Conference (VCT’17)*, (Sydney AU, June 2017).

M. Kaur, H. Hu, J. Martin, “Survey: Security in Vehicular Networks”, *Proceedings of the International Conference on Connected Vehicles and Expo (ICCVE’16)*, (Seattle, WA, Sept 2016).

A. Sarker, C. Qiu, H. Shen, A. Gil, J. Taiber, M. Chowdhury, J. Martin, M. Devine, A. Rindos, “An Efficient Wireless Power Transfer System to Balance the State of Charge of Electric Vehicles”, *Proceedings of the International Conference on Parallel Processing*, (Philadelphia, PA, August 2016).

K. Chen, R. Izard, H. Hu, K. Wang, J. Martin, J. Deng, “HetSDN: Exploiting SDN for Intelligent Network Usage in Heterogeneous Wireless Networks”, *Proceedings of IEEE/ACM International Symposium on Quality of Service (IWQoS 2016)*, (Beijing China, June 2016).

J. Liu, A. Rayamajhi, J. Martin, “Using MPTCP Subflow Association Control for Heterogeneous Wireless Network Optimization”, *Proceedings of International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt2016)*, (Tempe AZ, May 2016).

A. Alsuhaime, Z. Jing, J. Martin, “Design and Evaluation of Adaptive Switched Digital Video System”, *IEEE Consumer Communications and Networking Conference (CCNC16)*, (Las Vegas NV, January 2016).

F. Jackson, R. Amin, Y. Fu, J. Gilbert, J. Martin, “A User Study of Netflix Streaming”, *Proceedings of Human Computer Interaction (HCI) International (HCI15)*, (Los Angeles CA, August 2015).

J. Martin, G. Hong, J. Westall, “Managing Fairness and Application Performance with Active Queue Management in DOCSIS-based Cable Networks”, *Proceedings of ACM SIGCOMM Capacity Sharing Workshop (CSWS 2014)*, (Chicago IL, August 2014).

R. Izard, A. Hodges, J. Liu, J. Martin, K. Wang, K. Xu, "An OpenFlowTestbed for the Evaluation of Vertical Handover Decision Algorithms in Heterogeneous Wireless Networks", *Proceedings of 9th International Conference on Testbeds and Research Infrastructures for the Development of Networks & Communities (TRIDENTCOM 2014)*, (Guangzhou China, May 2014).

R. Amin, J. Martin, H. Russell, "Assessing Performance Gains Via the Use of Global Resource Controller for Realistic Heterogeneous Wireless Networks", *Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC 2014)*, (Istanbul Turkey, April 2014).

J. Anderson, J. Martin, "Towards a System for Controlling Client-Server Traffic in Virtual Worlds using SDN", *Proceedings of ACM Workshop on Network and Systems Support for Games (NetGames)*, (Denver CO, December 2013).

A. Hussien, R. Amin, J. Martin, A. Eltawil, "MPMAP: A High Level Synthesis and Mapping Tool for MPSoCs" *Proceedings of Asilomar Conference on Signals, Systems and Computers*, (Pacific Grove CA, November 2013).

C. Jackson, H. Russell, B. Wolf, J. Martin, "Investigation of MAC for a Hierarchical and Heterogeneous Multichannel Ad Hoc Network", *Proceedings of the Military communications Conference (MILCOM'13)*, (San Diego CA, November 2013).

Amin, R., Jackson, F., Gilbert, J.E., Martin, J., & Shaw, T., "Assessing the Impact of Latency and Jitter on the Perceived Quality of Call of Duty Modern Warfare 2", *Proceedings of the 15th International Conference (HCI International 2013)*, (Las Vegas, NV, July 2013).

K. Xu, R. Izard, K. Wang, J. Martin, "Cloud-based Handoff as a Service for Heterogeneous Vehicular Networks with OpenFlow (short paper)", *Proceedings of the GENI Research and Educational Experiment (GREE2013)*, (Salt Lake City UT, March 2013).

J. Martin, Y. Fu, N. Wourms, T. Shaw, "Characterizing Netflix Bandwidth Consumption", *Proceedings of the IEEE International Conference on Computers and Communications (CCNC2013)*, (Las Vegas, NV, January 2013).

R. Amin, J. Martin, X. Zhou, "Smart Grid Communication Using Next Generation Heterogeneous Wireless Networks", *Proceedings of the Third IEEE International Conference on Smart Grid Communications (SmartGridCom)*, (Tainan City, Taiwan, November 2012).

G. Hong, J. Martin, S. Moser, J. Westall, "Fair Scheduling on Parallel Bonded Channels with Intersecting Bonding Groups", *Proceedings of the IEEE International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems (Mascots)*, (Washington DC, August 2012).

J. Martin, R. Amin, A. Eltawil, A. Hussien, "Spectral Efficiency and Energy Consumption Tradeoffs for Reconfigurable Devices in Heterogeneous Wireless Systems", *Proceedings of the IEEE WCNC2012 Conference*, (Paris, France, April 2012).

R. R. Brooks, K.-C. Wang, J. Martin, K. Cameron, J. Deng, and L. Yu, "WiMAX: Bandwidth Contention Resolution – Vulnerability to Denial of Service Attacks," *Proceedings of the First GENI Research and Educational Experiment Workshop*, (Los Angeles, CA, March 2012).

A. Hussien, A. Eltawil, R. Amin and J. Martin, "Energy Aware Task Mapping Algorithm For Heterogeneous MPSoC Based Architectures", *Proceedings of International Conference on Computer Design (ICCD)*, (Montreal, Quebec, October 2011).

J. Martin, R. Amin, A. Eltawil, A. Hussien, "Using Reconfigurable Devices to Maximize Spectral Efficiency in Future Heterogeneous Wireless Systems", *Proceedings of the IEEE ICCCN 2011 Conference*, (Maui, HI, July 2011).

J. Martin, R. Amin, A. Eltawil, A. Hussien, "Limitations of 4G Wireless Systems", *Proceedings of the Wireless Symposium @ Virginia Tech*, (Blacksburg VA, June 2011).

J. Martin, J. Westall, J. Finkelstein, G. Hart, T. Shaw, G. White, R. Woundy, "Cable Modem Buffer Management in DOCSIS Networks", *Proceedings of the IEEE Sarnoff 2010 Symposium*, (Princeton University, Princeton NJ, April 2010).

S. Moser, J. Martin, J. Westall, B. Dean, "The Role of Max-min Fairness in DOCSIS 3.0 Downstream Channel Bonding", *Proceedings of the IEEE Sarnoff 2010 Symposium*, (Princeton University, Princeton NJ, April 2010).

J. Martin, B. Li, W. Pressly, J. Westall, "WiMAX Performance at 4.9 GHz", *Proceedings of the 2010 IEEE Aerospace Conference*, (Big Sky, Montana, March 2010).

J. Martin, J. Westall, "Evaluating WiMAX for Public Safety", *Proceedings of the Wireless Symposium @ Virginia Tech*, (Blacksburg, VA, June 2010).

M. Juang, K. Wang, J. Martin, "A Measurement Study on Link Capacity of a High Stress IEEE 802.11b/g Network", *Proceedings of the 2008 IEEE International Conference on Computer Communications and Networks (ICCCN 2008)*, (St. Thomas, Virgin Islands, August 2008).

M. Fenn, M. Murphy, J. Martin, S. Goasguen "An Evaluation of KVM for Use in Cloud Computing", *Proceedings of the 2nd International Conference on the Virtual Computing Initiative (ICVCI08)*, (RTP, NC, May 2008).

W. Spearman, J. Gao, J. Martin, "Traffic Prioritization for Lunar Surface Networking Using an Adaptive 802.11e Algorithm", *Proceedings of the 2008 IEEE Aerospace Conference*, (Big Sky, Montana, March 2008).

E. Harney, S. Goasguen, J. Martin, M. Murphy, M. Westall, "The Efficacy of Live Virtual Machine Migrations Over the Internet", *Proceedings of the 2nd International Workshop on Virtualization Technologies in Distributed Computing (VTDC 2007)*, (Reno, Nevada, November 2007).

J. Gong, D. Vivanco, J. Martin, "Simulation Study of the Spectral Capacity Requirements of Switched Digital Broadcast", *Proceedings of the 2007 IEEE Broadnets*, (RTP, NC, September 2007).

J. Martin, M. Westall, "Assessing the Impact of BitTorrent on DOCSIS Networks", *Proceedings of the 2007 IEEE Broadnets*, (RTP, NC, September 2007).

W. Spearman, J. Martin, "A Distributed Adaptive Algorithm for QoS in 802.11e Wireless Networks", *Proceedings of the 2007 International Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS'07)*, (San Diego, CA, July 2007).

J. Martin, M. Westall, "Validating an 'ns' Simulation Model of the DOCSIS Protocol", *Proceedings of the 2006 International Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS'06)*, (Calgary, CA, July 2006).

J. Gong, D. Reed, T. Shaw, D. Vivanco, J. Martin, "VoD QAM Resource Allocation Algorithms", *Proceedings of the IEEE/IFIP-Networking Conference*, (Coimbra Portugal, May 2006).

S. Kirtane, J. Martin, "Application Performance Prediction in Autonomic Systems", *Proceedings of the ACM SouthEast Conference*, (Melbourne, Florida, March 2006).

Scott Moser, Jim Martin, "Assessing Denial of Service Vulnerabilities in DOCSIS", *Proceedings of the ACM SouthEast Conference*, (Melbourne, Florida, March 2006).

A. Swaminathan, J. Martin, "Fairness Issues in Hybrid 802.11b/e Networks", *Proceedings of the IEEE Consumer Communications and Networking Conference*, (Las Vegas, NV, January 2006).

R. Geist, J. Martin, J. Westall, V. Yalla, "Performance Tuning of Gigabit Network Interfaces", *Proceedings of the 31st Annual International Conference of the Computer Measurement Group (CMG 2005)*, (Orlando, Florida, December 2005).

N. Shah, D. Kouvatsos, J. Martin, S. Moser, "A Tutorial on DOCSIS: Protocol and Performance Models", *Proceedings of the International Working Conference on*

Performance Modeling and Evaluation of Heterogeneous Networks, (Ikley, UK, July 2005).

J. Martin, M. Westall, V. Rajasekaran, "Virtual Machine Effects on Network Traffic Dynamics", *Proceedings of the IEEE International Performance, Computing, and Communications Conference*, (Phoenix, AZ, April 2005).

S. Howard, J. Martin, "DOCSIS Performance Evaluation: Piggybacking versus Concatenation", *Proceedings of the ACM Southeast Conference*, (Kennesaw State, GA, March 2005).

J. Martin, "The Impact of the DOCSIS 1.1/2.0 MAC Protocol on TCP", *Proceedings of the IEEE Consumer Communications and Networking Conference*, (Las Vegas, NV, January 2005).

J. Martin, M. Westall, V. Rajasekaran, "On the Impact of Virtual Machine Overhead on TCP Performance", *Proceedings of the IASTED International Conference on Communication and Computer Networks*, (Boston, MA, November 2004).

J. Martin, H. Karlapudi, "Web Application Performance Prediction", *Proceedings of the IASTED International Conference on Communication and Computer Networks*, (Boston, MA, November 2004).

R. Geist, J. Martin, J. Westall, "Small Aggregations of ON/OFF Traffic Sources", *Proceedings of the IASTED International Conference on Communication and Computer Networks*, (Boston, MA, November 2004).

S. Biyani, J. Martin, "A Comparison of TCP-Friendly Congestion Control Protocols", *Proceedings of the International Conference on Computers Communications and Networks 2004*, (Chicago, IL, October 2004).

J. Martin, "The Interaction Between the DOCSIS 1.1/2.0 MAC Protocol and TCP Application Performance", *Proceedings of the International Working Conference on Performance Modeling and Evaluation of Heterogeneous Networks*, (Ikley, UK, July 2004).

J. Martin, "Managing Best Effort IP Networks over Heterogeneous WANs", *Proceedings of the International Working Conference on Performance Modeling and Evaluation of Heterogeneous Networks*, (Ikley, UK, July 2004).

J. Martin, N. Shrivastav, "Modeling the DOCSIS 1.1/2.0 MAC Protocol", *Proceedings of the 2003 International Conference on Computer Communications and Networks*, (Dallas TX, October 2003).

J. Martin, A. Nilsson, "On Service Level Agreements for IP Networks", in *Proceedings of INFOCOM*, (New York, New York, July 2002).

J. Martin, A. Nilsson, I. Rhee, "The Incremental Deployability of RTT-based Congestion Avoidance for High Speed TCP Internet Connections", in *Proc. of ACM SIGMETRICS 2000, International Conference on Measurement and Modeling of Computer Systems* (ACM SIGMETRICS), (Santa Clara, CA, 2000).

J. Martin, A. Nilsson, "On Congestion Avoidance for TCP/IP Networks", *Proceedings of the 15th IFIP World Computer Congress*, (Budapest, Hungary, 1998).

J. Martin, A. Nilsson, "Congestion Control in HPR", in *Proceedings of IEEE GLOBECOM*, (Phoenix, AZ, 1997).

Technical Reports (available at <https://people.cs.clemson.edu/~jmarty/papers/papers.html>) :

J. Martin, G. Comert, M. Kaur, A. Alsuhaime, "Uncertainty Quantification of Cyber Attacks on Connected Vehicles and Infrastructure (Part 1)", United States Department of Transportation, National Transportation Library, Report #56057, Available online at <https://rosap.ntl.bts.gov/view/dot/56057>, June, 2020.

J. Martin, KC Wang, I. Seskar, "SciWiNet: Evaluating the Efficacy of a Mobile Virtual Network Operator for the Research Community – Project Report", August, 2017.
Available online:
<https://people.cs.clemson.edu/~jmarty/papers/SciWiNetProjectRecap.pdf>

J. Martin, Y. Fu, G. Hong, "On the Efficacy of the Dynamic Adaptive Streaming over HTTP (DASH) Protocol - Extended Version", April, 2013.

J. Martin, M. Westall, R. Amin, "Multicasting Video in Dense 802.11g Networks Using Application FEC", 2010

J. Westall, J. Martin, "An Introduction to Galois Fields and Reed-Solomon Coding", October 2010.

M. Bidwell, "MAC Layer DoS Vulnerabilities", 2006

J. Martin, A. Nilsson, "A Comparison of RTP and TCP/Reno Transport Protocols", IBM TR 29.2337, December 1997.

J. Martin, A. Nilsson, "The Evolution of Congestion Control in TCP/IP networks", IBM TR 29.2277, June 1997.

J. Martin, "Optimal MultiLink Transmission Group Scheduling Algorithms, IBM TR 29.1967, August 1997.

AWARDS

January 30, 2020, **Informal recognition** by Clemson students through results from the National Education Benchmarking Assessment Survey as “**a faculty who has made a positive difference to them during their time at Clemson University**”

Award, Wiley Publisher for my **services to Transactions on Emerging Telecommunications Technologies**, July 2019.

Best paper award : K. Chen, Xin Xing, Mijanur Rahaman Palash, Jianwei Liu, and James Martin, “Improving Wireless Network Performance under MPTCP based Multipath Access”, *Proceedings of the 43rd IEEE Conference on Local Computer Networks* (October 2018) [**best paper award: 1 out of 45**].

Clemson University **Board Of Trustees Award** for Excellence, received 2/8/18.

Three **IBM Faculty Awards**: 2004, 2013, 2015.

Competition Winner: Winner of Department of Transportation’s Connected Vehicle Technology Challenge, June 2011, <http://connectedvehicle.challenge.gov/submissions>.

PRESENTATIONS

“Thoughts on a LEO Satellite Mesh Network for Broadband Access”, Invited Talk, SpaceX, March 2020.

“Emerging Application Systems and the Need for the Citizen’s Wireless Internet (CWI)”, Invited Talk MIT Lincoln Labs, June 2019.

“USIgnite: “Enabling Connected Vehicle Applications Through Advanced Networking” Floor Demo, *USIgnite Application Summit*, Austin TX, June 2017.

“ThinGs In a Fog (TGIF): A Framework to Support MultiDomain Research in the Internet of Things”, Presented at the *CAIDA Workshop on Active Internet Measurements (AIMS2017)*, March 2017.

“Enabling Connected Vehicle Research in a Campus Environment”, Presented at *GENI Network Innovators Community Event, (GENI/NICE)*, December 2016.

“USIgnite: “Enabling Connected Vehicle Applications Through Advanced Networking” Floor Demo, *USIgnite Application Summit, Co-Located with Smart Cities Innovation s Summit*, Austin TX, June 2016.

“Software Defined Networks for Connected Vehicles”, *Presented at the 5'th Annual Automotive Summit*, Greenville, SC, February 2016.

“Enabling Connected Vehicle Applications Through Advanced Networking”, Presented at the Cellular Wireless Research Updates, *GENI/Network Innovators Community Event (GENI/NICE)*, November 2015.

“SciWiNet: A Large Scale Wireless Testbed for the Academic Community”, Presented at the *CAIDA Workshop on Active Internet Measurements (AIMS2014)*, March 2014.

“SciWiNet: a Science Wireless Network for the Research Community“, *4G LTE for Research Panel, Mobicom 2013*, October 2013.

“Building Cooperative Heterogeneous Wireless Networks With Re-Configurable Devices”, *Keynote at Workshop on Cooperative Heterogeneous Networks (coHetNet)*, ICCCN 2011, August 2011.

“Evaluating IEEE 802.16 Broadband Wireless as a Communications Infrastructure for Public Safety Activities”, Presented at the *International Association of Chiefs of Police 32nd Annual Law Enforcement Information Management Training Conference*, Nashville, TN, May 2008.

“Public Safety Requirements for WiMAX”, *WiMAX Forum, Application Architecture Working Group*, Washington DC, April 2007.

“Modeling a MAC Scheduler: Experiences with a DOCSIS Cable Network Simulation Model”, *WiMAX Forum, Application Architecture Working Group*, San Deigo, CA, July 2006.

"Understanding the Impact of BitTorrent on Cable Networks", *National Cable and Telecommunication Association's National Show*, Atlanta, GA, April 2006.

“DOCSIS Performance Issues”, *National Cable and Telecommunication Association's National Show*, San Francisco, CA, April 2005.

PATENTS

An Optimal Multilink Scheduling Algorithm, United States, patent number 6178448, granted January 23, 2001.

Adapting Receiver Thresholds to Improve Rate-Based Flow Control, United States, patent number 6657954, granted December 2, 2003.

Optimal Link Scheduling for Multiple Links, United States, patent number 6862618, granted March 1, 2005.

SPONSORED RESEARCH

Current Funding:

-

Past Funding:

“Network and Compute System Requirements for Ultra-reliable, Low Latency Applications Systems”, MIT Lincoln Labs, Principal Investigator, \$230,000 (August 15 2019 – May 15 2022).

“CPS:Synergy: Security of Distributed Cyber-Physical Systems with Connected Vehicle Applications”, NSF, Co-PI (P. Pisu PI, R. Brooks Co-PI), \$998,581 (November 2015 - December 2020).

“US Ignite: Track 1: Enabling Connected Vehicle Applications through Advanced Network Infrastructure”, NSF, Principal Investigator, (R Chowdhury, K. Wang Co-PIs), \$598,582 (September 2015 – December 2020).

“Uncertainty Quantification of Cyber Attacks on Intelligent Traffic Signals”, US DOT, Regional Center for Connected Multimodal Mobility, Principal Investigator, \$67,500 (Oct 2017 – December 2020).

“Extreme Orange: Engaging Clemson Students in Systems of Discovery”, IBM Faculty Award, Principal Investigator, (E. Kraemer, J. McClendon Co-PIs), \$200,000 (August 2015 -December 2019).

“DOCSIS 3.0/3.1 Studies”, Huawei Corporation, Principal Investigator, \$199,000 (August 2013 - December 2016).

“EAGER: Collaborative Research: SciWiNet: a Science Wireless Network For the Research Community”, NSF, Principal Investigator (KC Wang Co-PI), \$298,090 (August 2013 – December 2016).

“Understanding and Optimizing Dynamic Adaptive Streaming over HTTP in the Internet”, Comcast Corporation, Principal Investigator, \$95,000 (August 2013 – August 2016).

“Using Apache Virtual Classroom Lab (VCL) for Networking/Systems/Security Courses at Clemson University”, IBM Faculty Award, Principal Investigator, \$30,000 (June 2013 – December 2015).

“GENI Spiral 3 : GENI WiMAX at Clemson”, NSF, Co-PI (KC Wang PI), \$300,000, (January 2011 – December 2015).

“Assessing Perceived Quality of Dash-Based IPTV Broadcasts: Methods and Human Factors”, Intel Research , Co-PI, (J. Gilbert PI), \$50,000, (June 2013 - December 2014).

“Assessing Perceived Quality of Dash-Based IPTV Broadcasts: Methods and Human Factors”, CableLabs Research Grant, Principal Investigator, (J. Gilbert Co-PI), \$50,000, (June 2012 - December 2013).

“Developing the CyberInfrastructure to Support the Emerging Smart Grid”, IBM Faculty Award, Principal Investigator, \$20,000, (September 2011 – December 2012).

“Correlating the Perceived Quality of Networked Games to Broadband Cable Network Design Parameters”, CableLabs Research Grant, Principal Investigator, (J. Gilbert Co-PI), \$30,000, (May 2011 - May 2012).

“Broadcasting Video Content in Dense 802.11g Sports and Entertainment Venues”, Cisco Research Grant, Principal Investigator (M. Westall Co-PI), \$95,000, (August 2010 – December 2012).

“EAGER:Collaborative:Towards a Unified Wireless Network Involving Reconfigurable Devices”, NSF, Principle Investigator, \$75,000, (September 2009 – September 2011).

iTiger, internally funded CyberInfrastructure research project \$150,000 plus equipment donations from Cisco (\$150,000) and Apple \$50,000, (Jan 2008 – December 2009).

“DOCSIS 3.0 Scheduling Algorithms”, Cisco Research Grant, Principal Investigator, (M. Westall Co-PI), \$98,000, (August 2007 – December 2011).

“CableLabs DOCSIS Research”, CableLabs Corporation, Principal Investigator, \$14,630, (May 2007 – December 2007).

“Evaluation XEN and Microsoft Virtual Server”, BMW Corporation, Principal Investigator, (S. Goasguen Co-PI), \$12,000, (January 2007 - December 2007).

DELL Equipment Grant, Co-PI (S. Goasguen PI), \$20,000, (December 2006).

“Evaluating IEEE 802.16 Broadband Wireless as a Communications Infrastructure for Public Safety Activities”, Department of Justice National Institute of Justice, Principal Investigator, (M. Westall Co-PI), \$300,000, (October 2006 –October 2008).

“Evaluating IEEE 802.11 and 802.16 Wireless MAC Protocols for use in Future NASA Space Exploration Missions”, NASA/South Carolina Space Grant REAP program, Principal Investigator, \$30,000, (May 2006 – December 2007).

“Developing a Prediction-based Service Management System”, IBM University Partnership Proposal, Principal Investigator, \$30,000, (August 2005-August 2006).

Equipment gift from Cisco, Principal Investigator (M. Westall Co-PI), \$20,000, (January 2005).

“Developing Application Level Prediction Services in a WebSphere and Globus Grid Environments”, IBM University Partnership Proposal, Principal Investigator, \$40,000, (August 2004 - August 2005).

IBM SUR Equipment Grant, \$125,000, augmented by \$100,000 with a cost matching grant from the Provost, Co-PI, (M. Westall Co-PI and R. Geist PI), (June 2004).

GRADUATE STUDENT ADVISING

PhD Graduates

Manveen Kaur (PHD CS), “SNAP: A Software-Defined & Named-Data Publish-Subscribe Framework for Emerging Wireless Application Systems”, (August, 2022).

Jianwei Liu (PHD CS), “Unified Wireless Systems Involving Multiple Operators”, (Dec, 2019).

Anjan Rayamajhi (PHD ECE), (CoAdvising with Dr Harlan Russell, ECE) “Exploring Smart Infrastructure Concepts to Improve the Reliability and Functionality of Safety Oriented Connected Vehicle Applications”, (August 2019).

Mizan Raman (PHD Civil Eng), (CoAdvising with Dr Ronnie Chowdhury, Civil Eng) “Queue Warning Connected Vehicle Application: Assessing the Impacts of Heterogeneous Wireless Infrastructure”, (Dec, 2018).

Gongbing Hong (PHD CS), Bandwidth Management in Emerging DOCSIS-based Broadband Access Networks, (December 2015).

Rahul Amin (PHD ECE), “Towards Viable Large Scale Heterogeneous Wireless Networks”, (August 2013).

Scott Moser (PHD CS), “Scheduling Algorithms in DOCSIS-based networks”, (August 2011).

Masters Graduates

Adam Hodges (MSCS), “Broadband Mapping Emerging Heterogeneous Wireless Networks”, (August 2014).

Eric Harney (MSCS), “Modeling the Network Impacts of Live Migration in XEN”, (December 2009).

Rob Johnson (MSCS), “Evaluating the Use of SNMP as a Wireless Network Monitoring Tool for IEEE 802.11 Wireless Networks”, (May 2009).

Will Spearman (MSCS), “Distributed Adaptive Algorithm for 802.11e QoS”, (December 2007).

Ben Sangster (MSCS), “DoS Attacks in DOCSIS-based Networks”, (August 2007).

Himadeepa Karlapudi (MSCS), “Web Application Performance Prediction”, (August 2004).

Vinod Rajasekaran (MSCS), “Impact of Virtual Machine Overhead on TCP Performance”, (August 2004).

Shobhana Kirtane (MSCS), “Predicting the Performance of the gridFTP Application over Wide Area Grid Environments”, (May 2004).

Current Graduate Advising

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TEACHING EXPERIENCE

Courses Taught at Clemson:

CPSC 1110, Computer Programming in “C”, Fall 2018.

CPSC 3600, Distributed and Network Programming, Spring 2020, 2018, Fall 2017, Spring 2012, Fall 2012, Spring 2010-2011, Spring 2006-2007, Summer 2005, Spring/Fall 2004-2005.

CPSC 4240/6240, Linux System Administration and Security, Spring 2014-2019.

CPSC 8510, Software Systems for Data Communications, Fall 2016, Fall 2012-2014.

CPSC 8520 (formerly CPSC 8260), Internet Protocols, Fall 2019, Fall 2015, Spring 2014, Fall 2006-2011, Spring 2009, Spring 2003-2006, Fall 2002.

CPSC 8540 (formerly CPSC 8810), Internet Performance Analysis, Spring 2008-2012, Fall 2003-2006.

New Course Development at Clemson:

CPSC 8540, Internet Performance Analysis, Fall 2003-2006, Spring 2008-2012.

Courses Taught at North Carolina State University:

CSC/ECE 573, Internet Protocols, Spring 2001.

UNIVERSITY AND PUBLIC SERVICE

Committees:

School of Computing, Director's Advisory Committee (chair) 2019-2022.
School of Computing, Undergraduate Affairs Committee, 2019-2022.
School of Computing PhD Curriculum Committee, 2008-2009.
School of Computing, Faculty Advisory Board, 2018-2019.
School of Computing, External/Industrial Affairs Committee, 2014-2017.
School of Computing, Honors Program Director, 2012-2018.
School of Computing, Upsilon Pi Epsilon (UPE) Faculty Advisor, 2012-2019.
School of Computing, Space (lab and classroom) Committee, 2014-2017.
School of Computing, Faculty Search Committee, 2010-2013, 2015.
School of Computing, Sabbatical Review Committee, 2013-2019.
School of Computing, PhD Graduate Student Recruiting Committee, 2010-2011.
School of Computing, Graduate Affairs Committee, 2009-2010.
Department Research Committee, 2003-2004.
Department Computing Facilities Committee, 2004-2007.

Other service:

*Advisory Board Member, BitRipple 2020-.
*Editorial Board Member, Wiley's Internet Technology Letters, 2020-.
*Editorial Board Member, MDPI, Internet of Things Open-Access Journal, 2020-.
* IEEE International Conference on Mobile Ad-Hoc and Smart Systems Program Committee Member, 2019-.
*Review Committee, Urban Transportation Systems and Mobility, Frontiers in Sustainable Cities 2019-.
* Editorial committee for Transactions on Emerging Telecommunications, 2018-.
*Advisor for NSF Research Experience for Undergraduates (REU) students 2004-.
*Invited participant, NSF's PAWR Platform POWDER Workshop, June, 2018.
*Adhoc NSF Proposal Review, June 2018.
*Invited Session Chair, CAIDA Workshop on Active Internet Measurements, 2014,2017.
*IEEE ICCCN Program Committee Member, 2008-2017.
*IEEE Globecom Program Committee Member, 2015-2017.
*IEEE Communications Magazine, Guest Editor, 2015.
*Vice-Chair of the IEEE Cable Networks and Services Subcommittee (CNS), 2015-2017.
*NSF proposal review panel member, 2004, 2005, 2007, 2010, 2011, 2017.
*Guest editor, IEEE Communications Magazine, Feature on "Next Generation Cable Networks with DOCSIS 3.1 Technology", March 2015.
*Participant NSF PhantomNet Users' Workshop, Feb 2015.
*Participant NSF Workshop on Future Research Infrastructure for the Wireless Edge
*IEEE TridentComs Program Committee Member, 2014-2015.
*Organizing Committee Member, NSF Workshop on Vehicular Sensing (DriveSense'14), Old Dominion, November 2014.
*Publicity Chair, IEEE International Conference on Network Protocols, October 2014.
*Participant DOCSIS 3.1 Active Queue Management Working Group,
*Author of sections of CableLabs DOCSIS 3.1 specifications.

- *Clemson's Representative to NSF's Access Computing program, 2012- 2020.
- *NSF Future Heterogeneous Networks Workshop, Mountain View, CA, March 2011.
- *Public safety communications technology outreach through collaboration with DOJ National Institute of Justice, 2008 - 2015.
- *Clemson's Emerging Scholars, an outreach program to provide rural South Carolina high school students Computer Science and Internet skills, Summers 2005 - 2012.
- *Program committee member, IEEE Broadnets, 2007.
- *Advisory Board, International Conference on Performance Modeling and Evaluation of Heterogeneous Networks, Ikey, UK, July 2005 - 2006.

Last update: 2/18/2024