UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SPRINT SPECTRUM L.P., CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS, AND AT&T MOBILITY LLC
Petitioners

v.

ADAPTIX, INC.
Patent Owner

Case No. TBD
Patent 8,934,375

DECLARATION OF RICHARD D. GITLIN, Sc.D.

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I. INTRODUCTION

A. Background and Qualifications

1. My name is Richard D. Gitlin. I am currently a State of Florida 21st Century Scholar, Distinguished University Professor, and the Agere Systems Chaired Professor of Electrical Engineering at the University of South Florida ("USF"). I have more than 45 years of experience in the field of communications and wireless communications in particular. Throughout my career, I have managed and led research in wireline and wireless systems, broadband and optical networking, multimedia communications, and access technologies. My curriculum vitae is attached as Appendix B.

2. I have a Bachelor's Degree (with honors) in electrical engineering from the City College of New York and a Master of Science in electrical engineering and a Doctorate in engineering science from Columbia University.

3. After receiving my Doctorate from Columbia University in 1969, I joined Bell Laboratories ("Bell Labs"), which at the time was part of the Bell System, and successively became AT&T Bell Labs, and then Lucent Technologies-Bell Labs (which is now Nokia Bell Labs). I was with Bell Labs in its various instantiations for 32 years. My first assignment was in the data communications ("modem") area and, during this time, I contributed to the invention of many key modem technologies. I was also involved in the product

realization, standardization, and introduction of several pioneering modem products. I was the leader of the V.32 modem development team in the early 1980s, assembled the team that developed the V.34 modem, and I was a co-inventor of Digital Subscriber Line ("DSL") technology in 1985-1986.

4. In 1987, I moved to Bell Labs research to lead research on wireless systems, high-speed packet switching, optical networking, and related areas. I held several senior executive positions in Bell Labs, and one of these positions was Senior Vice President for Communication Sciences Research. In this position, included in my responsibilities were all of Bell Labs wireless communications research projects, including time division multiple access ("TDMA"), code division multiple access ("CDMA"), and orthogonal frequency division multiplexing ("OFDM") research for both cellular and wireless local area network ("WLAN" or WiFi) systems. In this position, I oversaw over 500 professionals, many of whom were involved in wireless communications and network research. In particular, I established and oversaw the Bell Labs research group located in Utrecht, The Netherlands that was focused on creating WLAN technology. This group was involved in the research and exploratory development of CDMA and OFDM WLAN systems. In addition, I oversaw cellular wireless research groups located in Swindon, UK. The Bell Labs research groups working on wireless research in the United States also reported to me and included several researchers

working on OFDM and multiple-in, multiple-out ("MIMO"). At Bell Labs, I was personally involved in MIMO technology working with and extending the work of some the original inventors.

5. I have had a long association and involvement with OFDM technology beginning when I joined Bell Labs in 1969. R.W. Chang and B. Saltzberg invented OFDM in the 1960s at Bell Labs[1]. Interest in OFDM was significantly increased by the pioneering work of Ebert and Weinstein (of Bell Labs) in 1971 that demonstrated that the Fast Fourier Transform ("FFT") could be used to efficiently generate and receive an OFDM signal. *See* S.B. Weinstein and Paul Ebert, "*Data Transmission by Frequency-Division Multiplexing Using the Discrete Fourier Transform*," IEEE Transactions on Communications Technology, October 1971. At various times in my career, I worked with Chang, Saltzberg, Ebert, and Weinstein, and I was keenly aware of OFDM shortly after I joined Bell Labs in 1969 and my interest and involvement with OFDM has continued.

6. In the mid-late 1980's I led the research at Bell Labs on the suitability of OFDM (referred to at that time as *multi-tone*) and other technologies as a modulation choice for a wireline data system, DSL. Around this time, it was clear

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[1] *See* Chang, R.W. *Synthesis of Band-Limited Orthogonal Signals for Multichannel Data Transmission*. Bell Sys. Tech. J.; Dec 1966; 45: 1775-1796; Saltzberg, B.R. *Performance of an Efficient Parallel Data Transmission System*. IEEE Trans. Commun.; Dec 1967; COM-15; 805-81.

to many at Bell Labs that OFDM was also a natural candidate for cellular and WiFi wireless systems.

7. Throughout my career, I have conducted and led pioneering research and development in digital communications, wireless systems, and broadband networking that has resulted in many innovative products. I am the named inventor on more than 55 issued United States patents, the author, or co-author, of over 100 journal and conference articles and a graduate level data communications textbook, and I have given numerous keynote presentations, including premier wireless conferences, such as Wireless Communications and Networking Conference 2015 ("WCNC 2015"), Wireless Telecommunications Symposium 2015 ("WTS 2015"), Mobicom 2004, Wireless Communications and Networking Conference 2003 ("WCNC 2003"), Wireless Telecommunications Symposium 2010 ("WTS 2010") and am scheduled to give the keynote presentation at the IEEE Wireless and Microwave Technology Conference 2016 ("WAMICON 2016"). I am the co-recipient of three prize paper awards including the 1995 IEEE Communications Society's Steven O. Rice Award, the 1994 IEEE Communications Society's Frederick Ellersick Award, and the 1982 Bell System Technical Journal Award.

8. In addition to my responsibilities at Bell Laboratories and Lucent Technologies, from 1999 to 2001, I was a Visiting Professor of Electrical Engineering at Columbia University, where I taught courses, conducted research,

and supervised doctoral students in the area of communications and wireless networking. From 2001 to 2003, I was an Adjunct Professor of Electrical Engineering at Columbia University.

9. From 2001 to 2004, I was Vice President, Technology and Chief Technical Officer of NEC Laboratories America, Inc., where I had specific responsibility for wireless networking, broadband and IP systems, system LSI, quantum communications, and bio-informatics.

10. From 2002 to 2005, I served on the Board of Directors of PCTEL, a NASDAQ company (PCTI) focused on wireless technologies.

11. From 2005 to 2008, I was Chief Technical Officer of Hammerhead Systems, a Silicon Valley venture-funded start-up and market leader in providing innovative data networking solutions for wireline, wireless, and cable service providers. At Hammerhead Systems, I was responsible for product line vision and system architecture, developing core technologies, representing product technology and directions with customers, partners, and standards bodies.

12. In 2008, I assumed my current position at USF and, in March 2010, I co-founded a medical device company to design and market *in vivo* wireless devices, based on OFDM, to facilitate minimally invasive surgery.

13. In 1986-1987, I was named a Fellow of the IEEE and an AT&T Bell Laboratories Fellow. In 2005, I was elected to the U.S. National Academy of

Engineering ("NAE"), and I was also a co-recipient of the Thomas Alva Edison patent award. I am also a Charter Fellow (2012) of the National Academy of Inventors ("NAI").

14. I served as the Chair of the Communication Theory Committee of the IEEE Communications Society (COMSOC), as a member of the COMSOC Awards Board, the Editor for Communications Theory of the IEEE Transactions on Communications, as a member of the Board of Governors of the IEEE Communications Society, and as a member of the Nominations and Elections Board.

15. I also served on the Advisory Committee for Computer Science and Engineering ("CISE") of the National Science Foundation.

16. I was a founding Editorial Board member of the Bell Labs Technical Journal, and have served on the Editorial Boards of Mobile Networks and Applications and the Journal of Communications Networks.

17. For more than 15 years, I presented an intensive five-day short course on wireless systems—including OFDMA—to industrial, government, and academic participants, from wireless organizations throughout the world.

18. Since joining USF in 2008, I have focused my research on the intersection of wireless communications and networking with medicine and created an interdisciplinary team that is focused on wireless networking of *in vivo*

miniature wirelessly controlled devices to advance minimally invasive surgery and other cyber-physical health care systems. I have also done research on 4G/5G wireless systems, with an emphasis on enhancing capacity by managing the Quality of Service (QoS). I teach graduate courses in Random Processes, Digital Communications, and Wireless Networking, and these courses cover aspects of OFDM.

19. A detailed record of my professional qualifications is set forth in the attached Appendix B, which is my curriculum vitae, including a list of publications, awards, research grants, and professional activities.

20. I have been asked to render opinions in this declaration as a technical expert. I have not been asked to offer any opinions of law in this IPR.

II. SCOPE OF WORK

21. I have been retained by McGuireWoods LLP, counsel for Sprint Spectrum L.P. ("Sprint"), WilmerHale LLP, counsel for Cellco Partnership d/b/a Verizon Wireless ("Verizon"), and Baker Botts L.L.P., counsel for AT&T Mobility LLC ("AT&T") (collectively, "Petitioners") as a technical expert in this matter. I bill $675 per hour for my services. No part of my compensation is dependent on my opinions or on the outcome of this proceeding. I have no financial interest, direct, indirect, beneficial or otherwise, in any of the parties.

22. I have been asked by counsel for Petitioners to offer an expert opinion on the validity of claims 1-32 (the "Challenged Claims") of U.S. Patent 8,934,375 (the "'375 Patent" or the "Patent," attached as Exhibit 1001). In connection with my analysis, I have reviewed the '375 Patent and its prosecution history. I have also reviewed and considered various other documents in arriving at my opinions, some of which are cited in this declaration. For convenience, the information I considered in arriving at my opinions is listed in Appendix A. In forming my opinions, I have also relied upon my education, training, knowledge of pertinent literature, and my years of experience in the field of the '375 Patent.

23. The individuals involved in the prosecution of the '375 Patent and the inventors are referred to respectively as the "Applicants" or "Patentee."

A. Topics of Opinions

24. In this declaration I offer opinions on the following general topics:

- the subject matter described and claimed in the '375 Patent;
- the level of ordinary skill in the art pertaining to the '375 Patent;
- the knowledge of one of ordinary skill in the art as of the time of the invention;
- the Challenged Claims of the Patent, including the meaning of certain claim terms as they would have been understood by a

person of ordinary skill in the art as of the time of the invention;

- the teachings of the prior art; and
- the invalidity of the Challenged Claims in view of the prior art, and the bases and reasons therefore.

III. LEVEL OF ORDINARY SKILL AND RELEVANT TIME

25. I have been advised that the relevant time frame for assessing validity of the '375 Patent is prior to its priority date of December 15, 2000. When I refer to "2000" in this Declaration, I mean specifically December 15, 2000, unless another specific date is referenced.

26. The "Field of the Invention" section of the '375 Patent specification states:

> *The invention relates to the field of wireless communications; more particularly, the invention relates to multi-cell, multi-subscriber wireless systems using orthogonal frequency division multiplexing (OFDM).* '375 Patent, 1:24–27.

27. The specification discusses systems and methods for allocating subcarriers to subscriber units in an orthogonal frequency division multiple access (OFDMA) system. This allocation is based on feedback received from the subscriber units. As demonstrated below, channel allocation based on feedback from subscriber units predates the '375 Patent (*supra* Section VI), and it is my

opinion that the '375 Patent does not disclose or claim any new and non-obvious method of actually allocating subcarriers.

28. I have considered the level of skill that would be needed to understand the specification and claims and to make and use the inventions claimed in the '375 Patent without undue experimentation.

29. In my opinion, a person of ordinary skill in the art relevant to the '375 Patent in 2000 would have had an in-depth knowledge of wireless communications as would be attained through a Bachelor's degree in electrical engineering or a similar degree, with at least three to four years of experience in wireless communication technology or other communication-related technology, or a Master's degree in electrical engineering or a similar degree, with at least two years of experience in wireless communication technology or other communication-related technology.

IV. LEGAL STANDARDS

30. As a technical expert, I will not offer opinions of law. Rather, I have been advised of several legal principles concerning claim construction and patent invalidity, which I applied in arriving at my conclusions.

A. Claim Construction

31. I have been advised that in determining whether a patent claim is anticipated or rendered obvious in view of the prior art, the Patent Office must

construe the claim by giving it the broadest reasonable interpretation consistent with the specification. The terms of the claim also are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the disclosure and the prosecution history. For the purposes of this review, I have analyzed each claim term in accordance with its ordinary and customary meaning under the required broadest reasonable interpretation. Further, construing the terms based on "the meaning that a term would have to a person of ordinary skill in the art in question at the time of the invention" as articulated by the Federal Circuit in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) would not change the analysis or conclusions covered in this declaration. The prior art teaches each claim limitation under any reasonable interpretation of the claim terms, and the analysis is not dependent on application of the "broadest reasonable interpretation" standard.

1. "pilot symbols"

32. I have been advised that in other litigations and a PTAB proceeding involving United States Patent No. 6,947,748 (the "'748 Patent"), a patent from the same family as the '375 Patent, the term "pilot symbols" was construed to mean "symbols, sequences, or signals known to both the base station and subscriber." Ex. 1012, Claim Construction Order, 6:13-cv-438, Dkt. 90 (E.D. Tex., Sept. 19, 2-14) at 17; Ex. 1011, IPR2015-00319 Institution Decision, Paper 10. This is consistent with how the term is described in the '375 Patent. *See, e.g.*, Ex. 1001, '375 Patent

at 5:38-40 ("The pilot symbols, often referred to as a sounding sequence or signal, are known to both the base station and the subscribers."). Accordingly, in my opinion, the broadest reasonable interpretation of "pilot symbol" is "symbols, sequences, or signals known to both the base station and subscriber."

2. "cluster"

33. The specification of the '375 Patent defines a "cluster" as "a logical unit that contains at least one physical subcarrier." *Id.* at 5:20-21. Accordingly, I believe that one of skill in the art would understand, from the specification of the '375 Patent, that the broadest reasonable construction of "cluster" is "a logical unit that contains at least one physical subcarrier."

3. "diversity cluster"

34. The specification of the '375 Patent describes a "diversity cluster" as a cluster "containing multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum." *Id.* at 14:28-30. As an example, the '375 Patent states that "the spread of subcarriers in diversity clusters is preferably larger than the channel coherence bandwidth, typically within 100 kHz for many cellular systems." *Id.* at 14:34–37. According to the '375 Patent, "the larger the spread, the better the diversity." *Id.* at 14:37–38. Accordingly, I believe that one of skill in the art would understand, from the specification of the '375 Patent, that the broadest reasonable construction of "diversity cluster" is "a cluster containing multiple

subcarriers with at least some of the subcarriers spread far apart over the spectrum."

4. "coherence cluster"

35. The specification of the '375 Patent describes a "coherence cluster" as a cluster "containing multiple subcarriers close to each other." *Id.* at 14:27-28. As shown above, the '375 Patent contrasts a coherence cluster with a diversity cluster. According to the '375 Patent, "[t]he closeness of the multiple subcarriers in coherence clusters is preferably within the channel coherence bandwidth, i.e., the bandwidth within which the channel response remains roughly the same, which is typically within 100 kHz for many cellular systems." *Id.* at 14:30–34. Accordingly, I believe that one of skill in the art would understand, from the specification of the '375 Patent, that the broadest reasonable construction of "coherence cluster" is "a cluster containing multiple subcarriers close to each other."

5. "coherence bandwidth"

36. The specification of the '375 Patent describes a "coherence bandwidth" as "the bandwidth within which the channel response remains roughly the same. A typical value of coherence bandwidth is 100 kHz for many cellular systems." *Id.* at 11:55-60. *See also id.* at 14:30–33 ("[t]he closeness of the multiple subcarriers in coherence clusters is preferably within the channel coherence bandwidth, i.e. ***the bandwidth within which the channel response remains***

roughly the same, which is typically within 100 kHz for many cellular systems").[2] Accordingly, I believe that one of skill in the art would understand, from the specification of the '375 Patent, that the broadest reasonable construction of "coherence bandwidth" is "the bandwidth within which the channel response remains roughly the same."

B. Obviousness

37. I am advised that a claim is unpatentable under 35 U.S.C. § 103 if the claimed subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time of the invention. I am also advised that an obviousness analysis takes into account the scope and content of the prior art, the differences between the claimed subject matter and the prior art, and the level of ordinary skill in the art at the time of the invention.

38. In determining the scope and content of the prior art, I am advised that a reference is considered appropriate prior art if it falls within the field of the inventor's endeavor. In addition, a reference is prior art if it is reasonably pertinent to the particular problem with which the inventor was involved. A reference is reasonably pertinent if it logically would have commended itself to an inventor's attention in considering his problem. If a reference relates to the same problem as

[2] Unless otherwise indicated, all emphasis is added.

the claimed invention, that supports use of the reference as prior art in an obviousness analysis.

39. To assess the differences between prior art and the claimed subject matter, I am advised that 35 U.S.C. § 103 requires the claimed invention to be considered as a whole. This "as a whole" assessment requires showing that one of ordinary skill in the art at the time of invention, confronted by the same problems as the inventor and with no knowledge of the claimed invention, would have selected the elements from the prior art and combined them in the claimed manner.

40. I am also advised that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to obtain predictable results; a predictable use of prior art elements according to their established functions; applying a known technique to a known device (method or product) ready for improvement to yield predictable results; choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

41. Lastly, I am advised that an obviousness analysis must consider whether there are additional factors that would indicate that the invention was non-obvious. Such factors include whether the invention was commercially successful, whether there was a long-felt need for the invention, whether others tried and failed to make the invention, and any other facts that would suggest that someone with ordinary skill in the art would not have found the invention obvious. In the present case, I am unaware of any evidence that would suggest that the claims of the '375 Patent would have been novel or non-obvious.

V. FACTUAL BACKGROUND AND RELEVANT CONTEXT

A. The '375 Patent

42. The following is a summary of the claimed invention of the '375 Patent, not from today's perspective, but rather from the perspective of what one of ordinary skill in the art would have understood at the time of the alleged invention in 2000.

43. The claims of the '375 Patent recite a method and apparatus for adaptively allocating subcarriers in an orthogonal frequency division multiple access ("OFDMA") system. Generally speaking, the claimed invention requires a subscriber unit to (1) measure channel information for subcarriers based on pilot symbols received from a base station; (2) provide feedback information to the base station, including a modulation and coding rate, for clusters of subcarriers based on the measurements; (3) receive an

allocation of OFDMA subcarriers from the base station, including a modulation and coding rate, selected by the base station for use by the subscriber unit; and (4) repeat these steps at a second time to receive a second allocation of OFDMA subcarriers that is different from the first allocation. *See, e.g.*, Claim 1.

44. Claims 1-16 of the '375 Patent are method claims, while claims 17-32 are corresponding apparatus claims. In other words, claim 1 of the '375 Patent is directed to a method for a wireless system employing OFDMA, while claims 17 is directed to a subscriber unit in a wireless system employing OFDMA, the wireless unit comprising a processor configured to perform the same exact steps as the method in claim 1. The Challenged Claims recite merely conventional steps for allocating subcarriers to a subscriber unit in an OFDMA system. A detailed analysis of why the steps were conventional is given below in the "Invalidity Analysis" section.

B. The Prosecution History of the '375 Patent

45. During prosecution, the Patent Owner submitted five Information Disclosure Statements (including a 48 page Form PTO-1449 upon initial filing), citing over 1,400 references, including hundreds of documents from pending litigation involving the '748 Patent (Ex. 1017) and U.S. Patent No. 7,454,212 ("the '212 Patent") (Ex. 1018). The Examiner noted, "the number of references submitted is unreasonably large in quantity and without any indication of relevancy. Examiner made only a best

effort in considering all of them. Any reference that may have escaped the Examiner's attention thus is because of this large number of reference[s] and application shares the burden for both, submitting a large quantity of references and failing to indicate the relevant ones." Ex. 1013, File History of 14/294,106, June 27, 2014 Non-Final Rejection at page 2. After multiple clarifying amendments to address rejections under 35 U.S.C. § 112, the Examiner issued a final notice of allowance. *Id.* at December 2, 2014, Notice of Allowance.

VI. INVALIDITY ANALYSIS

A. Summary of Invalidity Analysis

46. My invalidity analysis utilizes the prior art described below, namely Ritter, Gesbert, Thoumy, and Gitlin. Table 1 summarizes how each prior art is used in combination to establish the invalidity of each of the claims in the patent based on obviousness. Each of the rows in Table 1 corresponds to one of the six combinations for invalidity.

Table 1 – Invalidity Summary

Claims	Basis	References
1, 2, 8, 9, 12, 14-18, 24, 25, 28, and 30-32	§ 103(a)	Ritter, Gesbert, and Thoumy
3-7, 10, 11, 13, 19-23, 26, 27, and 29	§ 103(a)	Ritter, Gesbert, Thoumy, and Gitlin
1, 9, 15-17, 25, 31, and 32	§ 103(a)	Thoumy and Gesbert

Claims	Basis	References
3, 6-8, 10-13, 19, 22-24, and 26-29	§ 103(a)	Thoumy, Gesbert, and Gitlin
2, 14, 18, and 30	§ 103(a)	Thoumy, Gesbert, and Ritter
4, 5, 20, and 21	§ 103(a)	Thoumy, Gesbert, Gitlin and Ritter

B. Overview of German Patent No. DE 198009531 C1 to Ritter ("Ritter")

47. Ritter is a German patent entitled "Procedure and Radio Communication System to Allocate the Radio Resources of a Radio Interface." Ritter was published on July 29, 1999. Therefore, I understand that Ritter is prior art to the '375 Patent under at least 35 U.S.C. § 102(b). Ritter was cited on the face of the '375 Patent, but was not substantively discussed during prosecution of the application that issued as the '375 Patent. The English translation of Ritter in Ex. 1004 was substantively considered during prosecution of the '212 Patent, which shares a common disclosure and priority claim with the '375 Patent. *See, e.g.*, Ex. 1008, '212 Pros. Hist. Ritter was also substantively considered by the Board in multiple IPR petitions challenging claims of the related '748 and '212 Patents.

48. Ritter teaches an OFDMA wireless communication system in which groups of OFDMA subcarriers, referred to as "segments." are allocated between a fixed base station and multiple mobile stations. *See* Ex. 1004, Ritter at 3-4 ("[t]hus a number of subcarriers and also a segment of a frequency spectrum can be allocated for the communication link between the base station and the mobile

station."). Each mobile station uses a training sequence to measure the channel quality of segments of the frequency spectrum and transmits feedback information to the base station identifying suitable segments. Using this feedback information, the base station "evaluate[s] the information received from the mobile stations through the base station and allocate a segment for the respective communication link to each mobile station depending on the evaluation." *Id.* at 5. A "segment" may comprise a plurality of subcarriers, akin to a "cluster." *See id.* at 13 (describing an example where "the first mobile station determines a segment Sx, with subcarriers oc00 – oc40 as the best suitable segment for it.").

C. Overview of U.S. Patent No. 6,760,882 ("Gesbert")

49. Gesbert is a U.S. Patent titled "Mode Selection for Data Transmission in Wireless Communication Channels Based on Statistical Parameters." Gesbert was filed on September 19, 2000 and issued on July 6, 2004. Therefore, I understand that Gesbert is prior art to the '375 patent under 35 U.S.C. 102(e). Gesbert was cited on the face of the '375 Patent, but was not substantively discussed during prosecution. Gesbert generally teaches a wireless communication system in which modulation and coding rates are dynamically selected based on measured channel quality between a base station and subscriber units. Ex. 1005, Gesbert at 3:60-4:6.

50. Gesbert expressly teaches that its concepts can be used in an OFDMA wireless system. Ex. 1005, Gesbert at 3:57-59. To assess channel quality, Gesbert teaches that "training tones" are transmitted on each subcarrier by the base station. *Id.* at 8:14-19. These training tones are then used by the subscriber units to measure the quality of each channel. *Id.* at 5:24-54 (describing measurements on channels between BTS base station and subscriber units), 7:7-62 (same), 8:13-34 (describing a matrix that maps channel quality for each training phase), Fig. 5 (illustrating multiple sequences of training tones transmitted on each subcarrier). Based on these measurements, feedback information is transmitted from each subscriber unit to the base station. *Id.* at 9:52-10:8. Within this feedback information, the subscriber unit includes a "mode" that indicates a modulation and coding rate to be used for subsequent communications. *Id.* at 4:30-32 ("The system also has a ***feedback mechanism for communicating the subsequent mode from the receive unit to the transmit unit.***"), 6:35-39 (explaining that modes "identify the modulation and coding rates which are to be applied to data"), Table 1.

D. Overview of U.S. Patent No. 7,039,120 to Thoumy et al. ("Thoumy")

51. Thoumy is a U.S. Patent titled "Device and Method for the Dynamic Allocation of Frequencies for Multicarrier Modulation Systems." Thoumy was filed on November 30, 1999, and issued on May 2, 2006. Therefore, I understand that

Thoumy is prior art to the '375 patent under 35 U.S.C. § 102(e). Thoumy was not cited on the face of the '375 Patent.

52. Thoumy discloses a system for dynamic allocation of carrier frequencies in an OFDMA system. Ex. 1007, Thoumy at 13:10-19. Thoumy discloses a network with multiple peripheral stations (*id. at* 15:17-19 ("FIG. 14 is a general view of a network according to the invention including a base station SIB [sic] and several peripheral stations SPi;") & Fig. 14), implementing OFDM (*id.* at 1:28-41 ("one particular case is Orthogonal Frequency Division Multiplex, or OFDM")). Thoumy discloses continuously monitoring the actual conditions of the channel for transmission, providing feedback to the base station, and adapting the number of carriers and modulation based on those measurements. *Id.* at 13:20-23.

E. Overview of U.S. Patent No. 6,018,528 to Gitlin et al. ("Gitlin")

53. Gitlin is a U.S. Patent titled "System and Method for Optimizing Spectral Efficiency Using Time-Frequency-Code Slicing." Gitlin was filed on April 28, 1994 and issued on January 25, 2000. Therefore, I understand that Gitlin is prior art to the '375 Patent under 35 U.S.C. §§ 102(e) and 102(a). Gitlin was cited on the face of the '375 Patent, but was not substantively discussed during prosecution. Gitlin discloses a system and method for optimizing frequency allocation to multiple subscribers by using contiguous and non-contiguous frequency assignments for multi-tone, *i.e.*, OFDMA systems. Ex. 1006, Gitlin at 3:1-12, 5:32-6:18, Fig. 6.

F. Ritter In View Of Gesbert and Thoumy Renders Claims 1, 2, 8, 9, 12, 14-18, 24, 25, 28, and 30-32 Obvious Under 35 U.S.C. § 103(a)

1. Claims 1 and 17

54. It is my opinion that one of ordinary skill in the art in 2000 would understand that Ritter combined with Gesbert and Thoumy renders obvious claims 1 and 17 under 35 U.S.C. 103(a). Claim 1, a method claim, and claim 17, an apparatus claim, contain nearly identical limitations. Accordingly, I will treat claims 1 and 17 together in the ground below. Claim 17 additionally requires a processor in the subscriber unit to perform the recited steps. Ritter discloses a control means in the mobile station for measuring channel quality, selecting carriers, and transmitting and receiving information from the base station. Ex. 1004, Ritter at 5 ("Control means in each mobile station to measure the quality of various segments...[and] transmit appropriate information to the base station"). Ritter therefore teaches this limitation.

55. Table 2, below, shows which references are being relied on for disclosing the various elements of claim 1 (and by extension, claim 17). Reliance on a particular reference for disclosing a claim element in Table 2 does not mean that other references do not also disclose that claim element. For example, Thoumy also discloses a wireless system employing OFDMA, although Ritter is relied on for that disclosure in Table 2.

Table 2 – Ritter, Gesbert, and Thoumy vs. Claim 1

Claim 1	Ritter	Gesbert	Thoumy
A method for/subscriber unit in a wireless system employing orthogonal frequency division multiple access (OFDMA), the method comprising:	X		
measuring/measure, at a first time by a subscriber unit, a first channel information for a plurality of subcarriers . . .	X		
based on a first plurality of pilot symbols received from a base station;		X	
providing, by the subscriber unit,/provide a first feedback information relating to a plurality of feedback clusters based on at least the measuring of the first channel information for the plurality of subcarriers based on the first plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters being at least two subcarriers,	X		
the first feedback information relating to the plurality of feedback clusters based on the first plurality of pilot symbols includes an index corresponding to a first modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;		X	
receiving, by the subscriber unit,/receive a first allocation of OFDMA subcarriers based on at least the providing of the first feedback information selected by the base station for use by the subscriber unit,	X		
the first allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the first allocation of OFDMA subcarriers;			X
measuring/measure, at a second time by a subscriber unit, a second channel information for the plurality of subcarriers . . .	X		
based on a second plurality of pilot symbols received from a base station;		X	
providing, by the subscriber unit,/provide a second feedback information relating to the plurality of feedback clusters based on at least the measuring of the second channel information for the plurality of subcarriers based on the second plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters being at least two subcarriers,	X		
the second feedback information relating to the plurality of		X	

feedback clusters based on the second plurality of pilot symbols includes an index corresponding to a second modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;			
receiving, by the subscriber unit,/receive a second allocation of OFDMA subcarriers based on at least the providing of the second feedback information selected by the base station for use by the subscriber unit,	X		
the second allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the second allocation of OFDMA subcarriers,			X
the second allocation of OFDMA subcarriers being different from the first allocation of OFDMA subcarriers, the first and second allocations of OFDMA subcarriers being received by the subscriber unit at two different times.	X		

a. ***The preamble:*** **A method for/subscriber unit in a wireless system employing orthogonal frequency division multiple access (OFDMA), the method comprising:**

56. Ritter describes "a wireless system employing orthogonal frequency division multiple access (OFDMA)." Specifically, Ritter discloses that "[t]he procedure of the invention begins with the ***OFDMA multi-carrier procedure*** and the use of a number of subcarriers which are assigned for the communication link ***between the base station and the mobile stations***." Ex. 1004, Ritter at 4; *see also id.* at 4-5 (describing a wireless OFDMA system for allocating sets of subcarriers to multiple users).

b. ***Limitation (a):*** **measuring/measure, at a first time by a subscriber unit, a first channel information for a plurality of subcarriers based on a first plurality of pilot symbols received from a base station;**

57. Ritter teaches that each subscriber unit measures channel quality information for subcarriers between it and a base station. For example, Ritter discloses that:

> "[a]nother advantageous model of the invention to ***measure the quality of segments of the frequency spectrum envisions, that the mobile station receives all subcarriers in the time slot allocated to it, checks for each subcarrier***, whether an amplitude modulation of the data symbols transmitted in the time slot is present, and ***forms an average value from the results of the test for all subcarriers belonging to the respective segment.***

Id. at 8-9. According to Ritter, the advantage of this approach "lies in the two-step procedure in which initially ***the quality is determined for the individual subcarriers*** and then ***the quality of the subcarriers can be ascertained to determine the quality of the segment*** that was examined in particular." *Id.* at 9.

58. To the extent the Patent Owner argues that Ritter fails to disclose "measuring . . . based on a first plurality of pilot symbols," Gesbert teaches OFDMA subcarrier quality measurements based on training signals (known to both the subscriber and base station) received from the base station. *See, e.g.*, Ex. 1005, Gesbert at 8:13-34.

59. For example, Gesbert explains "FIG. 5 indicates that ***training is performed on all tones during an OFDM training symbol***, it will be clear to a person skilled in the art that a subset of these tones could be used for training and the corresponding frequency

response could be computed at the receiver by interpolating." Ex. 1005, Gesbert at 7:16-20. Gesbert uses these training tones to make channel quality measurements:

> "***SINR is sampled during training tones T*** occurring during sampling window τ_1. The present embodiment uses multiple carrier frequencies fc and thus the SINR is sampled and computed by block 102 for data 52 transmitted at each of the n carrier frequencies fc. ***By buffering the SINR values for all the training tones T during time window τ_1 statistics computation block 102 constructs the following matrix***:
>
> $$\begin{bmatrix} SINR_{1,1} & SINR_{1,2} & \dots & SINR_{1,w} \\ SINR_{2,1} & \dots & & \\ \dots & & & \\ SINR_{n,1} & & & SINR_{n,w} \end{bmatrix}$$
>
> where SINRi,j is the SINR at the i-th carrier frequency f_{ci} during training phase j. There are thus 1 to n carrier frequencies f_c and 1 to w training phases."

60. *Id.* at 8:13-34; *see also id.* at 7:57-59 ("quality parameters include signal-to-interference and noise ratio (SINR)"). In my opinion, one of ordinary skill in the art in 2000 would have understood these training symbols to be referred to in the patent as "pilot symbols"— "symbols, sequences, or signals known to both the base station and subscriber." Training tones are necessarily known to both the base station and subscriber and training tones were well known by those of ordinary skill in the art in 2000.[3]

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[3] *See, for example,* Bahai and Saltzberg, "Multi-Carrier Digital Communications Theory of Applications of OFDM," (Kluwer Academic Publishers, 1999), Ex. 1020 at 29 ("Usually, OFDM systems provide pilot signals for channel estimation.").

61. Like Ritter and the '375 Patent, Gesbert teaches an OFDMA system in which subscriber units (e.g., handsets) measure the quality of a wireless channel and provide feedback to the base station based on those measurements. Gesbert discloses that "***One or more quality parameters are sampled*** in the data received ***by the receive unit.*** Then, a first-order statistical parameter and a second-order statistical parameter of the ***quality parameter*** are computed and ***used for selecting a subsequent mode for encoding the data.***" *Id.* at 2:61–65. Gesbert discloses that "[t]he system also has a ***feedback mechanism for communicating the subsequent mode from the receive unit to the transmit unit.***" *Id.* at 4:30–32. Similarly, Ritter discloses that "***every mobile station, MS, measures the quality of various segments of the frequency spectrum***, whereby it receives all subcarriers in the time slot assigned to it, ***checks the quality of each individual subcarrier and then determines the quality of the subcarriers. Then each mobile station*** determines at least a suitable segment preferred for its own communication link and ***transmits appropriate information to the base station***, BS." Ex. 1004, Ritter at 12–13.

62. In my opinion, it would have been obvious to use pilot symbols to measure channel quality in the system of Ritter as taught by Gesbert for at least the following reasons. I have been advised that one rationale to combine is: "application of a known technique to a piece of prior art ready for the improvement" to "yield predictable results." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007).

63. **Base system:** Ritter discloses an OFDMA system that dynamically allocates subcarrier segments (*i.e.*, subcarriers) to a mobile station (*i.e.*, subscriber unit) based on the quality of the segments. Ex. 1004, Ritter at 8 ("According to another version of the invention a priority list is sent from the mobile station to the base station which contains information about the segment best suited for its communication link as well as other suitable segments preferred for its own communication link. As a result, the base station receives knowledge with respect to the best suited segments for it and can make appropriate new assignments of the segments of the frequency spectrum for all mobile stations which are better adapted to their transmitted needs."), 14 ("[t]he base station, BS, evaluates all information received from the mobile stations, MS, and assigns each mobile station a segment for the respective communication link depending on the evaluation."). *See also id.* at 16 (disclosing "training sequences" within data transmission between base station and subscriber units).

64. **Known technique**: As shown by Gesbert, using pilot symbols within an OFDMA wireless communication system to measure channel quality was well known in the art at the time of the alleged invention, and was a simple design choice from among many possible alternatives. Ex. 1005, Gesbert at 8:13-34. Even the '375 Patent acknowledges that measuring channel quality based on pilot symbols was a well-known technique. Ex. 1001, '375 Patent at 9:14-17 ("***The channel/interference estimation*** by processing block 301 ***is well-known in the art by monitoring the interference that is***

generated due to full-bandwidth pilot symbols being simultaneously broadcast in multiple cells.").

65. **Predictable results and improved system**: In my opinion, one of ordinary skill in the art in 2000 would have been motivated to modify Ritter to measure channel quality using pilot symbols, as taught by Gesbert, to obtain the predictable results of an improved channel allocation process. As such, channel quality measurements based on pilot symbols would have been an obvious and desirable design choice for a person of ordinary skill in the art in 2000.

66. I have been advised that another rationale to combine references is where the substitution of one known element for another yields predictable results. *KSR,* 550 U.S. at 401. As discussed above, using pilot symbols to measure channel quality was a well-known technique in the art at the time of the alleged invention. Ex. 1001, '375 Patent at 9:14-17. And both Ritter and Gesbert disclose allocating channels based on channel quality measurements and using pilot symbols transmitted from the base station (in some form). As such, in my opinion, those of ordinary skill in the art in 2000 would have recognized that it would be easy to modify Ritter to measure channel quality using pilot symbols, as described in Gesbert. Such a modification would have yielded predictable results without requiring undue experimentation, and therefore, it would have been obvious to modify Ritter's OFDMA system to perform the channel quality measurements using pilot symbols, as in Gesbert.

67. Further, those of ordinary skill in the art at the time would have been motivated to modify Ritter's communication system to measure channel quality using pilot symbols, as in Gesbert, based on the similar nature of the problem solved: both references provide solutions for adapting to varying channel conditions in wireless OFDMA systems. *See* Ex. 1004, Ritter at 4 ("[t]he invention has the goal of providing an improved procedure and radio communication system for allocating radio resources, when using a OFDMA multi-carrier procedure"); Ex. 1005, Gesbert at 2:45-48, 11:44-48. In my opinion, the extremely similar nature of the problem solved by Ritter and Gesbert, and the similar manner in which they each solve that problem, would have motivated those of ordinary skill in the art to modify Ritter's communication system to use channel quality measurements based on pilot symbols, as described in Gesbert, as a substitute for Ritter's amplitude based measurements to yield predictable results.

68. Accordingly, the combination of Ritter and Gesbert teach this limitation of claim 1 of the '375 Patent.

c. *Limitation (b):* **providing, by the subscriber unit,/provide a first feedback information relating to a plurality of feedback clusters based on at least the measuring of the first channel information for the plurality of subcarriers based on the first plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters being at least two subcarriers, the first feedback information relating to the plurality of feedback clusters based on the first plurality of pilot symbols includes an index corresponding to a first modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;**

69. Ritter teaches subscriber units providing channel information for a plurality of feedback clusters, that is, Ritter provides channel information for multiple subcarriers and subcarrier segments (feedback clusters), where each segment includes at least two subcarriers. For example, Ritter discloses the following process for measuring subcarriers:

> "According to the device of the invention ***every mobile station, MS, measures the quality of various segments of the frequency spectrum***, whereby it receives all subcarriers in the time slot assigned to it, ***checks the quality of each individual subcarrier and then determines the quality of the subcarriers. Then each mobile station determines at least a suitable segment preferred for its own communication link and transmits appropriate information to the base station, BS.*** In this example the first mobile station determines a segment, Sx, with subcarriers oc00 ... oc40 as the best suitable segment for it. In addition, it determines the segments, Sy, Sz as additional suitable segments preferred for its own communication link. ***Information about segments Sx, Sy, Sz is entered on a priority list, PL1, numbered according to their suitability for the communication link and sent to the base station, BS.***"

Ex. 1004, Ritter at pp. 12-13; *see also id.* at 15 ("Shown schematically in Figure 2 is the structure of a radio block with data symbols in a time slot, as well as the

OFDMA sub-carriers to form the segments .... There are thus available, for example, ***several hundred sub-carriers***, oc, - with a separation of several kilohertz between two adjacent carriers - in the radio cell of Figure 1 with three mobile stations, MS, linked to the base station, BS. ***Sub-carriers oc00 ... oc40 define segment Sx, sub-carriers oc41 ... oc60 define segment Sa, and sub-carriers oc61 ... oc100 define segment Sm.***"); *id.* at 19 ("In another step (4) ***the mobile station, MS, sends via the radio interface to the base station, BS, its priority lists, PL1 ... PL3, with the information about several preferred, suitable segments***, i.e., ***about segments Sx, Sy, Sz or Sa, Sb, sc or Sm, Sn, So*** for which a sequence of suitability is determined by the mobile station, MS."). Thus, Ritter discloses that the mobile units provide "first feedback information" to the base station in the form of information about various segments of subcarriers as a priority list according to each segments suitability as a communication link.

70. To the extent the Patent Owner argues that Ritter does not explicitly disclose "an index corresponding to a first modulation and coding rate," in my opinion, it would have been obvious to those of ordinary skill in the art at the time to include in the feedback an index corresponding to a modulation and coding rate, as described in Gesbert, to address the problem of efficiently providing feedback information to a base station. In particular, Gesbert discloses that receive units (*i.e.*, subscriber units) transmit an index indicating a modulation and coding rate to the

transmit unit (*i.e.*, base station). Ex. 1005, Gesbert at 10:17-22. Gesbert further teaches that "***[t]he modes are indexed by a mode number so as to conveniently identify the modulation and coding rates*** which are to be applied to data 52 in each mode." *Id.* at 6:37-39. Table 1 from Gesbert shows the mode indices and corresponding modulation and coding rates:

TABLE 1

Mode	Modulation Rate (bits/symbol)	Coding Rate	Throughput (bits/s/Hz)
1	2	3/4	3/2
2	2	2/3	4/3
3	2	1/2	1
4	2	1/3	2/3
5	4	3/4	3
6	4	2/3	8/3
7	4	1/2	2
8	4	1/3	4/3
9	5	3/4	15/4
10	5	2/3	10/3
11	5	1/2	5/2
12	5	1/3	5/3
13	6	3/4	9/2
14	6	2/3	4
15	6	1/2	3
16	6	1/3	2

71. According to Gesbert, "***[t]able 1 illustrates some typical modes with their modulation rates and coding rates*** and the corresponding throughputs for data 52." *Id.* at 6:35-37; *see also, id. at* 4:30-32 ("The system also has a ***feedback mechanism for communicating the subsequent mode from the receive unit to the***

transmit unit."); 4:60-62 ("transmit unit 12 is a Base Transceiver Station (BTS) and a receive unit 14 is a mobile or stationary wireless user device").

72. In my opinion, it would have been obvious to one of ordinary skill in the art in 2000 to modify Ritter to provide an indication of a modulation and coding rate in conjunction with the channel information for the subcarrier segments (*i.e.*, feedback clusters), as in Gesbert, based on the "application of a known technique to a piece of prior art ready for the improvement" to "yield predictable results." *KSR*, 550 U.S. at 401.

73. **Base system**: Ritter discloses the subscriber unit providing channel quality information for feedback clusters to the base station. *See, e.g.*, Ex. 1004, Ritter at 12-13 ("every mobile station, MS, measures the quality of various segments of the frequency spectrum, whereby it receives all subcarriers in the time slot assigned to it, checks the quality of each individual sub-carrier and then determines the quality of the sub-carriers. Then each mobile station determines at least a suitable segment preferred for its own communication link and transmits appropriate information to the base station, BS."), 15, 19.

74. **Known technique**: Gesbert discloses communicating an index to a modulation and coding rate associated with each feedback cluster. *See, e.g.*, Ex. 1005, Gesbert at 3:38-51, 6:35-42, 9:66-10-44, 11:9-24, Figs. 3-4.

75. **Predictable results and improved system**: In my opinion, a person having ordinary skill in the art in 2000 would have been motivated to combine Gesbert's well-understood technique of indicating a modulation and coding rate using an *index* with the teachings of Ritter in order to maximize network resources and optimally provide feedback information to a base station relating to subcarrier selection. Combining Ritter and Gesbert in this way would have resulted in an improved wireless communication system that included the well-known advantages of allocating subcarriers through an ongoing, adaptive feedback and allocation scheme, as taught by Ritter, and the advantages of adaptive modulation and coding schemes, as taught by Gesbert. Such a modification would have yielded predictable results without requiring undue experimentation. *See KSR*, 550 U.S. at 416 ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.").

76. Further, as previously demonstrated, both Ritter and Gesbert are in the same field of endeavor as the '375 Patent. *See* Claim 1, limitation (a). Ritter acknowledges that its "improved OFDMA multi-carrier procedure can be combined with other multiplex access procedures which transmit data symbols of a finite duration in time slot into a more effective radio system." Ex. 1004, Ritter at 7; *see also* M.P.E.P. § 2143 (another rationale to combine includes "some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill

to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention."). Therefore, it would have been obvious to modify Ritter's OFDMA system to provide an indication of a modulation and coding rate in conjunction with the channel quality feedback, as in Gesbert. Accordingly, the combination of Ritter and Gesbert discloses this limitation.

d. ***Limitation (c):*** **receiving, by the subscriber unit,/receive a first allocation of OFDMA subcarriers based on at least the providing of the first feedback information selected by the base station for use by the subscriber unit, the first allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the first allocation of OFDMA subcarriers;**

77. Ritter teaches a subscriber unit receiving a first allocation of OFDMA subcarriers selected by the base station based on feedback information from the subscriber unit. For example, Ritter describes "[b]y means of the allocation system described the advantages of the OFDMA multi-carrier procedure can be used and possibly ***optimal frequency resources can be provided for all communication links operated by a base station with the help of a flexible allocation of several sub-carriers and a thereby defined segment of a frequency spectrum.***" Ex. 1004, Ritter at 6. Notably, "***[t]he base station***, BS, evaluates all information received from the mobile stations, MS, and ***assigns each mobile station a segment for the respective communication link depending on the evaluation. The base station sends the mobile station information about the assigned segment.***" *Id.* at 14; *see also id.* at 20 ("In a step

(6) information about the allocated segments, Sx, Sa, and Sm is sent via the radio interface to the mobile stations, MS, which then use the received new frequency resources in the frequency spectrum for their individual communication links.").

78. It would have been obvious in 2000 to combine Gesbert's adaptive modulation and coding functionality with the adaptive channel allocation functionality of Ritter for all the reasons discussed above with respect to limitations (a) and (b). To the extent that the Patent Owner argues that Ritter fails to teach "the first allocation . . . including an indication of a modulation and coding rate associated with the first allocation," in my opinion, it would have further been obvious to modify the combined Ritter-Gesbert system to inform the subscriber unit of what modulation and coding rate to use to decode the allocated subcarriers, as taught by Thoumy.

79. For example, Thoumy teaches that the base station transmits information concerning allocated subcarriers to the subscriber unit, including an indication of modulation and coding. "***[T]he transmission parameters, namely the number of carriers and the modulation***, which are allocated to the transmission in question, ***are transmitted*** (step **2630**) ***by the management unit*** 2172 to the information reception unit 2072 and to the information sending unit 2070 ***with a view to the sending of these parameters to the peripheral station*** 1402." Ex. 1007, Thoumy at 31:16-22; *see also id.* at 9:31-34 ("the device proposed in this document

allocates a group of given carriers to each of the sources and selects an appropriate modulation type and coding efficiency for each of the groups.").

80. Thoumy, like the combination of Ritter and Gesbert, teaches dynamically allocating channels in an OFDMA system to account for changing channel conditions. *Id.* at 9:31-34 ("[T]he device proposed in this document allocates a group of given carriers to each of the sources and selects an appropriate modulation type and coding efficiency for each of the groups."); 12:65-13:9 ("[T]he invention relates to a method of receiving information coming from a radio communication channel, including ... a step of ***reconfiguring the number of carriers and the modulation to be selected according to a required service quality***, in terms of transmission error rate and transmission rate for a given information transmission, the number of carriers and the modulation reconfigured differing according to the required service qualities.").

81. In my opinion, it would have been obvious to one of ordinary skill in the art in 2000 to incorporate Thoumy's teaching of a base station indicating a modulation and coding rate to a subscriber unit into the combined Ritter-Gesbert system for the following reasons. First, one rationale to support a conclusion of obviousness includes "combining prior art elements according to known methods to yield predictable results." *KSR*, 550 U.S. at 416; M.P.E.P. § 2143. Those of ordinary skill in the art in 2000 would have recognized the benefits of using

adaptive allocation schemes, as well as the necessity of informing the subscriber unit of the allocated subcarriers, as taught by the combination of Ritter and Gesbert, and the particular modulation and coding rate to use, as taught by Thoumy, so that the subscriber unit can properly transmit and receive information on the allocated subcarriers. Accordingly, one of ordinary skill in the art in 2000 would have interchangeably applied the teachings of Thoumy, Ritter, and Gesbert to arrive at certain features of an OFDMA system. Therefore, it would have been obvious for one of ordinary skill in the art to combine Thoumy's teaching of informing the subscriber unit of the modulation and coding rate, in conjunction with the allocation of subcarriers, with the combined Ritter-Gesbert system at least because it would be a predictable use of prior art elements according to their established functions. *See KSR*, 550 U.S. at 416 ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.").

82. Another rationale to combine is the "application of a known technique to a piece of prior art ready for the improvement" to "yield predictable results." *Id.* at 401.

83. **Base system:** Ritter discloses an OFDMA system that dynamically allocates subcarrier segments (*i.e.*, subcarriers) to a mobile station (*i.e.*, subscriber unit) and then informs the subscriber unit of the allocated subcarriers. *See, e.g.*, Ex. 1004, Ritter at 6 (describing "transmission means in each base station to transmit information

across the assigned segment to each mobile station."), 8 ("[a]s a result, the base station receives knowledge with respect to the best suited segments for it and can make appropriate new assignments of the segments of the frequency spectrum for all mobile stations which are better adapted to their transmitted needs."), 19-20. Ritter explains that its "invention has the goal of providing an improved procedure and radio communication system for allocating radio sources, when using an OFDMA-multicarrier procedure." *Id.* at 4.

84. **Known technique:** Gesbert and Thoumy disclose adaptive modulation and coding. Gesbert recognized that it would be advantageous "to provide a mode selection technique which allows the system to rapidly and efficiently select the appropriate mode for encoding data in a quickly changing channel." Ex. 1005, Gesbert at 2:45-48. Likewise, Thoumy teaches that "a dynamic transmission method [] makes it possible to preserve optimum efficiency when there are variations in characteristics of the transmission channel." Ex. 1007, Thoumy at 5:4-7. Thoumy further teaches that the peripheral station (*i.e.*, "subscriber unit") has to be informed of the modulation and coding to use. *See, e.g.*, *id.* at 31:8-22, 31:66-32:9.

85. **Predictable results and improved system:** In my opinion, one of ordinary skill in the art in 2000 would have been motivated to include adaptive modulation and coding in the combined Ritter-Gesbert system, as taught by Gesbert and Thoumy, because Gesbert and Thoumy both teach that it increases system efficiency. One would

have been further motivated to inform the subscriber unit of what modulation and coding rate to use with the allocated subcarriers in order to correctly decode and demodulate data. Thus, the combined Ritter-Gesbert-Thoumy system would be capable of informing the subscriber unit of both the allocated subcarriers and the corresponding modulation and coding rate to use. Accordingly, the combination of Ritter, Gesbert, and Thoumy teaches this limitation.

e. ***Limitation (d):*** **measuring, at a second time by the subscriber unit, a second channel information for the plurality of subcarriers based on a second plurality of pilot symbols received from the base station;**

86. As described above with respect to claim element (a), the combination of Ritter and Gesbert likewise disclose measuring channel information based on pilot symbols. In addition, both Ritter and Gesbert describe performing repeated channel quality measurements for the plurality of subcarriers to obtain current and reliable channel quality measurements. For example, Ritter discloses "[i]n the process, ***the quality of the actual communication link plays a decisive role*** with respect to the frequency situation which ***according to the procedure of the invention can be individually changed after the determination of the best suitable segments in each mobile station overseen by a base station and can thereby be improved.***" Ex. 1004, Ritter at 6. Further, Ritter teaches that "***the best suited segments for communication can be determined at any time*** for individual communications links which differ from each other ***and they can be changed as***

needed." *Id.* at 7-8; *see also id.* at 16 ("In addition, for each mobile station the number of assigned subcarriers in a time slot ***can be variably adjusted by the base station***.").

87. Similar to Ritter, Gesbert discloses "[o]nce mode selection block 112 determines which modes should be used for each of the k streams, these subsequent modes are fed back to transmit unit 50 and applied to the k streams. ***This operation repeats itself***, and each new selection of subsequent modes is fed back to transmit unit 50 ***to thus account for the changing conditions of channel 22***." Ex. 1005, Gesbert at 11:20-25. Accordingly, the combination of Ritter and Gesbert discloses this limitation.

f. ***Limitation (e):*** **providing, by the subscriber unit, provide a second feedback information relating to the plurality of feedback clusters based on at least the measuring of the second channel information for the plurality of subcarriers based on the second plurality of pilot symbols, the second feedback information relating to the plurality of feedback clusters based on the second plurality of pilot symbols includes an index corresponding to a second modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;**

88. As discussed above with respect to claim elements (b) and (d), the combination of Ritter, Gesbert, and Thoumy discloses adaptively allocating OFDMA subcarriers and coding and modulation rates based on current channel conditions and informing the subscriber unit of the allocated subcarriers and coding and modulation rate. In other words, the Ritter-Gesbert-Thoumy combination discloses re-allocating subcarriers and modulation and coding rates

based on changing channel conditions. For example, Ritter teaches that "***the quality of the actual communication link plays a decisive role*** with respect to the frequency situation which ***according to the procedure of the invention can be individually changed after the determination of the best suitable segments in each mobile station overseen by a base station and can thereby be improved.***" Ex. 1004, Ritter at 6. *See also id. at* 7-8 ("[t]he best suited segments for communication can be determined at any time for individual communications links which differ from each other ***and they can be changed as needed.***"), 16 ("In addition, for each mobile station the number of assigned subcarriers in a time slot can be variably adjusted by the base station.").

89. Similarly, Gesbert discloses that "[o]nce mode selection block 112 determines which modes should be used for each of the k streams, these subsequent modes are fed back to transmit unit 50 and applied to the k streams. ***This operation repeats itself***, and each new selection of subsequent modes is fed back to transmit unit 50 ***to thus account for the changing conditions of channel 22.***" Ex. 1005, Gesbert at 11:20-25.

90. Furthermore, as described above with respect to claim element (b), Gesbert discloses "the second feedback information . . . includes an index corresponding to a second modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters." It would have been obvious to combine this disclosure in Gesbert

with Ritter for all the reasons previously stated in the discussion above with respect to claim element (b). Accordingly, the combination of Ritter and Gesbert disclose this limitation.

g. ***Limitation (f):*** **receiving, by the subscriber unit,/receive a second allocation of OFDMA subcarriers based on at least the providing of the second feedback information selected by the base station for use by the subscriber unit, the second allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the second allocation of OFDMA subcarriers, the second allocation of OFDMA subcarriers being different from the first allocation of OFDMA subcarriers, the first and second allocations of OFDMA subcarriers being received by the subscriber unit at two different times.**

91. As described above with respect to claim limitation (c), the combination of Ritter, Gesbert, and Thoumy discloses adaptively allocating OFDMA subcarriers and modulation and coding rates, and informing the subscriber unit of the allocated subcarriers and modulation and coding rate. In other words, when combined with Gesbert and Thoumy, Ritter's OFDMA system re-allocates subcarriers and modulation and coding rates based on changing channel conditions, including instances where the second allocation is different from the first allocation.

92. For example, Ritter teaches an OFDMA system for adaptively allocating subcarriers to subscriber units: "[t]he best suited segments for communication can be determined at any time for individual communications links which differ from each other ***and they can be changed as needed.***" Ex. 1004, Ritter at 7-8; *see also id.* at 16 ("In

addition, for each mobile station ***the number of assigned subcarriers in a time slot can be variably adjusted by the base station***.").

93. Similarly, Gesbert teaches that the base station dynamically adjusts wireless channel parameters in accordance with the channel feedback information. *Compare* Ex. 1005, Gesbert at 3:46-48 ("***[T]he subsequent mode is*** communicated to the transmit unit and ***applied to the data to maximize a communication parameter in the channel***."), *and id.* at 1:30-33 ("***as the channel changes in time, the communication parameters also change***. Under altered conditions former data rates, coding techniques and data formats may no longer be feasible.") *with* Ex. 1004, Ritter at 11 ("The Operation and Maintenance Center, OMC, and the base station control, BSC, usually perform the functions of ***regulating and adapting the allocation of radio resources*** within the radio cells of the base station, BS."), *and* 14 ("***The base station***, BS, evaluates all information received from the mobile stations, MS, and ***assigns each mobile station a segment for the respective communication link depending on the evaluation***.").

94. Thoumy also describes adaptively reconfiguring the modulation based on current transmission conditions. Ex. 1007, Thoumy at 13:15-22. ("Advantageously, the result of this measurement supplies information on the actual conditions of the current transmission and therefore makes it possible to ***reconfigure the number of carriers and the modulation allocated to this transmission*** where the required service quality is not met. The actual conditions of the current transmission can therefore be monitored

continuously ***and the number of carriers and the modulations adapted accordingly***."); *id.* at 11:35-44 ("[T]he method includes a step of ***determining a number of carriers to be allocated which is different from that which was previously allocated*** to said at least one communication channel between the base station and the peripheral station ... for example in order to guarantee a required service quality....").

95. For the reasons presented with respect to limitation (c) of claim 1, in my opinion, it would have been obvious to those of ordinary skill in the art in 2000 to combine Ritter with the teachings of Gesbert and Thoumy regarding methods for adaptively selecting modulation and coding rates. Specifically, it would have been obvious to combine Ritter, Gesbert, and Thoumy in the proposed manner based on: "application of a known technique to a piece of prior art ready for the improvement" to "yield predictable results." *KSR*, 550 U.S. at 401 (2007).

96. **Base system:** Ritter discloses a base station that allocates sets of subcarriers based on channel quality feedback in order to efficiently utilize available bandwidth in light of dynamically changing channel conditions. Ex. 1004, Ritter at 8 ("[a]ccording to another version of the invention a priority list is sent from the mobile station to the base station which contains information about the segment best suited for its communication link as well as other suitable segments preferred for its own communication link. As a result, the base station receives knowledge with respect to the best suited segments for it

and can make appropriate new assignments of the segments of the frequency spectrum for all mobile stations which are better adapted to their transmitted needs."), 19-20.

97. **Known technique:** Gesbert and Thoumy disclose dynamically allocating modulation and coding rates based on subscriber feedback information. Ex. 1005, Gesbert at 1:30-33, 3:46-48; Ex. 1007, Thoumy at 10:31-37, 13:15-22.

98. **Predictable results and improved system:** Upon reading the disclosures of both Gesbert and Thoumy, in my opinion, a person of ordinary skill would have recognized that the advantages of dynamically allocating modulation and coding rates based on feedback information from the subscriber unit would similarly benefit the system of Ritter and result in a more robust OFDMA system in which both the allocated subcarriers and modulation and coding rates for those allocated subcarriers would be dynamically adjusted as system conditions change. For example, the system described in Ritter already includes a base station that allocates subcarriers based on channel quality feedback in order to efficiently utilize available bandwidth in light of dynamically changing channel conditions. While allocating subcarriers, the system of Ritter would benefit from additionally adjusting the modulation and coding rates applied to the allocated subcarriers as disclosed in Gesbert and Thoumy. Because Ritter, Thoumy, and Gesbert each disclose providing channel quality feedback from the subscriber unit to the base station, the adaptive modulation and coding functionality of Gesbert and Thoumy could easily be added to the subcarrier allocation functionality of Ritter in order to

improve transmission quality and the bandwidth utilization of the OFDMA wireless system. The result of combining Gesbert's and Thoumy's dynamic modulation and coding functionality with the adaptive channel allocation functionality of Ritter would result in a system where (1) channel feedback information from the subscriber unit to the base station identifies both the proposed subcarrier segments and corresponding modulation and coding rate, and (2) the allocation received by the subscriber unit from the base station identifies both the allocated subcarrier segments and a particular modulation and coding rate to use. Such a modification would have yielded predictable results without requiring undue experimentation.

99. Accordingly, the combination of Ritter, Gesbert, and Thoumy render claims 1 and 17 obvious.

2. Claims 2 and 18: "wherein the plurality of feedback clusters at the second time is different than the plurality of feedback clusters at the first time"

100. Claims 2 and 18 depend from claims 1 and 17, respectively. In addition to disclosing all the limitations of claims 1 and 17, in my opinion, the combination of Ritter, Gesbert, and Thoumy disclose that the plurality of feedback clusters at the second time is different than (i.e., not identical to) the plurality of feedback clusters at the first time, as required by claims 2 and 18. Specifically, Ritter discloses that the mobile station takes measurements of "the quality of various segments." Ex. 1004, Ritter at 27. As noted above, segments are comprised of a

plurality of subcarriers. Claims 1 and 17 define feedback clusters to be at least two subcarriers. One of ordinary skill in the art would understand that Ritter's disclosure of the language "various segments" to mean that the subscriber unit can measure different segments at different times. Further, Ritter discloses an embodiment in which each mobile station provides feedback on only certain segments. *See* Ex. 1004, Ritter at 13 ("In this example the first mobile station determines a segment, Sx, with subcarriers . . . In addition, it determines segments, Sy, Sz as additional suitable segments preferred for its own communication link."). Because only three segments are sent to the base station during reporting and Ritter acknowledges that channel conditions change and the "best suited segments for communications are determined at any time for individual communications," in my opinion, one of ordinary skill in the art would understand that Ritter's system could include a different plurality of feedback clusters at a second time. *Id.* at 15. Accordingly, Ritter discloses the plurality of feedback clusters at a second time is different than the plurality of feedback clusters at the first time. Furthermore, it would have been obvious to combine Ritter with Gesbert and Thoumy for all the reasons discussed above with respect to claim 1.

3. Claims 9 and 25: "wherein the receiving/receipt of the first allocation of OFDMA subcarriers includes receiving/receipt a first allocation of at least one group of clusters selected by the base station for use by the subscriber unit"

101. Claims 9 and 25 depend from claims 1 and 17, respectively. In addition to disclosing all the limitations of claims 1 and 17, in my opinion, the

combination of Ritter, Gesbert, and Thoumy discloses receiving a first allocation of at least one group of clusters selected by the base station for use by the subscriber unit. As described above, the '375 Patent states that a cluster is "a logical unit that contains at least one physical subcarrier." *Supra* IV.A.2. If one physical subcarrier can constitute a "cluster," then a group of two or more physical subcarriers can constitute a "group of clusters." As described above with respect to limitation (b) of claim 1, Ritter discloses the subscriber unit receiving a first allocation of a segment comprising multiple subcarriers (*i.e.*, a group of clusters) for use by the subscriber unit. Ex. 1004, Ritter at 19-20 ("the base station, BS, assigns the segments, Sx, Sa and Sm . . . [I]nformation about the allocated segments, Sx, Sa, Sm is sent via the radio interface to the mobile stations"). Thus, Ritter teaches this limitation, and claims 9 and 25 would have been obvious to those of ordinary skill in the art in view of the combination of Ritter, Gesbert, and Thoumy.

4. Claims 8 and 24: "wherein the receiving/receipt of the first allocation of OFDMA subcarriers is receiving/receipt a first allocation of at least one coherence cluster"

Claims 12 and 28: "wherein the receiving/receipt of the first allocation of OFDMA subcarriers includes consecutive clusters."

102. Claim 8 depends from claim 1; claim 24 depends from claim 17; claim 12 depends from claim 9, which depends from claim 1; and claim 28 depends from 25, which depends from claim 17. In addition to disclosing the limitations of claims 1, 9, 17, and 25, in my opinion, the combination of Ritter, Gesbert, and Thoumy discloses

consecutive clusters and coherence clusters as recited in claims 8, 12, 24, and 28. As discussed above, the '375 Patent describes a coherence cluster as "a cluster containing multiple subcarriers close to each other." *Supra* IV.A.4.

103. Ritter's allocated "segments" are comprised of large numbers of adjacent subcarriers. For example, Ritter discloses that "***[t]here are thus available, for example, several hundred sub-carriers***, oc, - with a separation of several kilohertz between two adjacent carriers - in the radio cell of Figure 1 with three mobile stations, MS, linked to the base station, BS. ***Sub-carriers oc00 ... oc40 define segment Sx, sub-carriers oc41 ... oc60 define segment Sa, and sub-carriers oc61 ... oc100 define segment Sm.***" Ex. 1004, Ritter at 15. As explained above with respect to claims 9 and 25, the subcarrier segment of Ritter is a "group of clusters," each cluster comprising at least one subcarrier. As such, the adjacent subcarriers (*i.e.*, clusters) within each segment (*i.e.*, group) of Ritter constitute consecutive subcarriers (*i.e.*, clusters). Ritter's adjacent subcarriers within each segment are consecutive carriers and are close to each other, thereby being coherence clusters. Furthermore, it would have been obvious to combine Ritter with Gesbert and Thoumy for all the reasons discussed above with respect to claim 1. Accordingly, Ritter teaches these claim limitations and claims 8, 12, 24, and 28 would have been obvious to those of ordinary skill in the art in view of the combination of Ritter, Gesbert, and Thoumy.

5. Claims 14 and 30: "wherein the receiving/receipt of the first allocation of the at least one group of clusters includes receiving/receive a group identifier that identifies one group of the first allocation of the at least one group of clusters."

104. Claim 14 depends from claim 9, which depends from claim 1, and claim 30 depends from 25, which depends from claim 17. In addition to disclosing the limitations of claims 1, 9, 17, and 25, in my opinion, the combination of Ritter, Gesbert, and Thoumy discloses receiving a group identifier that identifies one group of the first allocation of the at least one group of clusters. For example, Ritter describes the base station assigning segments of subcarriers, *i.e.*, groups of subcarriers, where the segments are identified as Sx, Sa, and Sm. *See* Ex. 1004, Ritter at 19-20 ("the base station, BS, assigns the segments, Sx, Sa and Sm . . . [I]nformation about the allocated segments, Sx, Sa, Sm is sent via the radio interface to the mobile stations."). Sx, Sa and Sm are the group identifiers that identify at least one group of the first allocation of the at least one group of clusters. Furthermore, it would have been obvious to combine Ritter with Gesbert and Thoumy for all the reasons discussed above with respect to claim 1. Accordingly, Ritter teaches this claim limitation and claims 14 and 30 are obvious in view of the combination of Ritter, Gesbert, and Thoumy.

6. **Claims 15 and 31: "wherein the measuring/measurement of the first channel information for the plurality of subcarriers based on the first plurality of pilot symbols includes measuring channel information for all available clusters allocable by the base station."**

105. Claims 15 and 31 depend from claims 1 and 17, respectively. In addition to disclosing all the limitations of claims 1 and 17, in my opinion, the combination of Ritter, Gesbert, and Thoumy discloses measuring channel information for all available clusters allocable by the base station as recited in claims 15 and 31. For example, Thoumy discloses measuring channel information for all available clusters allocable by the base station. Ex. 1007, Thoumy at 6:37-38 ("signal representing the transmission quality observed by the remote device B ***on each subcarrier***"). As discussed above with respect to limitations (c) and (f) of claim 1, it would have been obvious to combine Ritter, Gesbert, and Thoumy to form an OFDMA system that adaptively allocates subcarriers and modulation and coding rates.

106. In my opinion, it would have further been obvious to measure channel quality for all subcarriers in the combined Ritter-Gesbert-Thoumy system, as taught by Thoumy, based on the application of a known technique to a piece of prior art ready for the improvement to yield predictable results. *KSR*, 550 U.S. at 401.

107. **Base system**: Ritter discloses measuring the quality of subcarriers. Ex. 1004, Ritter at 4-5 and 12 ("every mobile station, MS, measures the quality of various segments of the frequency spectrum, whereby it receives all subcarriers in the time

slot assigned to it, ***checks the quality of each individual subcarrier*** and then determines the quality of the subcarriers."), 18-19 ("In an initial step (1) the mobile stations, MS, receive in a parallel manner all subcarriers, oc, in the time slot, ts, assigned to them. ***For each sub-carrier***, oc, ***the mobile station checks*** as a second step (2), ***whether an amplitude modulation is present in the data symbols transmitted in the time slot***, ts, ***and thus has a measurement result about the quality of the respective subcarrier***, oc. It forms an average value from the results of the check for all-subcarriers belonging to a selected segment which ***results in a quality value for the entire segment***."); *see also id.* at 8-9, 20-21.

108. **Known technique**: Thoumy discloses measuring channel information for all available subcarriers allocable by the base station. Ex. 1007, Thoumy at 6:35-40.

109. **Predictable results and improved system**: In my opinion, a person of ordinary skill in the art would have been motivated to incorporate the well-known technique of measuring channel information for all available subcarrier clusters allocable by the base station into the combined Ritter-Gesbert-Thoumy combination, as taught by Thoumy, to improve transmission quality in an OFDMA system. As such, measuring the quality of all available subcarriers in an OFDMA system would have been an obvious and desirable design choice for a person of ordinary skill in the art in 2000. Accordingly, Thoumy discloses this limitation and claims 15 and 31 are obvious in view of the combination of Ritter, Gesbert, and Thoumy.

7. Claims 16 and 32: "providing/provide the first feedback information relating to all of the plurality of feedback clusters."

110. Claims 6 and 32 depend from claims 1 and 17, respectively. In addition to disclosing all the limitations of claims 1 and 17, in my opinion, the combination of Ritter, Gesbert, and Thoumy discloses providing feedback information relating to all of the plurality of feedback clusters. As described above with respect to claim limitation 1(b), Ritter describes the subscriber unit providing feedback to the base station for each of the three segments (*e.g.*, feedback clusters) it measured. Ex. 1004, Ritter at 12-13 ("each mobile station determines at least a suitable segment preferred for its own communication link and transmits appropriate information to the base station, BS. In this example the first mobile station determines a segment, Sx, with subcarriers oc00 … 0c40 as the best suitable segment for it. In addition, it determines the segments Sy, Sz as additional suitable segments preferred for its own communication link. Information about segments Sx, Sy, Sz is . . . sent to the base station, BS."). These three subcarrier segments constitute the entirety of the "plurality of feedback clusters" because they are the clusters that the mobile station in Ritter provides feedback information for. Because Ritter reports information for *each* segment (*e.g.*, each feedback cluster), Ritter teaches providing feedback information relating to all of the plurality of feedback clusters. Furthermore, it would have been obvious to combine Ritter with Gesbert and Thoumy for all the reasons discussed above with respect to claim 1. Accordingly, Ritter discloses this

limitation and claims 16 and 32 are obvious in view of the combination of Ritter, Gesbert, and Thoumy.

G. Ritter in View of Gesbert, Thoumy, and Gitlin Renders Claims 3-7, 10-11, 13, 19-23, 26-27, and 29 Obvious Under 35 U.S.C. § 103(a)

111. Table 3, below, shows which references are being relied on for disclosing the various elements of claims 3-7, 10-11, and 13 (and by extension, claims 19-23, 26-27, and 29). Reliance on a particular reference for disclosing a claim element in Table 3 does not mean that other references do not also disclose that claim element.

Table 3 – Ritter, Gesbert, Thoumy, and Gitlin v. claims 3-7, 10-11, and 13

Claim	Ritter	Gesbert	Thoumy	Gitlin
[The method of claim 1]	X	X	X	
3. The method of claim 1, wherein at least one subcarrier of the first allocation of OFDMA subcarriers is non-contiguous with other subcarriers of the first allocation of OFDMA subcarriers.				X
4. The method of claim 3, wherein the first allocation of OFDMA subcarriers includes a cluster identifier that identifies a first plurality of subcarriers in a first time slot and a second plurality of subcarriers in a second time slot, at least two subcarriers of the first plurality of subcarriers and of the second plurality of subcarriers being disjoint.				X
5. The method of claim 4, wherein				X

at least one subcarrier of the first plurality of subcarriers in the first time slot is different than all of the subcarriers of the second plurality of subcarriers in the second time slot.				
6. The method of claim 1, wherein the receiving of the first allocation of OFDMA subcarriers is receiving a first allocation of at least one diversity cluster.				X
7. The method of claim 6, wherein the at least one diversity cluster includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel.				X
10. The method of claim 9, wherein at least one cluster of the first allocation of the at least one group of clusters is disjoint from at least one other cluster of the first allocation of the at least one group of clusters to obtain frequency diversity.	X [claim 9]	X [claim 9]	X [claim 9]	X
11. The method of claim 10, wherein disjoint clusters of the first allocation of the at least one group of clusters are spread farther apart than a coherence bandwidth of a respective channel.				X
13. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes an indication of space between each cluster of the first allocation of the at least one group of clusters.	X [claim 9]	X [claim 9]	X [claim 9]	X

112. Gitlin is directed to "a system and method for maximizing usage of a communications transmission medium while preserving optimum access to the medium for users of differing access speeds and while maximizing spectral use and bandwidth efficiencies." Ex. 1006, Gitlin at 1:8-12. Gitlin discloses dividing bandwidth into time and frequency domains in order to allocate time-frequency slices to users with varying user-application and access rates:

> A system and method for optimizing usage of a communications transmission medium. ***The transmission medium may be sliced into time and frequency domains so as to create time-frequency slices for assignment to users having varying access rates and user-application requirements. Through scheduling of the various speed users within the frequency and time domains, the system and method can efficiently allocate and make use of the available spectrum, thereby accommodating higher rate users requiring greater bandwidths and time slot assignments while still preserving cost-efficient access for lower speed users***. Depending on the signal modulation scheme, the time-frequency slices may be allocated on non-contiguous frequency bands.

Id. at Abstract.

113. Gitlin further discloses that users can be allocated consecutive or non-consecutive frequency tones at various times in order to maximize the use of the system bandwidth. *Id.* at 3:5-12 ("For higher speed users, frequency slots are

usually assigned contiguously in order to optimize the design of modulation and transmission architectures (e.g. a single transmitter for higher rate users). In a variant of this embodiment, where frequency adjacency requirements can be eased, higher speed users can be assigned two or more non-contiguous time-frequency slices to further maximize spectral efficiency."); *see also id.* at Abs., 5:32-6:30. As explained below, Gitlin is relied upon below for teaching an allocation of "non-contiguous" subcarriers and "disjoint" subcarrier clusters. In addition, Gitlin describes a "multi-tone" system, which is another way to describe an OFDM system. *Id.* at 5:35-41. Gitlin also describes a system with multiple users. *Id.* at 1:6-12. Thus, in my opinion, Gitlin describes an OFDMA system.

114. In my opinion, it would have been obvious to those or ordinary skill in the art to incorporate the teachings of Gitlin, including the teaching of "non-contiguous" and "disjoint" allocations to mitigate the effect of frequency-selective fading, into the combined Ritter-Gesbert-Thoumy system. Gitlin, Thoumy, Ritter, and Gesbert are all in the same field of endeavor (wireless OFDMA systems) and are directed to solving the same problem (providing quality service to multiple users in changing conditions). Since Gitlin teaches a method of fully utilizing the available spectrum, with both contiguous and non-contiguous subcarrier clusters, that results in increased spectral efficiency (see Gitlin 9:46-50) and performance improvement (see Gitlin 6:12-16), a person of ordinary skill in the art in 2000

would have been motivated to combine the teachings of Gitlin with other wireless, OFDMA references or systems, such as Ritter, Thoumy, and Gesbert. Further, combining Gitlin's teachings of subcarrier allocation with the teachings of Ritter, Thoumy, and Gesbert would be a predictable use of prior art elements according to their established functions. *KSR*, 550 U.S. at 416 ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.")

1. **Claims 3 and 19: "wherein at least one subcarrier of the first allocation of OFDMA subcarriers is non-contiguous with the other subcarriers of the first allocation of OFDMA subcarriers"**

   Claims 4 and 20: "wherein the first allocation of OFDMA subcarriers includes a cluster identifier that identifies a first plurality of subcarriers in a first time slot and a second plurality of subcarriers in a second time slot, at least two subcarriers of the first plurality of subcarriers and of the second plurality of subcarriers being disjoint"

   Claims 6 and 22: "wherein the receiving/receipt of the first allocation of OFDMA subcarriers is receiving/receipt a first allocation of at least one diversity cluster"

   Claims 10 and 26: "wherein at least one cluster of the first allocation of the at least one group of clusters is disjoint from at least one other cluster of the first allocation of the at least one group of clusters to obtain frequency diversity."

115. Claims 3 and 6 depend from claim 1, claim 4 depends from claim 3, and claim 10 depends from claim 9, which depends from claim 1. Claims 19 and 22 depend from claim 17, claim 20 depends from claim 19, and claim 26 depends

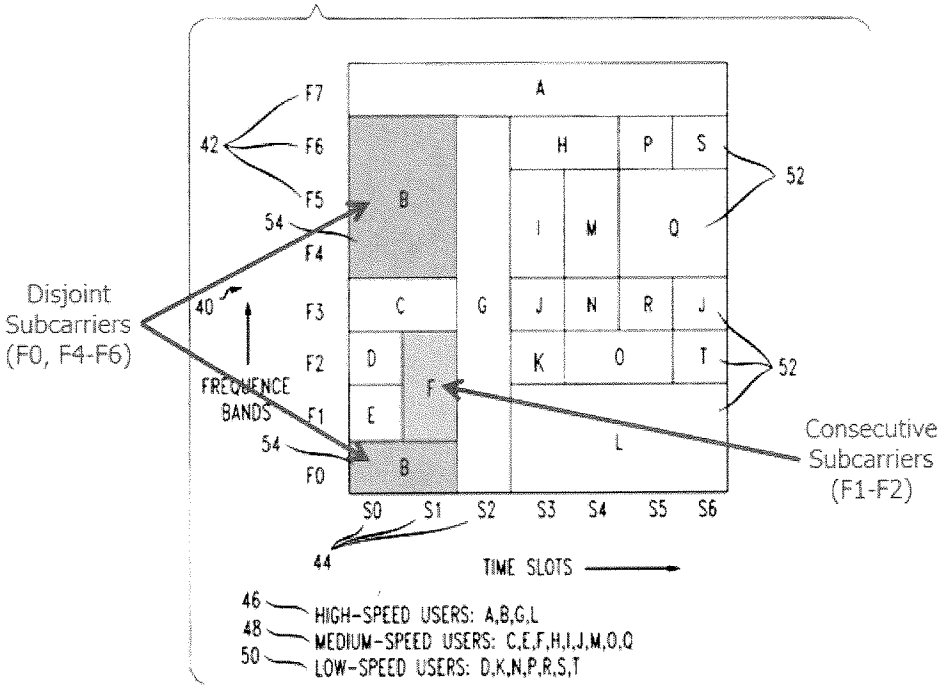
from claim 25, which depends from claim 1. All of these claims recite some variation of subcarrier allocation wherein either the individual subcarriers or the groups of subcarriers are not adjacent. For example, claims 3 and 19 requires at least one subcarrier to be "non-contiguous" with another subcarrier; claims 4 and 20 require at least two "subcarriers being disjoint"; claims 6 and 22 require "receipt of a diversity cluster"; and claims 10 and 26 require "at least one group of clusters is disjoint from at least one other cluster…to obtain frequency diversity." In addition to disclosing all the limitations of the parent claims, in my opinion, the combination of Ritter, Gesbert, Thoumy, and Gitlin discloses all the limitations of claims 3, 4, 6, 10, 19, 20, 22, and 26.

116. Ritter teaches a subscriber unit receiving a first allocation of OFDMA subcarriers. For example, "**[t]*he base station***, BS, evaluates all information received from the mobile stations, MS, and ***assigns each mobile station a segment for the respective communication link depending on the evaluation. The base station sends the mobile station information about the assigned segment.***" Ex. 1004, Ritter at 14.

117. Regarding claims 3 and 19, to the extent the Patent Owner argues that Ritter fails to describe allocating "non-contiguous" subcarriers, Gitlin teaches subcarrier allocation where some subcarriers of an allocation are non-contiguous with other subcarriers of the same allocation: "FIG. 6 thus depicts a variation of the time-frequency slicing method of the invention where ***noncontiguous frequency***

arrangements may be employed. For instance, higher-speed users 46 operating on multi-tone modulation may benefit from ***non-contiguous frequency arrangements***." Ex. 1006, Gitlin at 5:47-51; *see also id.* at 3:5-12. Figure 6 of Gitlin (shown below) best illustrates this disclosure (annotation in red added).

FIG. 6



Gitlin – Figure 6

118. The frequency units in Gitlin Fig. 6 are generic and the smallest frequency cluster may include multiple subcarriers. For example, frequency bands F0, F4, F5, and F6 of Gitlin may each comprise a plurality of frequencies (*i.e.*, subcarriers). As seen above, Figure 6 of Gitlin shows an allocation of frequency bands, *i.e.,* clusters of subcarriers, to High-Speed User B [54] that includes

frequency bands F0 and F4-F6. Accordingly, User B's allocation of F0 and F4-F6 is a non-contiguous allocation.

119. Further, as it pertains to claims 10 and 26, the frequency bands allocated to User B are also disjoint. The specification of the '375 Patent describes disjoint as being the opposite of consecutive. Ex. 1001, '375 Patent at 5:22-23 ("A cluster can contain consecutive or disjoint subcarriers."). As shown in Figure 6 of Gitlin, Frequency band F0 is not consecutive with frequency bands F4-F6, and thus they are disjoint. Further, in this allocation in Gitlin Figure 6, frequency bands F0 and F4-F6 constitute a group of clusters wherein at least one cluster (F0) is disjoint from at least one other cluster (*e.g.*, F6) to obtain frequency diversity. Gitlin explains that allocating disjoint clusters may reduce the degradation from frequency-selective multipath fading. Ex. 1006, Gitlin at 6:10-16 ("These tones may be scheduled in possibly non-contiguous frequency slots within one or more time slots, as, for example, for user B in FIG. 6. In fact, it has been found that spreading the frequency allocations of a high-speed user may offer some propagation benefits (e.g., a reduction in the degradation from frequency-selective multipath fading)."). In my opinion, those of ordinary skill in the art would understand this disclosure as an example of allocating disjoint clusters to obtain frequency diversity.

120. As noted above, the '375 Patent defines a "cluster" as "a logical unit that contains at least one physical subcarrier." *Supra* IV.A.2. Accordingly, the allocation to User B shown in Figure 6 of Gitlin, also discloses a disjoint, frequency diverse, allocation of two clusters: the first cluster being frequency band F0 and the second cluster being frequency band F4-F6. Furthermore, each frequency band F0, F4, F5, and F6 are comprised of a plurality of frequencies, that is, a plurality of subcarriers. Should the term "cluster" require more than one subcarrier, because each frequency band, *e.g.,* F0, contains a plurality of frequencies or subcarriers, Figure 6 of Gitlin discloses a disjoint, frequency diverse allocation under this alternative reading of the term cluster.

121. As it pertains to claims 6 and 22, the '375 Patent describes a diversity cluster as "a cluster containing multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum." *See supra* IV.A.3. Gitlin discloses an allocation of OFDMA subcarriers that satisfies this requirement. Figure 6 of Gitlin shows an allocation of frequency bands F0 and F4-F6 to User B. In this allocation, the subcarriers in frequency bands F0 and F4-F6 are spread far apart over the frequency spectrum (which comprises frequency bands F0-F7). Ex. 1006, Gitlin at 5:47-51, Fig. 6.

122. Regarding claims 4 and 20, these claims require a "cluster identifier." Claims 14 and 30 require a group identifier and are discussed above with respect to

the Ritter-Gesbert-Thoumy combination. *Supra* VI.F.5. As discussed with respect to claims 14 and 30, Ritter teaches a subscriber unit receiving allocations of OFDMA subcarriers that include a cluster identifier. Ritter describes the base station assigning segments of subcarriers, where the segments (clusters) are identified as Sx, Sa, and Sm. Ex. 1004 at 14, 19-20 ("the base station, BS, assigns the segments, Sx, Sa and Sm . . . [I]nformation about the allocated segments, Sx, Sa, Sm is sent via the radio interface to the mobile stations"). Sx, Sa, and Sm each constitutes a cluster identifier that identifies a plurality of subcarriers in a time slot, as recited in claims 4 and 20. Figure 6 of Gitlin teaches allocations wherein some subcarriers of an allocation are disjoint from other subcarriers, both within the same time slot and across two different time slots (e.g., User B is allocated disjoint frequency bands F0 and F6 in time slots S0 and S1), as explained above.

123. Accordingly, claims 3, 4, 6, 10, 19, 20, 22, and 26 are obvious in view of the combination of Ritter, Thoumy, Gesbert and Gitlin.

2. <u>Claims 13 and 29:</u> "wherein the receiving of the first allocation of the at least one group of clusters includes an indication of space between each cluster of the first allocation of the at least one group of clusters"

124. Claim 13 depends from claim 9 (which depends from claim 1) and claim 29 depends from claim 25, which depends from claim 17. In addition to disclosing the limitations of claims 1, 9, 17, and 25, in my opinion, Gitlin discloses "an indication of space between each cluster." As noted above, Gitlin discloses an

allocation of frequency bands (group of clusters) for User B of F0 (a first cluster) and F4-F6 (a second cluster). Ex. 1006, Gitlin at Fig. 6. Gitlin also discloses an indication of space between each of the clusters, *i.e.*, the space of unallocated frequency bands F1-F3. *Id.* at Fig. 6. Accordingly, the combination of Ritter, Thoumy, Gesbert, and Gitlin discloses the limitations of claims 13 and 29. It would have been obvious to combine Gitlin with Ritter, Thoumy, and Gesbert, for all the reasons previously stated.

3. Claims 7 and 23: "wherein the at least one diversity cluster includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel"

Claims 11 and 27: "wherein disjoint clusters of the first allocation of the at least one group of clusters are spread farther apart than a coherence bandwidth of a respective channel"

125. Claim 7 depends from claim 6, which depends from claim 1; claim 11 depends from 10, which depends from claim 9, which depends from claim 1; claim 23 depends from 22, which depends from claim 17; and claim 27 depends from claim 26, which depends from claim 25, which depends from claim 17. All of claims 7, 11, 23, and 27 require an allocation of subcarriers or clusters that are spread farther apart than a coherence bandwidth of a respective channel. The '375 Patent describes "a coherence bandwidth" as "the bandwidth within which the channel response remains roughly the same." Ex. 1001, '375 Patent at 11:55-57; *supra* IV.A.5.

126. As discussed above, Gitlin teaches allocation of a diversity cluster of subcarriers to User B comprising frequency bands F0 and F4-F6, where each set of subcarriers is at the band edge. Ex. 1006, Gitlin at 5:47-51 and Fig. 6. In my opinion, one of ordinary skill in the art would understand that this arrangement is a diversity cluster, and that the subcarriers of frequency band F0 and the subcarriers of frequency band F6 are spread farther apart than the coherence bandwidth. S*ee also* Ex. 1019, Theodore Rappaport, "Wireless Communications: Principles & Practice (1995) at 335 ("Frequency diversity transmits information on more than one carrier frequency. The rationale of this technique is that frequencies separated by more than the coherence bandwidth will not experience the same fades."). Thus, Gitlin discloses the limitations of 7, 11, 23, and 27.

127. Accordingly, claims 7, 11, 23, and 27 are obvious in view of the combination of Ritter, Gesbert, Thoumy, and Gitlin.

4. <u>Claims 5 and 21</u>: "wherein at least one subcarrier of the first plurality of subcarriers in the first time slot is different than all of the subcarriers of the second plurality of subcarriers in the second time slot"

128. Claim 5 depends from claim 4 (which depends from claims 3 and 1) and claim 21 depends from claim 20 (which depends from claims 19 and 17). In addition to disclosing all the limitations of claims 4 and 20, in my opinion, the combination of Ritter, Gesbert, Thoumy and Gitlin discloses that at least one

subcarrier of the first plurality of subcarriers is different from all of the subcarriers of the second plurality of subcarriers.

129. In my opinion, one of ordinary skill in the art would understand from Gitlin that a user could be allocated one frequency band in the first time slot and a different frequency band in the second time slot (*e.g.*, frequency band F1 in time slot S1 and frequency band F2 in time slot S2). Ex. 1006, Gitlin at 5:8-10; Figure 6. In such an allocation, the subcarriers allocated in the first time slot are different from all of the subcarriers allocated in the second time slot. Additionally, Thoumy discloses that the given number of subcarriers allocated in a time slot can be less than the number that was previously allocated. Ex. 1007, Thoumy at 11:61-64 ("The given number of carriers to be allocated to said at least one communication channel between the base station and the peripheral station can also be less than that allocated previously to this communication channel."). In this example from Thoumy, at least one subcarrier allocated in the first time slot would not be allocated in the second time slot and therefore would be different from all of the subcarriers allocated in the second time slot, as claims 5 and 21 require. Accordingly, the combination of Ritter, Gesbert, Thoumy, and Gitlin renders claims 5 and 21 obvious.

H. Thoumy in View of Gesbert Renders Claims 1, 9, 15-17, 25, 31, and 32 Obvious Under 35 U.S.C. § 103(a)

1. Independent claims 1 and 17

130. In my opinion, one of ordinary skill in the art would understand that Thoumy combined with Gesbert renders obvious claims 1 and 17 under 35 U.S.C. 103(a). Claim 1, a method claim, and claim 17, an apparatus claim, contain nearly identical limitations. Accordingly, I will treat claims 1 and 17 together in the below ground. Claim 17 additionally requires a processor in the subscriber unit to perform the recited steps. Thoumy discloses a processor for executing the steps described in his patent. Ex. 1007, Thoumy at 14:32-34 ("a micro-processor holding instructions of a computer program, wherein it permits implementation of the process according to the invention").

131. Table 4, below, shows which references are being relied on for disclosing the various elements of claim 1 (and by extension, claim 17). Reliance on a particular reference for disclosing a claim element in Table 4 does not mean that other references do not also disclose that claim element.

Table 4 – Thoumy and Gesbert v. Claim 1

Claim 1	Thoumy	Gesbert
A method for/subscriber unit in a wireless system employing orthogonal frequency division multiple access (OFDMA), the method comprising:	X	
measuring/measure, at a first time by a subscriber unit, a first channel information for a plurality of subcarriers . . .	X	
based on a first plurality of pilot symbols received from a	X	X

base station;		
providing, by the subscriber unit,/provide a first feedback information relating to a plurality of feedback clusters based on at least the measuring of the first channel information for the plurality of subcarriers based on the first plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters being at least two subcarriers,	X	
the first feedback information relating to the plurality of feedback clusters based on the first plurality of pilot symbols includes an index corresponding to a first modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;		X
receiving, by the subscriber unit,/receive a first allocation of OFDMA subcarriers based on at least the providing of the first feedback information selected by the base station for use by the subscriber unit,	X	
the first allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the first allocation of OFDMA subcarriers;	X	
measuring/measure, at a second time by a subscriber unit, a second channel information for the plurality of subcarriers . . .	X	
based on a second plurality of pilot symbols received from a base station;	X	X
providing, by the subscriber unit,/provide a second feedback information relating to the plurality of feedback clusters based on at least the measuring of the second channel information for the plurality of subcarriers based on the second plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters being at least two subcarriers,	X	
the second feedback information relating to the plurality of feedback clusters based on the second plurality of pilot symbols includes an index corresponding to a second modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;		X
receiving, by the subscriber unit,/receive a second allocation of OFDMA subcarriers based on at least the providing of the second feedback information selected by	X	

the base station for use by the subscriber unit,		
the second allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the second allocation of OFDMA subcarriers,	X	
the second allocation of OFDMA subcarriers being different from the first allocation of OFDMA subcarriers, the first and second allocations of OFDMA subcarriers being received by the subscriber unit at two different times.	X	X

(a) *The preamble*

132. Thoumy discloses a method of operating an OFDMA wireless system. For example, Thoumy discloses that his "invention concerns the allocation of carrier frequencies for transmission systems using multi-carrier type modulation." Ex. 1007, Thoumy at 1:11-13; 15:17-19 ("FIG. 14 is a general view of a network according to the invention including a base station SIB [sic] and several peripheral stations SPi"), Fig. 14. And, "one particular case is Orthogonal Frequency Division Multiplex, or OFDM." *Id.* at 1:37-38; *see also id.* at 9:24-28.

(b) *Limitation (a)*

133. Thoumy teaches an OFDMA system that includes subscriber stations repeatedly performing channel quality measurements. For example, Thoumy describes, "[T]he device also has: a post-demodulator means including: ***a means of extracting, from the signal issuing from the demodulator, an FCD signal representing the transmission quality observed by the remote device B on each subcarrier*** in the "outward" direction A→B, said signal being generated by the remote device B." Ex.

1007, Thoumy at 6:33-39; *see also id.* at 5:14-20, 5:56-61. Thoumy also acknowledges that pilot symbols or signals are known to persons of skill in the art for measuring channel quality. *Id.* at 18:6-9 ("There are several analysis techniques (***pilot signals*** at fixed frequencies, at frequencies sliding in time, etc.) known to persons skilled in the art."). As noted above, the term "pilot symbols" should be construed to mean "symbols, sequences, or signals known to both the base station and subscriber."

134. Thoumy's remote device B provides a FCD signal that represents the characteristics of the channel observed by the remote device. Ex. 1007, Thoumy at 18:21-23. FCD refers to a frequency classification extraction unit 210. *Id.* at 17:61-63. Thoumy teaches the use of pilot symbols to perform channel characteristics analysis and also explains that pilot symbols are known to those skilled in the art. *Id.* at 18:6-9. Accordingly, one of ordinary skill in the art would understand that Thoumy is describing performing channel quality measurements at the remote device B using pilot symbols from the base station A.

135. To the extent the Patent Owner argues Thoumy does not specifically disclose the subscriber monitoring pilot symbols from a base station, as discussed above with respect to Ground 1, in my opinion, Gesbert teaches the subscriber making OFDMA subcarrier quality measurements based on training signals (known to both the subscriber and base station) received from the base station. For example, "FIG. 5 indicates that ***training is performed on all tones during an OFDM training symbol***, it

will be clear to a person skilled in the art that a subset of these tones could be used for training and the corresponding frequency response could be computed at the receiver by interpolating." Ex. 1005, Gesbert at 7:16-20; *see also id.* at 8:13-34, 7:57-59.

136. In my opinion, it would have been obvious to modify the OFDMA system of Thoumy to measure channel quality using pilot symbols, as in Gesbert, based on: "the substitution of one known element for another yields predictable results to one of ordinary skill in the art." *In re ICON Health & Fitness, Inc.,* 496 F.3d 1374 (Fed. Cir. 2007); M.P.E.P. § 2143(I)(B). One of ordinary skill in the art would recognize that training tones are necessarily known to both the base station and subscriber, and that training tones were well known by those of skill in the art. It would be obvious for one of ordinary skill to combine the training tones and subscriber measurements of Gesbert with Thoumy's channel quality measurement techniques. Pilot symbols were well known in the art and their use for channel quality measurements was a simple design choice from among many possible alternatives. The '375 Patent itself disclosed that this technique was well known in the art. Ex. 1001, '375 Patent at 9:14-17 ("***The channel/interference estimation*** by processing block 301 ***is well-known in the art by monitoring the interference that is generated due to full-bandwidth pilot symbols*** being simultaneously broadcast in multiple cells."). Because both Thoumy and Gesbert disclose subscriber units measuring channel quality, and also teach pilot symbols transmitted from the

subscriber unit (Ex. 1007, Thoumy at 18:6-9 (also acknowledging the use of pilot symbols for channel quality measurements)), the pilot symbol-based measurements disclosed in Gesbert could easily be added to the channel quality measurement functionality of Thoumy. Such a modification would have yielded predictable results without requiring undue experimentation. Further, as is evident from the descriptions above, both Thoumy and Gesbert are in the same field of endeavor as the '375 Patent and are each therefore analogous to the '375 Patent. Accordingly, the combination of Thoumy and Gesbert teaches this limitation.

(c) ***Limitation (b)***

137. Thoumy teaches an OFDMA system that includes subscriber units repeatedly performing channel quality measurements and transmitting those measurements back to the base station. For example, "the device also has: a post-demodulator means including: a means of extracting, from the signal issuing from the demodulator, an FCD signal ***representing the transmission quality observed by the remote device B on each subcarrier in the "outward" direction A→B,*** said signal being generated by the remote device B." Ex. 1007, Thoumy at 6:33-39. Further, "[t]he FCD extractor unit 210 extracts, from the data received and demodulated by the demodulator 70, an FCD signal 230, a signal generated and inserted by the channel analysis unit 220 and data insertion control unit 115 of the remote device B. ***This FCD signal 230 represents the characteristics of the***

channel in the direction A→B, as observed by the remote device B." *Id.* at 18:18-23; *see also id.* at 19:40-50. Accordingly, Thoumy discloses the subscriber unit providing feedback on all subcarriers, which means Thoumy necessarily discloses providing feedback of channel quality on a plurality of feedback clusters, where each feedback cluster includes at least two subcarriers.

138. To the extent the Patent Owner argues that Thoumy does not explicitly disclose "an index corresponding to a first modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters," it would have been obvious to those of ordinary skill in the art to include in the feedback an index corresponding to a modulation and coding rate, as described in Gesbert. *See supra* VI.F.1.c.

139. For example, Gesbert discloses that receive units (*i.e.*, subscriber units) transmit an index indicating a modulation and coding rate to the transmit unit (*i.e.*, base station). Ex. 1005, Gesbert at 10:17-22. Gesbert further teaches that "***[t]he modes are indexed by a mode number so as to conveniently identify the modulation and coding rates*** which are to be applied to data 52 in each mode." *Id.* at 6:37-39.

TABLE 1

Mode	Modulation Rate (bits/symbol)	Coding Rate	Throughput (bits/s/Hz)
1	2	3/4	3/2
2	2	2/3	4/3
3	2	1/2	1
4	2	1/3	2/3
5	4	3/4	3
6	4	2/3	8/3
7	4	1/2	2
8	4	1/3	4/3
9	5	3/4	15/4
10	5	2/3	10/3
11	5	1/2	5/2
12	5	1/3	5/3
13	6	3/4	9/2
14	6	2/3	4
15	6	1/2	3
16	6	1/3	2

140. Table 1 from Gesbert shows the mode indices and corresponding modulation and coding rates. According to Gesbert, "***[t]able 1 illustrates some typical modes with their modulation rates and coding rates*** and the corresponding throughputs for data 52." *Id.* at 6:35-37; *see also id.* at 4:30-32 ("The system also has a ***feedback mechanism for communicating the subsequent mode from the receive unit to the transmit unit.***"); *id.* at 4:60-62 ("transmit unit 12 is a Base Transceiver Station (BTS) and a receive unit 14 is a mobile or stationary wireless user device").

141. Like Thoumy and the '375 Patent, Gesbert teaches an OFDMA system in which subscriber units (*e.g.*, handsets) measure the quality of a wireless channel and

provide feedback to the base station based on those measurements. *Compare* Ex. 1005, Gesbert at 2:61-65 ("***One or more quality parameters are sampled*** in the data received ***by the receive unit. Then, a*** first-order statistical parameter and a second-order statistical parameter of the ***quality parameter*** are computed and ***used for selecting a subsequent mode for encoding the data.***"), 4:30-32 ("The system also has a ***feedback mechanism for communicating the subsequent mode from the receive unit to the transmit unit.***"), *with* Ex. 1007, Thoumy at 18:18-23 ("[t]he FCD extractor unit 210 extracts, from the data received and demodulated by the demodulator 70, an FCD signal 230, a signal generated and inserted by the channel analysis unit 220 and data insertion control unit 115 of the remote device B. ***This FCD signal 230 represents the characteristics of the channel in the direction A→B, as observed by the remote device B.***").

142. In my opinion, it would have been obvious to one of ordinary skill in the art to modify Thoumy to provide an indication of a modulation and coding rate in conjunction with the channel characteristics, as in Gesbert, based on: "application of a known technique to a piece of prior art ready for the improvement" to "yield predictable results." *KSR*, 550 U.S. at 401 (2007).

143. **Base system**: Thoumy discloses the subscriber unit providing channel quality information on feedback clusters to the base station. *See, e.g.*, Ex. 1007, Thoumy at 18:18-23.

144. **Known technique**: Gesbert discloses communicating an index corresponding to a modulation and coding rate associated with each feedback cluster. *See, e.g.*, Ex. 1005, Gesbert at 3:38-51, 6:35-42, 9:66-10-44, 11:9-24, Figs. 3-4.

145. **Predictable results and improved system**: As both Gesbert and Thoumy teach techniques for implementing an OFDMA system, it would be obvious for one of skill in the art to take Gesbert's index of modulation and coding rate and combine it with Thoumy's system. Thoumy is concerned with continually monitoring channel quality and adjusting modulation and coding based on channel quality. Gesbert teaches an index for easily transmitting to the base station an indication of modulation and coding rate based on signal measurements performed by the subscriber.

146. A person having ordinary skill in the art would have been motivated to combine Gesbert's well-understood technique of using an index corresponding to a modulation and coding rate with the teachings of Thoumy in order to maximize network resources and optimally provide feedback information to a base station relating to subcarrier selection. Such a modification would have yielded predictable results without requiring undue experimentation. *See KSR*, 550 U.S. at 416. Therefore, it would have been obvious to one of ordinary skill in the art to modify Thoumy's OFDMA system to provide an index corresponding to a

modulation and coding rate in conjunction with the channel quality measurements, as in Gesbert. Accordingly, the combination of Thoumy and Gesbert teaches this limitation.

(d) *Limitation (c)*

147. Thoumy teaches a subscriber unit receiving (1) a first allocation of OFDMA subcarriers and (2) a modulation and coding rate for those subcarriers, both selected by the base station based on feedback information from the subscriber unit. For example, "the device proposed in this document ***allocates a group of given carriers to each of the sources and selects an appropriate modulation type and coding efficiency for each of the groups.***" Ex. 1007, Thoumy at 9:31-34; *see also id.* at 10:6-22. Further, "[t]he method proposes, ***for a given group of carriers of an OFDM symbol, to select a type of modulation and a coding efficiency which are appropriate according to the interference affecting the communication channel and the protection level required.***" *Id.* at 9:24-28. And, "[t]he determination means 2174 determines the number of carriers and the modulation adapted to a service quality request, with a view to their allocation to the radio communication channel allocated to the relevant information transmission. These determination means 2174 communicate with the information sending unit 2070 in order to transmit to the peripheral station 1402 the transmission parameters ***which are the number of carriers and the modulation.***" *Id.* at 30:8-15; *see also id.* at 31:8-22, 31:66-32:9. Accordingly, Thoumy discloses the subscriber unit receiving both (1) an allocation

of subcarriers based on the feedback provided by the subscriber unit and (2) an indication of the modulation and coding rate for the allocation of subcarriers.

(e) *Limitation (d)*

148. Thoumy discloses repeatedly monitoring channel conditions, including using pilot symbols to make those channel condition measurements. For example, "[a]ccording to the results of measurements of the noise level and the quality of reception of the OFDM symbols transmitted over the communication channel, the base station decides to replace some of the carriers which, for example, give rise to data transmissions affected by an excessively high error rate, with other carriers less affected by noise." Ex. 1007, Thoumy at 9:53-59. And, "[t]he invention makes provision for adapting, to each required service quality which, as has just been seen, can be very different from one information transmission to another, a given pair consisting of a number of carriers and a modulation." *Id.* at 30:46-50; *see also id.* at 10:60-67; *id.* at 13:10-22; *id.* at 32:51-65. To the extent the Patent Owner argues Thoumy does not explicitly disclose pilot symbols, as argued above regarding limitation (a), Gesbert teaches this limitation.

(f) *Limitation (e)*

149. The combination of Thoumy and Gesbert discloses the subscriber repeatedly submitting (1) feedback information related to the channel conditions for a plurality of feedback clusters and (2) an index for a modulation and coding rate. For example, Gesbert discloses that "[o]nce mode selection block 112 determines which

modes should be used for each of the k streams, these subsequent modes are fed back to transmit unit 50 and applied to the k streams. ***This operation repeats itself***, and each new selection of subsequent modes is fed back to transmit unit 50 ***to thus account for the changing conditions of channel 22***." Ex. 1005, Gesbert at 11:20-25; *see also id.* at 1:30-33. Thoumy describes "the method according to the invention includes a step of carrying out at least one measurement of the transmission error rate on the radio communication channel allocated to the information transmission in question. Advantageously, the result of this measurement supplies information on the actual conditions of the current transmission and therefore makes it possible to reconfigure the number of carriers and the modulation allocated to this transmission where the required service quality is not met. ***The actual conditions of the current transmission can therefore be monitored continuously and the number of carriers and the modulations adapted accordingly***." Ex. 1007, Thoumy at 13:10-22; *see also id.* at 30:46-50. Accordingly, the combination of Thoumy and Gesbert discloses this limitation.

(g) *Limitation (f)*

150. Thoumy discloses adaptively allocating OFDMA subcarriers and modulation and coding rates based on updated feedback from the subscriber unit. For example, "According to the results of measurements of the noise level and the quality of reception of the OFDM symbols transmitted over the communication channel, the base station ***decides to replace some of the carriers which, for example, give rise to data***

transmissions affected by an excessively high error rate, with other carriers less affected by noise." Ex. 1007, Thoumy at 9:53-59. Additionally, Thoumy discloses that the second, updated allocation can have a different allocation as a prior allocation. *Id.* at 11:35-39 ("[T]he method includes ***a step of determining a number of carriers to be allocated which is different from that which was previously allocated to said at least one communication channel between the base station and the peripheral station.***"); *see also id.* at 11:39-52. Thoumy also describes adaptively reconfiguring the modulation based on current transmission conditions. *Id.* at 13:15-22 ("Advantageously, the result of this measurement supplies information on the actual conditions of the current transmission and therefore ***makes it possible to reconfigure the number of carriers and the modulation allocated to this transmission where the required service quality is not met. The actual conditions of the current transmission can therefore be monitored continuously and the number of carriers and the modulations adapted accordingly***.").

151. Thoumy teaches first and second allocations of OFDMA subcarriers that are different. Ex. 1007, Thoumy at 11:35-44 ("[T]he method includes a step of determining a number of carriers to be allocated ***which is different from that which was previously allocated*** to said at least one communication channel between the base station and the peripheral station ... for example in order to guarantee a required service quality...."). Accordingly, Thoumy teaches this limitation, and the combination of Thoumy and Gesbert teach all the limitations of claims 1 and 17.

2. Claims 9 and 25

152. In addition to disclosing all the limitations of claims 1 and 17, in my opinion, the combination of Thoumy and Gesbert discloses receiving a first allocation of at least one group of clusters selected by the base station for use by the subscriber unit. As discussed above with respect to claim 1, limitation (c), Thoumy discloses receiving an allocation of at least one group of clusters selected by the base station. *Id.* at 9:31-34 ("[T]he device proposed in this document ***allocates a group of given carriers to each of the sources and selects an appropriate modulation type and coding efficiency for each of the groups.***"). Accordingly, Thoumy discloses this limitation and claims 9 and 25 are obvious in view of the combination of Thoumy and Gesbert.

3. Claims 15 and 31

153. In addition to disclosing all the limitations of claims 1 and 17, the combination of Thoumy and Gesbert discloses measuring channel information for all available clusters allocable by the base station. As discussed above with respect to claim element (a) of claim 1, Thoumy discloses measuring channel information for all available clusters allocable by the base station. *See id.* at 6:37-38 ("signal representing the transmission quality observed by the remote device B ***on each subcarrier***"). Accordingly, Thoumy discloses this limitation and claims 15 and 31

would have been obvious to those of ordinary skill in the art in view of the combination of Thoumy and Gesbert.

4. Claims 16 and 32

154. In addition to disclosing all the limitations of claims 1 and 17, the combination of Thoumy and Gesbert discloses providing feedback relating to all of the plurality of feedback clusters. As discussed above with respect to claim element (b), claim 1, Thoumy discloses providing first feedback information relating to all of the subcarriers. *See id.* at 6:37-38 ("signal representing the transmission quality observed by the remote device B ***on each subcarrier***"). Accordingly, Thoumy discloses this limitation and claims 16 and 32 would have been obvious to those of ordinary skill in the art in view of the combination of Thoumy and Gesbert.

I. Thoumy in View of Gesbert and Gitlin Renders Claims 3, 6-8, 10-13, 19, 22-23, and 26-29 Obvious Under 35 U.S.C. § 103(a)

155. Table 5, below, shows which references are being relied on for disclosing the various elements of claims 3, 6-8, and 10-13 (and by extension, claims 19, 22-23, and 26-29). Reliance on a particular reference for disclosing a claim element in Table 5 does not mean that other references do not also disclose that claim element.

Table 5 – Thoumy, Gesbert, and Gitlin v. claims 3, 6-8, and 10-13

Claim	Thoumy	Gesbert	Gitlin

[The method of claim 1]	X	X	
3. The method of claim 1, wherein at least one subcarrier of the first allocation of OFDMA subcarriers is non-contiguous with other subcarriers of the first allocation of OFDMA subcarriers.			X
6. The method of claim 1, wherein the receiving of the first allocation of OFDMA subcarriers is receiving a first allocation of at least one diversity cluster.			X
7. The method of claim 6, wherein the at least one diversity cluster includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel.			X
8. The method of claim 1, wherein the receiving of the first allocation of OFDMA subcarriers is receiving a first allocation of at least one coherence cluster			X
10. The method of claim 9, wherein at least one cluster of the first allocation of the at least one group of clusters is disjoint from at least one other cluster of the first allocation of the at least one group of clusters to obtain frequency diversity.	X [claim 9]	X [claim 9]	X
11. The method of claim 10, wherein disjoint clusters of the first allocation of the at least one group of clusters are spread farther apart than a coherence bandwidth of a respective channel.			X
12. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes consecutive clusters.	X [claim 9]	X [claim 9]	X
13. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes an indication of space between each cluster of the first allocation of the at least one group of clusters.	X [claim 9]	X [claim 9]	X

156. Gitlin is directed to "a system and method for maximizing usage of a communications transmission medium while preserving optimum access to the medium for users of differing access speeds and while maximizing spectral use and bandwidth efficiencies." Ex. 1006, Gitlin Patent at 1:9-12. Gitlin describes a "multi-tone" system, which is another way to describe an OFDM system. *Id.* at 5:35-41. Gitlin also describes a system with multiple users. *Id.* at 1:6-12. Thus, in my opinion, Gitlin describes an OFDMA system. As discussed above (*see supra* VI.G), in my opinion, a person of ordinary skill in the art at the relevant time would have been motivated to combine the teachings of Gitlin with other wireless, OFDMA references or systems, such as Thoumy and Gesbert. Gitlin is relied upon below for teaching allocation of consecutive and non-consecutive clusters.

1. Claims 3, 6, 10, 19, 22, and 26

157. All of these claims recite some variation of subcarrier allocation wherein either the individual subcarriers or the groups of subcarriers are not adjacent. For example, claims 3 and 19 require at least one subcarrier to be "non-contiguous"; claims 6 and 22 require "receipt of a diversity cluster"; and claims 10 and 26 require "at least one group of clusters is disjoint from at least one other cluster…to obtain frequency diversity." In addition to disclosing all the limitations

of the parent claims, in my opinion, the combination of Thoumy, Gesbert, and Gitlin discloses all the limitations of claims 3, 6, 10, 19, and 26.

158. Regarding claims 3 and 19, Gitlin teaches subcarrier allocation where some subcarriers of an allocation are non-contiguous with other subcarriers of the same allocation, as previously discussed above. *See supra* VI.G.1. Similarly, regarding claims 6 and 22, Gitlin teaches receipt of a "disjoint cluster." *Id.* Finally, Gitlin discloses allocating at least one group of clusters that is disjoint from at least one other cluster to obtain "frequency diversity," as previously discussed. *Id.* Accordingly, claims 3, 6, 10, 19, and 26 are obvious in view of the combination of Thoumy, Gesbert and Gitlin.

2. Claims 13 and 29

159. In addition to disclosing the limitations of claims 1, 9, 17, and 25, Gitlin discloses "an indication of space between each cluster," as discussed previously. *Supra* VI.G.2. Accordingly, the combination of Thoumy, Gesbert, and Gitlin discloses the limitations of claims 13 and 29.

3. Claims 7 and 23 and Claims 11 and 27

160. All of claims 7, 11, 23, and 27 require an allocation of subcarriers or clusters that are spread farther apart than a coherence bandwidth of a respective channel. As previously discussed, Gitlin discloses the additional limitations of

claims 7, 11, 23, and 27. *See supra* VI.G.3. Accordingly, claims 7, 11, 23, and 27 are obvious in view of the combination of Thoumy, Gesbert, and Gitlin.

4. Claims 8 and 24 and Claims 12 and 28

161. In addition to disclosing the limitations of claims 1, 9, 17, and 25, the combination of Thoumy, Gesbert, and Gitlin discloses consecutive clusters and coherence cluster recited in claims 8, 12, 24, and 28. As discussed above, the '375 Patent describes a coherence cluster as "a cluster containing multiple subcarriers close to each other." *See supra* IV.A.4.

162. Gitlin discloses allocating frequency bands comprising contiguous subcarriers. For example, Gitlin discloses that "[o]ftentimes, it is advantageous that high-speed users 46 be assigned contiguous frequencies 42. Such contiguous assignments eliminate the need for guard bands between the frequencies assigned to a given user." Ex. 1006, Gitlin at 5:31-35. Figure 6 of Gitlin shows an example of allocating to User F contiguous frequency bands F1 and F2. *Id.* at Fig. 6. The contiguous subcarriers in each frequency band allocated in Gitlin constitute a "coherence cluster." Accordingly, the combination of Thoumy, Gesbert, and Gitlin renders claims 8 and 24 obvious.

163. Regarding claims 12 and 28, Gitlin teaches allocating consecutive clusters of subcarriers with respect to an OFDMA system. For example, "Oftentimes, it is advantageous that high-speed users 46 be assigned ***contiguous***

frequencies 42. Such ***contiguous assignments eliminate the need for guard bands between the frequencies assigned to a given user***." Ex. 1006, Gitlin at 5:31-35. Accordingly, Gitlin teaches allocation of contiguous frequency subcarriers, *i.e.*, consecutive clusters. Because all three of Gitlin, Thoumy, and Gesbert disclose techniques for implementing and using OFDMA systems, it would have been obvious for one of ordinary skill in the art to apply Gitlin's disclosure of allocating contiguous frequency subcarriers to the subcarrier allocation schemes described in Gesbert and Thoumy. Accordingly, the combination of Thoumy, Gesbert, and Gitlin disclose the features of claims 12 and 28.

J. Thoumy in View of Gesbert and Ritter Renders Claims 2, 14, 18, and 30 Obvious Under 35 U.S.C. § 103(a)

164. Table 6, shown below, shows which references are being relied on for disclosing the various elements of claims 2 and 14 (and by extension, claims 18 and 30). Reliance on a particular reference for disclosing a claim element in Table 6 does not mean that other references do not also disclose that claim element.

Table 6 – Thoumy, Gesbert, and Ritter v. claims 2 and 14

Claim	Thoumy	Gesbert	Ritter
[The method of claim 1]	X	X	
2. The method of claim 1, wherein the plurality of feedback clusters at the second time is different than the plurality of feedback clusters at the first time.			X
14. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes	X [claim 9]	X [claim 9]	X

receiving a group identifier that identifies one group of the first allocation of the at least one group of clusters.			

1. Claims 2 and 18

165. In addition to disclosing all the limitations of claims 1 and 17, the combination of Ritter, Gesbert, and Thoumy discloses that the plurality of feedback clusters at the second time is different than the plurality of feedback clusters at the first time, as discussed above. *Supra* VI.F.2. Accordingly, claims 2 and 18 are obvious in view of Thoumy, Gesbert, and Ritter.

2. Claims 14 and 30

166. In addition to disclosing the limitations of claims 1, 9, 17, and 25, the combination of Ritter, Gesbert, and Thoumy discloses receiving a group identifier, as previously discussed. *See supra* VI.F.5. Accordingly, claims 14 and 30 are obvious in view of Ritter, Gesbert, and Thoumy.

167. For at least these reasons, claims 2, 14, 18, and 30 of the '375 Patent should be rejected and cancelled under § 103(a) as being obvious over Thoumy in view of Gesbert and Ritter.

K. Thoumy in View of Gesbert, Ritter, and Gitlin Renders Claims 4, 5, 20, and 21 Obvious Under 35 U.S.C. § 103(a)

168. Table 7, shown below, shows which references are being relied on for disclosing the various elements of claim 4 and 5 (and by extension, claims 20 and

21). Reliance on a particular reference for disclosing a claim element in Table 7 does not mean that other references do not also disclose that claim element.

Table 7 – Thoumy, Gesbert, Ritter, and Gitlin v. claims 4 and 5

Claim	Thoumy	Gesbert	Ritter	Gitlin
[The method of claim 3]	X	X	X	
4. The method of claim 3, wherein the first allocation of OFDMA subcarriers includes a cluster identifier that identifies a first plurality of subcarriers in a first time slot and a second plurality of subcarriers in a second time slot, at least two subcarriers of the first plurality of subcarriers and of the second plurality of subcarriers being disjoint.				X
5. The method of claim 4, wherein at least one subcarrier of the first plurality of subcarriers in the first time slot is different than all of the subcarriers of the second plurality of subcarriers in the second time slot	X			

1. Claims 4 and 20

169. In addition to the limitations of claims 1, 3, 17, and 19, claims 4 and 20 require a cluster identifier and at least two of the "subcarriers being disjoint." As discussed above, Gitlin and Ritter disclose the additional features of claims 4 and 20. *See supra* VI.G.1. Accordingly, the combination of Thoumy, Gesbert, Gitlin, and Ritter disclose all the limitations of claims 4 and 20.

2. Claims 5 and 21

170. In addition to disclosing all the limitation of claims 4 and 20, in my opinion, the combination of Thoumy, Gesbert, Ritter, and Gitlin discloses that at least one subcarrier of the first plurality of subcarriers is different from all of the subcarriers of the second plurality of subcarriers. As previously discussed (*see supra* VI.G.4), Thoumy discloses that at least one carrier in the first plurality of subcarriers would not be in the second plurality of subcarrier and, then, that at least one subcarrier in the first plurality of subcarriers in the first time slot is different than all the subcarriers in the second plurality of subcarriers in the second time slot. Thus, Thoumy discloses the limitations of claims 5 and 21. Therefore, claims 5 and 21 are obvious in view of Thoumy, Gesbert, and Gitlin.

VII. CONCLUDING STATEMENTS

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

that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: March 29, 2016

By: Richard D. Gitlin
Richard D. Gitlin

APPENDIX A
MATERIALS CONSIDERED

All Materials Referenced in this Declaration, and other Relevant Materials, Including the Following:

Patents and Patent Applications
U.S. 8,934,375 (Li et al.) and its prosecution history
U.S. 7,454,212 (Li et al.) and its prosecution history
U.S. 6,947,748 (Li et al.)
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Textbooks
Bahai and Saltzberg, "Multi-Carrier Digital Communications Theory of Applications of OFDM" (1999)
Theodore Rappaport, "Wireless Communications: Principles & Practice" (1995)

APPENDIX B

Richard D. Gitlin

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Education

- Eng. Sc. D., Electrical Engineering, Columbia University, 1969.
- M.S., Electrical Engineering, Columbia University, 1965.
- B.E.E., The City College of New York, 1964 [with honors].

Employment [detailed accomplishments available on request]

- **March 2010-present: Founder, co-CEO, and CTO, Innovatia Medical Systems LLC** ---a medical device start up in Tampa, FL that uses advanced wireless networking technologies for robotic surgery.

- **2008-present: State of Florida 21st Century Scholar, Distinguished University Professor, and Agere Systems Chair of Electrical Engineering at the University of South Florida.**

- **2005-2008: Chief Technology Officer, Hammerhead Systems.** A Silicon Valley startup providing innovative data networking solutions for wireline, wireless, and cable service providers. Responsible for developing a product line vision, developing core technology, representing product technology and directions with customers, partners, and standards bodies, and management of intellectual property. Personal research contributions in applications-aware networking.

- **2001-2004: Vice President Technology, NEC Laboratories America**
  Responsible for research in Broadband, IP, and Mobile Networking, System LSI, Secure Systems, and Quantum IT. Initiated many systems projects in wireless networks, 4G communications, system LSI, and secure, reliable systems.

1969-2001: Bell Labs, Lucent Technologies

- **1998-2001: Senior Vice President R&D and CTO for Lucent Data and Lucent Cable BUs**
  Responsible for applied research, system architecture, standards, and network performance for IP/ATM data networking business unit. Initiatives included Bell Labs high-speed router (Packetstar), Cable Modem Termination System (CMTS), and BLAST (MIMO) commercialization.

- **1995-1998: Senior Research Vice President, Communications Sciences Research**
  Responsible for leading and managing a broad range of research programs in broadband (IP/ATM) networking, wireless communications, multimedia systems, and system LSI. Managed ~500 people in 5 research labs, in multiple locations and continents [initiated labs in The Netherlands and the UK --- the

first Bell Labs research locations outside the US]. Maintained personal research agenda in wireless and networking and significantly influenced the IS-95B (CDMA) multicode standard. I made significant personal contributions to the R&D of WiFi and CDMA systems.

- **1992-1995: Vice President, Communications Systems Research**
  Led and managed ~100 research staff lab in communications, broadband networking, and access networking. Accomplishments include pioneering BLAST [MIMO space time coding], Packetstar IP Router/Switch, Atlanta 2.5 Gbps ATM chip set, and the DoCSIS cable protocol.

- **1987-1992: Director, Network Systems Research**
  Initiated smart antenna research program, co-inventor of multicode CDMA (used in IS-95B and other standards), 20 Gbps Globeview ATM switch, LuckyNet Gigabit testbed, Diversity Coding, and Optical Equalization. Made strong personal contribution to smart antennas (today referred to as MIMO).

- **1986-1987: Director, Data Communications Research**
  Co-inventor of DSL, initiated 56K modem development, helped create Globespan (DSL spinoff that went public).

- **1969-1986: Director, Supervisor and Member of Staff in Advanced Data Communications**
  Co-inventor of the passband equalizer and made many other significant contributions to QAM systems, including scrambling, timing and carrier recovery, coded modulation, and echo cancellation. Championed the standardization and development of V.32/V.34 modems.

Expert Witness Experience: Cases where I have given a deposition or testified at trial are underline[1].

- PanOptis Wireless Technology v ZTE, U.S. District Court Eastern District of Texas, Case No. 2:15-cv-300. McKool Smith on behalf of PanOptis retained me and the contact attorney is Ramzi Khazen. The case involves three patents in the 4G LTE domain. The trial is scheduled for the week of August 1, 2016. I gave a deposition in January 2016 on a Claim Construction Declaration.
- Wi-LAN v Kyocera Communications, U.S. District Court Eastern District, Texas, Case/Reference No: 2:13-cv-202-JRG. McKool Smith on behalf of Wi-LAN retained me and the contact attorney is Brett Cooper. The case was in the 3G wireless space, and I submitted expert reports on infringement and validity and was deposed in September, 2015. Trial was scheduled for January 2016 and settled in November 2015.
- Mobile Telecommunications Technologies, LLC vs. T-Mobile, U.S. District Court Eastern District, Texas, Case/Reference No: 2:13-cv-00886. McKool Smith on behalf of T-Mobile retained me and the contact attorney is Pierre Hubert. The case is in the 3G/4G wireless space and I prepared invalidity and non-infringement expert reports and have been deposed in the case. The case was settled about 6 weeks before the scheduled trial date in May 2015.
- Cell and Network Selection LLC v. MetroPCS Communications Inc. [now T-Mobile], et al., 6:13-CV-404 (Eastern District of Texas). McKool Smith on behalf of T-Mobile retained me and the contact attorney is Brett Cooper. The case was in the 3G/4G

[1] AT&T, VZ, Sprint and T-Mobile also retained me in three other cases that are not yet disclosed.

wireless space. I prepared an expert report on non-infringement and I gave a deposition in September 2014. Trial was scheduled for March 2015. Case settled, December 2014.

- Brandywine Communications Technologies, LLC v. AT&T Corp. Case No. 6:12-cv-283-Orl-36DAB, Northern District of California. Kilpatrick Townsend & Stockton LLP retained me on behalf of AT&T, and the contact attorney is Kristopher Reed. The case was in the wireline modem (V.34 modem and DSL) domain. I prepared an expert report on non-infringement and gave deposition in March 2014. The case was settled in July 2014.
- CSIRO v. Cisco Systems, Inc. Eastern District of Texas [Tyler]. Case 6:11-CV-343. The case is in the 3G/4G wireless domain. Heim, Payne & Chorush has retained me on behalf of CSIRO, and the contact attorney is Michael Heim. The case was in the 802.11 Wireless LAN domain. I prepared an expert report on infringement, gave a deposition, and testified at the trial in February 2014.
- Ericsson v. Samsung, ITC Investigation No. 337-TA-862. The case is in the 3G and 4G wireless domains. McKool Smith, on behalf of Ericsson, retained me, and the contact attorneys are Ted Stevenson and Kevin Burgess. I gave a deposition and testified at the ITC hearing in September 2013. The parties settled before a ruling from the judge.
- Samsung v Apple, Northern District of California, San Jose Division: CV 11-02079. The case was in the 3G wireless domain (HSDPA). WilmerHale, representing Apple, retained me to work on both the invalidity and non-infringement of two Samsung patents. The WilmerHale attorneys were Peter Kolovos and Richard Goldenberg. I prepared two expert reports and I gave a deposition. Two weeks before the trial was scheduled to begin in August 2012 in the Northern District of California, Samsung withdrew the patents that they were asserting.
- Wi-LAN Inc. v. Acer, Inc., et al. Civil Action No. 2-07CV-473 and Wi-LAN v. RIM 2:08-CV-247 and Wi-LAN v. Westell 2:07-CV-474 in the Eastern District of Texas. McKool Smith representing Wi-LAN retained me. Contact attorney is Robert Cote (212) 402-9415. The case involved 3 patents covering OFDM and CDMA2000 wireless cellular and wireless LAN (802.11a/g/n) technologies, as well as DSL power management. I prepared both validity and infringement expert reports for these patents, I was deposed for two days, and I was actively involved in preparing reconsideration brief for Judge Ward (Marshall, TX) that resulted in a reversal of a critical claim construction element just two weeks before trial. The impact was substantial and resulted in the defendants (Intel, Broadcom, Atheros, and MARVELL) settling with Wi-LAN in January 2011.
- Rembrandt Data Technologies v AOL, LLC, Hewlett Packard UNITED STATES District Court for the Eastern District of Virginia- Alexandria Division, C.A. No. 1:08-cv-01009-GBL-IDD). I was retained by Jennifer Albert of Goodwin Proctor (202-346-4322) representing HP, Michael Jacobs of Crowell and Moring (202-624-2568) representing Canon, and Alex Pilmer of Kirkland and Ellis (213-680-8405) representing Direct TV. The case involved voice-band modems. I prepared two expert reports and was deposed and I expected to testify at the trial in July 2009. At the Markman hearing, the judge supported all of our claim constructions and he ruled one of the patents was invalid. Based upon these outcomes, the attorneys have told me that Rembrandt "gave up."
- Nokia v InterDigital: Certain 3G Mobile Handsets and Components Thereof, Investigation, United States International Trade Commission; I was engaged by Finnegan Henderson representing InterDigital and the contact attorney is Chris Isaac (571.203.2740). The case was in the 3G wireless

domain and was closely related to the Samsung v InterDigital case below. I prepared three expert reports and was deposed. I testified at the ITC hearing in May/June 2009.

- Samsung v InterDigital: Certain 3G Mobile Handsets and Components Thereof, Investigation No. 337-TA-613, United States International Trade Commission, Engaged by Finnegan Henderson representing InterDigital and the contact attorney was Houtan Esfahani [(202) 408-4106]. The case was in the 3G wireless domain. I wrote 3 expert reports, gave was deposed twice, and I testified at the ITC hearing in July 2008.
- Cable Networks v Rembrandt: Engaged by Mr. Leroy M. Toliver [(404) 815-6483] of Kilpatrick Stockton LLP, representing Cox Cable. The case involves cable modem and over the air digital television access protocols that use trellis coded modulation. I performed preliminary work as a technical consultant, prepared an initial expert report, and was deposed. Cox was part of a group of cable companies (Cox, Comcast, Time Warner, Charter,) that engaged me in this case. As a result of a briefing that I co-authored there was a summary judgment in favor of the cable companies.
- Nokia Corporation v. InterDigital Technology Corporation, Claim No. HC-04-C01952 in the High Court of Justice Chancery Division Patents Court ("UK1"). I was retained by Milbank Tweed (London) representing InterDigital and contact attorney was Ben Thomson +44 20766345. I prepared an expert report and was deposed. The case went to trial in London in November 2006 and I testified at trial. The case was in the wireless 2G GSM domain.
- Nokia Corporation v. InterDigital Communication Corporation, et al.; Arbitration No. 12 829/JNK in the International Chamber of Commerce, International Court of Arbitration ("2G Arbitration"). Fulbright & Jaworski engaged me and the contact attorney is Richard Zembek (713) 651-5283. I prepared an expert report. The case went to trial and I testified. The case was in the wireless 2G GSM domain.

Awards and Honors

- **Distinguished University Professor, USF** (2013)
- **Charter Fellow of the National Academy of Inventors (NAI)** (2012)
- **Distinguished Professor of Electrical Engineering USF** (2008)
- **National Academy of Engineering**, for "contributions to communications systems and networking" (2005)
- **Thomas Alva Edison patent award** for innovation in wireless networking (2005)
- **AT&T Bell Labs Fellow**, for "contributions to data communications" (1987)
- **IEEE Fellow** for "contributions to data communications techniques" (1986)
- **IEEE Communications Society Steven O. Rice Award** for the best original paper published in the ***IEEE Transactions on Communications***: "Analog Diversity Coding to Provide Transparent Self-Healing Communication Networks" [first application of forward error control to realize fault tolerant broadband/optical networks. Co-authors: E. Ayanoglu, I. Bar-David, and Chih-Lin I] (1995)
- **IEEE Communications Society Frederick Ellersick Award** for the best paper published in ***IEEE Communications:*** "Reducing the Effects of Transmission Impairments in Digital Fiber Optic Systems", ***IEEE Communications***, June 1993 [design of gigabit fiber optic equalizer to compensate for polarization mode dispersion]. Co-authors: S. Kasturia and J. Winters (1994).
- ***Bell System Technical Journal Award*** for the best paper in communications science " The Tap-Leakage Algorithm: An Algorithm for the Stable Operation of a Digitally Implemented, Fractionally Spaced Adaptive Equalizer", ***Bell System Technical Journal***, vol.61, no.8 p.1817-39, Oct. 1982 [invented and

analyzed a new class of adaptation algorithms for stabilizing the adjustment of the tap weights in fractionally spaced equalizers]. Co-authors: E. Ho and J. Mazo (1982).

- Honor Societies: Tau Beta Pi, Eta Kappa Nu, and Sigma Xi

Selected Keynote Speeches and Invited Lectures

- WAMICON 2016
- WTS 2015
- WCNC 2015
- WAMICON 2012
- COMCAS 2011
- WTSI 2010
- MPLS 2006
- Mobicomm 2004
- WCNC 2003
- APOC [Asian Pacific Optical and Wireless Conference] 2002
- Globecomm 1998

Professional Service

- NAE Nominating committees for the Electronics and Computer Science sections [2006]
- Member, IEEE Communications Society Board of Governors [1988-1991]
- Member, IEEE Communications Society Awards Board [1991-1994]
- President, Communication Theory Group, IEEE Communications Society [1988-1990]
- Chair, Communication Theory Workshop [1992]
- Member, Advisory Board for Computer Science and Engineering [CISE], National Science Foundation [1995-1998]
- Member, Industrial Advisory Board, Department of Electrical Engineering and Computer Science, University of California, Berkeley [1995-1996].
- Advisory/Editorial Board Member
  - Editor, Communication Theory, the *IEEE Transactions on Communications* [1977-1986]
  - *Bell Labs Technical Journal* [founding member in 1996 -2000]
  - *Journal of Communications Networks* [1998-present]
  - *Mobile Networks and Applications* [1996-present]
- Editor of several special issues of communications and networking journals.

Books

Data Communications Principles, Gitlin, Hayes, and Weinstein, Plenum Press (1992)

Selected Scientific Papers

1. C. He and R. D. Gitlin, "Limiting Performance of Massive MIMO Downlink Cellular Systems," IEEE Information Theory and Applications Workshop (ITA), 2016, San Diego, CA, February 2016.

2. C. A. Perumalla, T. P. Ketterl, R. D. Gitlin and P. J. Fabri, "Integrated Vectorcardiogram (*i*VCG) Rotation Modeling and Compensation, " 20th IEEE International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD), September 2015.

3. Z. E. Ankaral, A. F. Demir, M. Qaraqe, Q. H. Abbasi, E. Serpedin, H. Arslan and R. D. Gitlin, "Physical Layer Security for Wireless Implantable Medical Devices, " 20th IEEE International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD), September 2015.

4. C. He and R. D. Gitlin, "User-Specific QoS Aware Scheduling and Implementation in Wireless Systems," 2015 IEEE Wireless Telecommunications Symposium (WTS), April 2015.

5. C. A. Perumalla, T. P. Ketterl, G. E. Arrobo, R. D. Gitlin and P. J. Fabri, "Wireless iVCG Optimization Using A Least-Squares Fit," IEEE 16th Wireless and Microwave Technology Conference (WAMICON), April 2015.

6. Y. Liu and R. D. Gitlin, "A Phenomenological Path Loss Model of the In Vivo Wireless Channel," IEEE 16th Wireless and Microwave Technology Conference (WAMICON), April 2015.

7. C. He, G. E. Arrobo, and R. D. Gitlin, "Improving System Capacity Based upon User-Specific QoS for Heterogeneous Networks," IEEE Wireless Communications and Networking Conference (WCNC), March 2015.

8. C. A. Perumalla, G. E. Arrobo, T. P. Ketterl, R. D. Gitlin and P. J. Fabri, "Wireless Vectorcardiogram System Optimization using Adaptive Signal Processing," IEEE International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-BIO), December 2014.

9. C. He, Y. Liu, T. P. Ketterl, G. E. Arrobo, and R. D. Gitlin, "Performance Evaluation for MIMO *In Vivo* WBAN Systems," IEEE International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-BIO), December 2014.

10. Y. Liu, T. P. Ketterl, G. E. Arrobo, and R. D. Gitlin, "Modeling the Wireless *In vivo* Path Loss," IEEE International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-BIO), December 2014.

11. G. E. Arrobo, C. A. Perumalla, Y. Liu, T. P. Ketterl, R. D. Gitlin, P. J. Fabri, "A Novel Vectorcardiogram System," 2014 IEEE 16th International Conference on e-Health Networking, Applications and Services (IEEE Healthcom), October 2014.

12. C. He and R. D. Gitlin, "Application-Specific and QoS-Aware Scheduling for Wireless Systems," IEEE 25th International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), September 2014, Washington D.C.

13. C. He and R. D. Gitlin, "User Specific QoS and its Application in Resources Scheduling for Wireless System," The 5th International Workshop on Wireless Networks and Multimedia (WNM), August 2014, Dalian, China and appearing in the *14th International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP),* Springer International Publishing, 2014, pp. 809–821.

14. C. He, Y. Liu, T. P. Ketterl, G. E. Arrobo, and R. D. Gitlin, "MIMO *in vivo*," IEEE 15th Annual Wireless and Microwave Technology Conference (WAMICON), June 2014, Tampa, FL.

15. G. E. Arrobo, C. A. Perumalla, S. B. Hanke, T. P. Ketterl, P. J. Fabri, and R. D. Gitlin, "An Innovative Wireless Cardiac Rhythm Management (*iCRM*) System," Wireless Telecommunication Symposium 2014, April 9-11, 2014.

16. G. E. Arrobo and R. D. Gitlin, "Minimizing Energy Consumption for Cooperative Network and Diversity Coded Sensor Networks," Wireless Telecommunication Symposium 2014, April 9-11, 2014.

17. G. E. Arrobo and R. D. Gitlin, "Improving the Reliability of *In Vivo* Video Wireless Communications," National Academy of Inventors: Journal of Technology and Innovation, December 2013, pp. 227–236

18. C. A. Castro, S. Smith, A. Alqassis, T. P. Ketterl, Yu Sun, S. Ross, A. Rosemurgy, P. P. Savage, and R. D. Gitlin, "A Wireless Miniature Robot for Networked Expedited Laparoscopy," IEEE Transactions on Biomedical Engineering (TBME), April 2013, pp. 930-936.

19. G. E. Arrobo and R. D. Gitlin, "Improving the Performance of OFDM-based Vehicular Systems through Diversity Coding," IEEE Journal of Communications and Networks, April 2013, pp. 132–141.

20. T. P. Ketterl, G. E. Arrobo, and R. D. Gitlin, "SAR and BER Evaluation Using a Simulation Test Bench for *In Vivo* Communication at 2.4 GHz," IEEE 14th Annual Wireless and Microwave Technology Conference (WAMICON), April 2013, Orlando, FL.

21. A. Alqassis, C. A. Castro, S. Smith, T. P. Ketterl, Yu Sun, P. P. Savage, and R. D. Gitlin, "A Wireless Robotic Video Laparo- Endoscope for Minimal Invasive Surgery," IEEE Workshop On Robot Vision (WorV), January 2013.

22. G. E. Arrobo and R. D. Gitlin, "Minimizing Energy Consumption for Cooperative Network and Diversity Coding Sensor Networks," 4th Latin-American Conference on Communications (LATINCOM), 2012, Cuenca, Ecuador.

23. G. E. Arrobo, R. D. Gitlin, and Z. J. Haas, "Temporal Diversity Coding for Improving the Performance of Wireless Body Area Networks," 7th International Conference on Body Area Networks - BodyNets, 2012, Oslo, Norway, pp. 187-190.

24. A. Alqassis, T. P, Ketterl, C. A. Castro, R. D. Gitlin, S. Ross, Yu Sun, and A. Rosemurgy, "MARVEL *In Vivo* Wireless System," National Academy of Inventors: Journal of Technology and Innovation, 2012, vol. 14, no. 3, pp. 329-340.

25. C. A. Castro, S. Smith, A. Alqassis, T. P. Ketterl, Yu Sun, S. Ross, A. Rosemurgy, P. P. Savage, and R. D. Gitlin, "MARVEL: A Wireless Miniature Anchored Robotic Videoscope for Expedited Laparoscopy," IEEE International Conference on Robotics and Automation (ICRA), 2012, St. Paul, MN.

26. Thomas P. Ketterl, Gabriel E. Arrobo, Alphan Sahin, Thomas J. Tillman, Huseyin Arslan, and Richard D. Gitlin, *"In Vivo* Wireless Communication Channels," WAMICON 2012, April 2012.

27. Cristian A. Castro, Sara Smith, Adham Alqassis, Thomas Ketterl, Yu Sun, Sharona Ross, Alexander Rosemurgy, Peter P. Savage, and Richard D. Gitlin "MARVEL: A Wireless Miniature Anchored Robotic Videoscope for Expedited Laparoscopy," 2012 IEEE International Conference on Robotics and Automation, May 14-18, 2012.

28. G. Arrobo and R. D. Gitlin, "New Approaches to Reliable Wireless Body Area Networks," in *IEEE International Conference on Microwaves, Communications, Antennas and Electronics Systems*, (COMCAS 2011), November 2011.

29. G. Arrobo and R. D. Gitlin, "Improving the Reliability of Wireless Body Area Networks," in *Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (EMBC 2011), August 2011.

30. G. Arrobo and R. D. Gitlin, "Effect of the number of clusters on the performance of Cooperative Network Coding," *Wireless Telecommunications Symposium 2011* (WTSI 2011), April 2011.

31. G. Arrobo and, R. D. Gitlin, "Effect of the Connectivity on the Performance of Cooperative Network Coding," in *12th Annual IEEE Wireless and Microwave Technology Conference* (WAMICON 2011), April 2011.

32. G. Arrobo, R.D. Gitlin, and Z. Haas, "Effect of Link-Level Feedback and Retransmissions on the Performance of Cooperative Networking", WCNC 2011, Cancun, Mexico, April 2011.

33. G. Arrobo and R.D. Gitlin, "Effect of the Connectivity on the Performance of Cooperative Network Coding," WAMICON 2011, Clearwater, FL, April 2011

34. G. Arrobo and R.D. Gitlin, "Effect of the number of clusters on the performance of Cooperative Network Coding," WTS 2011, New York, NY, April 2011.

35. J. Medrano, J. I. Rey, R. J. Connolly, A. Anderson, M. Jaroszeski, and R. Gitlin, "Online bioimpedance feedback for *in vivo* electroporated tissues," *Journal of Physics*, Conference Series, Vol. 205, April 2010

36. Julio Medrano, R.J. Connolly, Jose Rey, Adam Anderson, Mark Jaroszeski and Richard Gitlin, "Bioimpedance as an Indicator of DNA Delivery by Electroporation" First American Medical Association and IEEE Engineering in Medicine and Biology Society Conference on Medical Technology, Washington DC, March 2010.

37. Coordinated load balancing, handoff/cell-site selection, and scheduling in multi-cell packet data systems, Aimin Sang, Xiaodong Wang, Mohammad Madihian, and Richard D. Gitlin, *Wireless Networks,* June 2008.

38. A flexible downlink scheduling scheme in cellular packet data systems, Sang, A.; Xiaodong Wang; Madihian, M.; Gitlin, R.D.; *IEEE Transactions on Wireless Communications*, Volume 5, Issue 3, March 2006 Page(s): 568 - 577

39. Incentive Scheduling for Cooperative Relay in WWAN/WLAN Two-Hop-Relay Networks, Hung-yu Wei and Richard D. Gitlin, *WCNC 2005,* March 2005.

40. Dynamic Channel Management in MIMO OFDM Cellular Systems, Ben Lu, Xiaodong Wang, Richard D. Gitlin and Mohammad Madihian, *Wireless Communications and Mobile Computing (J. Wiley Interscience)*, November, 2005.

41. Downlink Scheduling Schemes in Cellular Packet Data Systems of Multiple-Input Multiple-Output Antennas, A. Sang, M. Madihian, X. Wang, and R.D. Gitlin, Globecomm *2004*, December 2004.

42. A Load-aware Handoff and Cell-site Selection Scheme in Multi-cell Packet Data Systems, A. Sang, M. Madihian, X. Wang, and R.D. Gitlin, *Globecomm 2004*, December 2004.

43. Coordinated Load Balancing, Handoff/Cellsite Selection, and Scheduling in Multicell Packet Data Systems, A. Sang, M. Madihian, X. Wang, and R.D. Gitlin, *Mobicom 2004*, September 2004.

44. Two-hop Relay Architecture for Next-Generation WWAN/WLAN Integration, H-Y Wei, and Richard D. Gitlin, *Wireless Communications*, April 2004

45. WWAN/WLAN Two-Hop-Relay Architecture for Capacity Enhancement, H-Y Wei and Richard D. Gitlin, *WCNC2004*, March 2004

46. Secure Candidate Access Router Discovery, E. Shim, J. Redlich, R. Gitlin, *WCNC2003*, New Orleans, March 2003.

47. Low Latency Handoff for Wireless IP QOS with NeighborCasting, E. Shim, H. Wei, Y. Chang, R.Gitlin, *ICC 2002*, New York, USA, May 2002

48. IP Paging in Mobile Multihop Networks, H-Y Wei and R.D. Gitlin, *Mobicomm*, 2002

49. Next-Generation Networks, Dowden, D., Gitlin, R. D., Martin, R. L, *Bell Labs Technical Journal*, vol. 3, no. 4, October-December 1998

50. Time-Frequency-Code Slicing: Efficiently Allocating the Communications Spectrum to Multirate Users, Karol, M. J., Haas, Z. J., Woodworth, C. B., Gitlin, R. D., *IEEE Transactions on Vehicular Technology* vol. 45, no. 4, November 1997

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52. IS-95 Enhancements for Multimedia Services, Chih-Lin I, Charles A. Webb III, Howard C. Huang, Stephan ten Brink, Sanjiv Nanda, Richard D. Gitlin, *Bell Labs Technical Journal* Volume 1, Issue 2, Date: Autumn (Fall) 1996.

53. The Expanding World of Wireless Technology, Richard D. Gitlin, George I. Zysman, *Bell Labs Technical Journal*, Volume 1, Issue 2, Date: Autumn (Fall) 1996.

54. Challenges for Nomadic Computing: Mobility Management and Wireless Communications, La Porta, T.F.; Sabnani, K.K.; Gitlin, R.D. *Mobile Networks and Applications (MONET)* vol.1, no.1 p.3-16 Aug. 1996

55. Broadband Network Restoration, Ayanoglu, E., Gitlin, R.D., *IEEE Communications* vol.34, no.7 p.110-19 July 1996

56. Performance of Multi-code CDMA Wireless Personal Communications Networks, Chih-Lin I; Pollini, G.P.; Ozarow, L.; Gitlin, R.D., *1995 IEEE 45th Vehicular Technology Conference.* P.907-11 vol.225-28 July 1995

57. Optimum Location Area Sizes and Reverse Virtual Call Setup in PCSNetworks, Chih-Lin I; Pollini, G.P.; Gitlin, R.D., *1995 IEEE 45th Vehicular Technology Conference*, p.140-4 vol.1 p.25-28 July 1995

58. Multi-Code CDMA Wireless Personal Communications Networks Chih-Lin I; Gitlin, R.D. *1995 IEEE International Conference on Communications* p.1060-4 vol.2, 18-22 June 1995

59. The Reverse Virtual Call Setup Algorithm for Mobility Management in PCS Networks Chih-Lin I; Pollini, G.P.; Gitlin, R.D., *1995 IEEE International Conference on Communications* p.745-9 vol.2 18-22 June 1995

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66. An Integrated Multimedia Terminal for Teleconferencing, Woodworth, C.; Golden, G.D.; Gitlin, R.D., *Proceedings of GLOBECOM '93*, 29 Nov.-2 Dec. 1993

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8. 8,619,784 Mapping PBT and PBB-TE traffic to VPLS and other services
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11. 8,416,342 Implantable imaging device
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13. 8,358,981 Minimally invasive networked surgical system and method
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