EXPERT DECLARATION OF DR. KEVIN NEGUS
FOR
INTER PARTES REVIEW OF U.S. PATENT NO. 7,177,369

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I. INTRODUCTION

1. I, Dr. Kevin Negus, submit this declaration in support of a Petition for *Inter Partes* Review of United States Patent No. 7,177,369 (the "'369 Patent"), owned by XR COMMUNICATIONS, LLC, dba VIVATO TECHNOLOGIES ("XR" or "Patent Owner"). I have been retained in this matter by counsel for Ericsson, Inc. and Nokia Corporation of America ("Petitioners"). I understand that Petitioners are the Real Party-in-Interest to this Petition.

2. I make this declaration based upon my personal knowledge. I am over the age of 21 and am competent to make this declaration.

3. The statements herein include my opinions and the bases for those opinions, which relate to at least the following documents of the pending *inter partes* review petition:

- U.S. Patent No. 7,177,369 by W. Crilly, Jr., entitled "Multipath communication methods and apparatuses" (the "'369 Patent") (Ex. 1001).
- File History for U.S. Patent No. 7,177,369 (Ex. 1002).
- US Provisional Patent Application No. 60/287,163 (the "'163 Application") (Ex. 1011).
- U.S. Patent No. 6,252,914 by T. Yamamoto, entitled "Radio Communication System" ("Yamamoto") (Ex. 1004).
- "Multiuser OFDM with Adaptive Subcarrier, Bit, and Power Allocation" by C. Y. Wong et al., *IEEE Journal on Selected Areas in Communications*, Vol. 17, No. 10, Oct. 1999 ("Wong") (Ex. 1005).
- "An Investigation into Time-Domain Approach for OFDM Channel Estimation" by H. Minn et al., *IEEE Transactions on Broadcasting*, Vol. 46, No. 4, Dec. 2000 ("Minn") (Ex. 1006).
- "Channel Estimation Using Pilot Tones in OFDM Systems" by C. Yeh et al., *IEEE*

Transactions on Broadcasting,Vol. 45, No. 4, Dec. 1999 ("Yeh") (Ex. 1007).

- *OFDM Wireless LANs: A Theoretical and Practical Guide*, by J. Heiskala and J. Terry, ISBN: 0672321572, Sams Publishing, First Printing: Dec. 2001 ("Heiskala") (Ex. 1008).
- U.S. Patent No. 6,594,318 by N. Sindhushayana, entitled "Method and apparatus for computing soft decision input metrics to a turbo decoder" ("Sindhushayana") (Ex. 1009).
- "An Overview of Smart Antenna Technology for Mobile Communications Systems", *IEEE Communications Surveys*, 4th Quarter, 1999, Vol. 2, No. 4 by Per H. Lehne and Magne Pettersen ("Lehne") (Ex. 1010).
- Declaration of Dr. Ingrid Hsieh-Yee (Ex. 1012).
- Plaintiff XR Communications, LLC's Preliminary Disclosure of Asserted Claims and Infringement Contentions (Ex. 1013).
- G. J. Foschini and M. J. Gans, "On limits of wireless communications in a fading environment when using multiple antennas", *Wireless Personal Communications* 6, pp. 311–335, 1998 (Ex. 1014).

4. My materials considered for forming my opinions herein have included at least the above-referenced documents.

5. Although I am being compensated for my time at my normal and customary rate in preparing this declaration, the opinions herein are my own, and I have no stake in the outcome of the review proceeding. My compensation does not depend in any way on the outcome of the Petitioner's petition.

II. QUALIFICATIONS

6. I am qualified by education and experience to testify as an expert in the field of telecommunications. Attached, as Attachment A, is a copy of my resume detailing my experience and education. Additionally, I provide the following overview of my background as it pertains to my qualifications for providing expert testimony in this matter.

7. I am currently a Full Professor of Electrical Engineering at Montana Tech University in Butte, MT. I lead research programs at Montana Tech that include developing communications solutions for extremely low power sensors in challenging locations such as alpine mountains and watersheds including federally-designated wilderness areas and for control of critical infrastructure distributed continentally and globally including within severe environments such as arctic forests. For example, I am currently the Principal Investigator on a Montana Tech research program funded indirectly by the US military to improve wireless communications under battlefield conditions for the US Army 11th Airborne based in Alaska. I also mentor, supervise and teach both senior undergraduate and graduate students of Electrical Engineering in the general fields of telecommunications and networking with an emphasis on wireless systems.

8. In 1988, I received my Ph.D. in Engineering from the University of Waterloo in Canada. The Departments of Electrical Engineering and Mechanical Engineering jointly supervised my Ph.D. research on the modeling of bipolar semiconductor devices. My graduate course work was primarily in Electrical Engineering and included such subjects as semiconductor device physics and fabrication, wireless circuit design, and wireless propagation analysis. For my Ph.D. work, I received the Faculty Gold Medal in 1988 for the best Ph.D. thesis in the entire Faculty of Engineering across all Departments for that year. My Ph.D. thesis

research also formed the basis of a paper published in 1989 that won the award for Best Paper in 1989 for the IEEE (Institute of Electrical and Electronic Engineers) journal in which it was published.

9. In 1984 and 1985, respectively, I received the B.A.Sc. and M.A.Sc. Degrees in Mechanical Engineering from the University of Waterloo in Canada. My coursework and research work included, amongst many other topics, extensive embedded firmware development for automation applications and implementation of networks and communications protocols. For my M.A.Sc. Degree research and academic achievements, I received the prestigious University Gold Medal in 1985 for the best Masters thesis in the entire University of Waterloo for that year.

10. In 1986, I joined the Palo Alto Research Center of Fairchild Semiconductor in Palo Alto, CA. At Fairchild, I participated in the development of devices and products for high-speed applications such as wired networking, RISC microprocessors and wireless communications.

11. In 1988, I took the position of Member of the Technical Staff at Avantek, Inc. in Newark, CA. I was hired to develop products for both wireless and wired data networking applications. Some of the components I developed early in my career at Avantek were used for 1st generation wireless local area network (WLAN) products, voice band modem equipment, wired data networking both in the LAN and WAN and 1st generation cellular handsets and base stations based on AMPS or TACS.

12. In 1991, the Hewlett-Packard Company purchased Avantek, Inc. I continued to work for Hewlett-Packard until 1998 in such roles as IC Design Manager, Director of Chipset Development and Principal System Architect. In 1992, Hewlett-Packard assigned me to work on the “Field of Waves” project, which was a major multi-division effort to build WLAN products

for mobile computers. The project was cancelled in 1993. However, the work I did on the project was leveraged into producing the world's first IEEE 802.11 chipset, which my division at Hewlett-Packard first offered for sale in 1994. I led the project to develop and market this chipset for many early WLAN product companies including Proxim, Symbol (now part of Motorola) and Aironet (now part of Cisco). I also helped coordinate efforts within Hewlett-Packard to guide extensive research projects on WLAN protocols and technology at Hewlett-Packard's central research laboratories in Palo Alto, CA and Bristol, U.K.

13. In 1998, I joined Proxim, Inc. in Mountain View, CA. At that time, Proxim was engaged in the development and sale of wired and wireless products for home and enterprise networking applications based on several different wired and wireless networking protocols. I stayed at Proxim through 2002 and was the Chief Technology Officer for this publicly-traded company at the time of my departure. During my career at Proxim, I led or participated in the development of many WLAN and WWAN products and/or chipsets for network adapters, OEM design-in modules, access points, bridges, switches, and routers that used a wide variety of bus, LAN, or WAN wired interfaces. I have supervised many engineers including those responsible for embedded firmware development to implement various wired and wireless networking, reservation, and security protocols at the MAC layer and above, those responsible for HDL code creation of baseband chips to implement PHY and MAC algorithms, as well as other engineers that developed hardware reference designs, modem algorithms and chipsets.

14. I note that specific to this matter that while I was Chief Technology Officer at Proxim that we developed the world's first Orthogonal Frequency Division Multiplexing (OFDM) wireless networking products for high speed data communications including custom integrated circuit chips and software. These products, which we first developed during 2000 and

2001, were based on the IEEE 802.11a standard and proprietary extensions that we added for increased performance. These products also utilized many of the same technology elements described and/or claimed in the '369 Patent when sold in the USA starting in 2001.

15. Since 2002, I have been an independent consultant and have provided services to a number of companies including some that have developed IEEE 802.11 products. In particular, from 2002 until 2007 I was Chairman of WiDeFi, Inc. – a company that developed chips and embedded firmware for 802.11 repeater products based on 802.11a, b, g and draft n amendments. From 2007-2011, I was Chairman of Tribal Shout – a company that delivered IP voice and audio streaming media using VoIP to any cellular or landline phone including those reachable only by the circuit-switched connections such as the PSTN and 2nd generation cellular radio. From 2010-2016, I was Chairman and Chief Technology Officer of CBF Networks, Inc. (dba Fastback Networks) – a company that developed fiber extension products for backhaul of data networks including Wi-Fi, HSPA, CDMA2000, WiMAX and LTE cellular radio systems.

16. I have been a Board Observer on behalf of the venture capital firm Camp Ventures at two companies that develop semiconductor components including one that developed technology specifically to improve the system performance of HSPA and LTE cellular radio systems (Quantance) and another that provides system on a chip (SOC) microcontrollers, OEM design-in modules and firmware with 802.11 and wired interfaces for embedded applications (GainSpan). I have also been a technology and/or business strategy advisor to multiple early stage companies that are developing such products as new wireless communications security systems (AirTight), RFID radio systems (Mojix), time/frequency reference components (SiTime), and application of machine learning to wireless communications (Aira).

17. I have actively monitored or participated in the IEEE 802.11 standards process continuously since 1989. I am a listed contributor to the highly successful IEEE 802.11g standard published in 2003 that describes a wireless communications protocol in use worldwide by over 5 billion devices. In 2002 and 2003, I participated in the IEEE 802.11 Wireless Next Generation Committee that was responsible for launching the 802.11n standards development process.

18. I am an author or co-author of many papers that have been published in distinguished engineering journals or conferences such as those of the IEEE or ASME. An exemplary list of these publications is included in my resume.

19. I am also a former member of the Federal Communication Commission's Technological Advisory Committee as an appointee of then Chairman Michael Powell. I have also served on the Wyoming Telecommunications Council as an appointee of then Governor Jim Geringer after confirmation by the Wyoming State Senate.

20. I am named as an inventor on numerous U.S. patents all of which have related in at least some way to products for wired and/or wireless networks. I believe that the following is a complete list as of this date for my approximately 88 issued U.S. Patents: 4,839,717, 5,111,455, 5,150,364, 5,436,595, 5,532,655, 6,587,453, 7,035,283, 7,085,284, 7,187,904, 8,095,067, D704174, 8,238,318, 8,300,590, 8,311,023, 8,385,305, 8,422,540, 8,467,363, 8,502,733, 8,638,839, 8,649,418, 8,761,100, 8,811,365, 8,824,442, 8,830,943, 8,872,715, 8,897,340, 8,928,542, 8,942,216, 8,948,235, 8,982,772, 8,989,762, 9,001,809, 9,049,611, 9,055,463, 9,178,558, 9,179,240, 9,226,295, 9,226,315, 9,252,857, 9,282,560, 9,313,674, 9,325,398, 9,345,036, 9,350,411, 9,374,822, 9,408,215, 9,474,080, 9,490,918, 9,572,163, 9,577,700, 9,577,733, 9,578,643, 9,609,530, 9,655,133, 9,712,216, 9,713,019, 9,713,155,

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21. I have provided expert testimony, reports or declarations in the cases of *Agere v. Sony* (on behalf of plaintiff Agere), *Linex v. Belkin et al.* (on behalf of defendant Cisco), *CSIRO v. Toshiba et al*. (multiple related cases on behalf of plaintiff CSIRO), *Freedom Wireless v. Cingular et al.* (on behalf of plaintiff Freedom Wireless), *Rembrandt v. HP et al*. (on behalf of defendant HP), *DNT v. Sprint et al.* (on behalf of the defendants Sprint, T-Mobile, US Cellular, Verizon and Novatel), *Teles v. Cisco* (on behalf of defendant Cisco), *WiAV v. HP* (on behalf of defendant HP), *SPH v. Acer et al*. (on behalf of defendants Sony, Nokia, Motorola, Novatel, Sierra and Dell), *LSI v. Funai* (on behalf of plaintiff LSI), *WiAV v. Dell and RIM* (on behalf of the defendants Dell and RIM), *Wi-LAN v. RIM* (on behalf of defendant RIM), *LSI v. Barnes & Noble* (on behalf of plaintiff LSI), *Novatel v. Franklin and ZTE* (on behalf of plaintiff Novatel), *LSI v. Realtek* (on behalf of plaintiff LSI), *Wi-LAN v. Apple et al.* (on behalf of defendants Apple, Sierra and Novatel), *EON v. Sensus et al*. (on behalf of defendants Motorola, US Cellular and Sprint), *M2M/Blackbird v Sierra et al*. (multiple related cases on behalf of defendants Sierra and Novatel), *Intellectual Ventures v. AT&T et al*. (on behalf of defendants AT&T, T-Mobile and Sprint), *Intellectual Ventures v. Motorola* (on behalf of defendant Motorola), *TQ Beta v. DISH et al*. (on behalf of defendant DISH), *Qurio v. DISH et al*. (on behalf of defendant DISH), *Fatpipe v. Talari* (on behalf of the defendant Talari), *EON v. Apple* (on behalf of defendant Apple), *Chrimar v. Dell* (on behalf of defendant Dell), *Nokia v. LGE* (on behalf of plaintiff Nokia),

PanOptis v. Blackberry (on behalf of defendant Blackberry), *Customedia v. DISH et al.* (on behalf of defendant DISH), *Blackberry v. BLU* (on behalf of plaintiff Blackberry), *MTel v. Charter et al.* (on behalf of defendants Charter, Time Warner, Cox and Bright House), *Huawei v. Samsung* (on behalf of plaintiff Huawei), *Alacritech v. Wistron* (on behalf of defendant Wistron), *IPA v. DISH et al.* (on behalf of defendant DISH), *XR v. Ruckus et al.* (on behalf of defendants Ruckus, Netgear and Belkin), *Twilio v. Telesign* (on behalf of plaintiff Twilio), *Hera/Sisvel v. Arris et al.* (on behalf of defendants Arris/Ruckus, Netgear, Amazon, Roku and Belkin), *Intellectual Ventures v. Ericsson et al*. (on behalf of defendants Ericsson, T-Mobile and Sprint), *Sol IP v. AT&T et al*. (on behalf of defendants AT&T, Verizon and Sprint), *Soundview v DISH et al.* (on behalf of defendants DISH and Sling Media), *DISH v Peloton, iFIT and MIRROR* (on behalf of plaintiffs DISH and Sling Media), *XR v. D-Link et al.* (on behalf of defendants D-Link, HP, Netgear and Belkin), *SPV v HP* (on behalf of defendant HP) and *DISH v MG et al.* (on behalf of plaintiffs DISH and Sling Media). I believe that the preceding list includes all cases that I have testified in as an expert at trial or by deposition at least during the past four years.

III. PERSON OF ORDINARY SKILL IN THE ART

22. I understand that the content of a patent (including its claims) and prior art should be interpreted the way a person of ordinary skill in the art (or "POSITA") would have interpreted the material at the alleged time of invention.

23. I understand that the "alleged time of invention" here is no earlier than the date that the applicants for the '369 Patent first filed an application related to the '369 Patent, namely, Apr. 27, 2001.

24. A person of ordinary skill in the art (referred to herein as a "POSITA") at the alleged time of invention for the '369 Patent would have been a person familiar with wireless communications networks, equipment and integrated circuit chips, and would have had at least a working knowledge of the design of physical layer signal processing for Orthogonal Frequency Division Multiplexing (OFDM) wireless communications including the use of multiple antennas.

25. For example, such a POSITA would have had at least a Bachelor's degree in Electrical Engineering or an equivalent field, and at least two years of work experience in developing OFDM-based wireless communications. Alternatively, a POSITA would have had a more advanced degree, such as a Master's degree in Electrical Engineering or an equivalent field, combined with at least one year of work experience in developing OFDM-based wireless communications.

26. In addition to my testimony as an expert, I am prepared to testify as someone who actually practiced in the field from 1986 to present, who actually possessed at least the knowledge of a POSITA within that time period including at the alleged time of invention, and who actually worked with others possessing at least the knowledge of a POSITA within that time period including at the alleged time of invention.

27. I understand that the POSITA is a hypothetical person who is assumed to be aware of all the pertinent information that qualifies as prior art. In addition, the POSITA makes inferences and takes creative steps.

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IV. LEGAL UNDERSTANDING

28. I have a general understanding of validity based on my experience with patents and my discussions with counsel.

29. I understand that the claims of a patent are presumed valid. I understand that one factor to be considered in challenging this presumption of validity is whether or not prior art references cited by Petitioner are cumulative to one or more prior art references considered by the U.S. Patent and Trademark Office (the "PTO") in allowing the claims at issue. I understand that prior art references not specifically considered by the PTO are presumed to be non-cumulative. I understand that if Patent Owner contends that certain prior art references are cumulative to one or more prior art references considered by the PTO, then Patent Owner has the burden to prove this contention with specificity, and further that Petitioner and/or its experts will be allowed to rebut the Patent Owner's contention.

30. I have a general understanding of prior art and priority date based on my experience with patents and my discussions with counsel.

31. I understand that inventors may be entitled to a priority date earlier than an actual date of filing of a patent application that provides written description support for a particular claim to the extent that they can show complete possession of such a particular claimed invention at such an earlier priority date and reasonable diligence to reduce such a particular claimed invention to practice between such an earlier priority date and such an actual date of filing. I understand that if Patent Owner contends that particular claims are entitled to such an earlier priority date than such an actual date of filing, then Patent Owner has the burden to prove this contention with specificity.

32. I understand that an invention by another must be made before the priority date of a particular patent claim in order to qualify as "prior art" under 35 U.S.C. § 102 or § 103, that a printed publication must be publicly available before the priority date of a particular patent claim in order to qualify as "prior art" under 35 U.S.C. § 102(a), that a printed publication must be publicly available more than one year prior to the actual date of filing of a patent application that provides written description support for a particular claim in the United States in order to qualify as "prior art" under 35 U.S.C. § 102(b), or that the invention by another must be described in an application for patent filed in the United States before the priority date of a particular patent claim in order to qualify as "prior art" under 35 U.S.C. § 102(e). I understand that Petitioner has the burden of proving that any particular reference or product usage or offer for sale is prior art.

33. I have a general understanding of obviousness based on my experience with patents and my discussions with counsel.

34. I understand that a patent claim is invalid under 35 U.S.C. § 103 as being obvious only if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in that art. An obviousness analysis requires consideration of four factors: (1) scope and content of the prior art relied upon to challenge patentability; (2) differences between the prior art and the claimed invention; (3) the level of ordinary skill in the art at the time of the invention; and (4) the objective evidence of non-obviousness, such as commercial success, unexpected results, the failure of others to achieve the results of the invention, a long-felt need which the invention fills, copying of the invention by competitors, praise for the invention, skepticism for the invention, or independent development.

35. I understand that a prior art reference is proper to use in an obviousness determination if the prior art reference is analogous art to the claimed invention. I understand that a prior art reference is analogous art if at least one of the following two considerations is met. First a prior art reference is analogous art if it is from the same field of endeavor as the claimed invention, even if the prior art reference addresses a different problem and/or arrives at a different solution. Second, a prior art reference is analogous art if the prior art reference is reasonably pertinent to the problem faced by the inventor, even if it is not in the same field of endeavor as the claimed invention.

36. I understand that it must be shown that a person of ordinary skill in the art at the time of the invention would have had a reasonable expectation that a modification or combination of one or more prior art references would have succeeded. Furthermore, I understand that a claim may be obvious in view of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of a person of ordinary skill in the relevant art. However, I understand that it is inappropriate to resolve obviousness issues by a retrospective analysis or hindsight reconstruction of the prior art and that the use of "hindsight reconstruction" is improper in analyzing the obviousness of a patent claim.

37. I further understand that the law recognizes several specific guidelines that inform the obviousness analysis. First, I understand that a reconstructive hindsight approach to this analysis, i.e., the improper use of post-invention information to help perform the selection and combination, or the improper use of the listing of elements in a claim as a blueprint to identify selected portions of different prior art references in an attempt to show that the claim is obvious, is not permitted. Second, I understand that any prior art that specifically teaches away from the

claimed subject matter, i.e., prior art that would lead a person of ordinary skill in the art to a specifically different solution than the claimed invention, points to non-obviousness, and conversely, that any prior art that contains any teaching, suggestion, or motivation to modify or combine such prior art reference(s) points to the obviousness of such a modification or combination. Third, while many combinations of the prior art might be "obvious to try", I understand that any obvious to try analysis will not render a patent invalid unless it is shown that the possible combinations are: (1) sufficiently small in number so as to be reasonable to conclude that the combination would have been selected; and (2) such that the combination would have been believed to be one that would produce predictable and well understood results. Fourth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references uses known methods or techniques that yield predictable results, then that factor also points to obviousness. Fifth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of known work in one field prompting variations of it for use in the same field or a different one based on design incentives or other market forces that yields predicable variations, then that factor also points to obviousness. Sixth, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of routine optimization, then that factor also points to obviousness. Seventh, I understand that if a claimed invention that arises from the modification or combination of one or more prior art references is the result of a substitution of one known prior art element for another known prior art element to yield predictable results, then that factor also points to obviousness.

38. I understand that a dependent claim incorporates each and every limitation of the claim from which it depends. Thus, my understanding is that if a prior art reference fails to

anticipate an independent claim, then that prior art reference also necessarily fails to anticipate all dependent claims that depend from the independent claim. Similarly, my understanding is that if a prior art reference or combination of prior art references fails to render obvious an independent claim, then that prior art reference or combination of prior art references also necessarily fails to render obvious all dependent claims that depend from the independent claim.

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V. THE '369 PATENT

39. The '369 Patent, entitled "Multipath communication methods and apparatuses" relates "to data communications, and more particularly to wireless communication systems, apparatuses and related methods that support wireless communication in a multipath signal propagation environment" (see, for example, Ex. 1001 at 1:14-17).

A. Overview of the '369 Patent

40. In the "**Background**" section, the '369 Patent observes that at the time of the invention that there was a desirability that "the *user of a portable device* will be *free to move* around a region that is supported by the *wireless network*" even though "*as the subscribers move* about freely there will *not always be a clear or otherwise unobstructed communication path* between a transmitting network resource and the receiving device" and thus "there is *need for improved methods* and apparatuses that can *support wireless communications within such varying environments*" (emphasis added, see, for example, Ex. 1001 at 1:37-39, 1:49-52, 1:58-60).

41. In the "**Summary**" section, the '369 Patent states that "The *above stated needs* and/or others are satisfied, for example, by a *method in accordance with certain exemplary implementations* of the present invention that includes *identifying at least one multipath transmission delay within a reverse path data signal*, *determining at least one forward path pre-equalization parameter based on the transmission delay*, and *modifying a forward path data signal based on the forward path pre-equalization parameter*" and further that "In accordance with certain other implementations, such *pre-equalization techniques* can be advantageously *combined*, for example, with *antenna arrangements that support transmission diversity, spatial division transmission, and/or other like techniques*" (emphasis added, see, for example, Ex. 1001 at 2:1-8, 2:24-28).

42. In a section entitled "**Multipath Propagation Delays**", the '369 Patent observes as known in the art at the time of the alleged invention that "*Multipath propagation* is primarily the result of *reflections and diffraction from objects in the coverage area* of the transmitting and receiving antennas" and further that "*High data rate communication systems* may be subject to *detrimental intersymbol interference* caused by such *multipath propagation or fading*" (emphasis added, see, for example, Ex. 1001 at 3:12-17).

43. Additionally, the '369 Patent observes as known in the art at the time of the alleged invention that "*Multipath fading* may be observed by *examining the frequency domain characteristics* of the communication channel" at least because such "multipath fading will often cause the *channel transfer function to have frequency-dependent responses* that alter the amplitude and phase modulation content of a received signal" (emphasis added, see, for example, Ex. 1001 at 3:22-27).

44. In a section entitled "**Traditional Modulation Techniques for Dealing with Multipath Propagation Delays**", the '369 Patent admits as known in the art at the time of the alleged invention that "Various *modulation techniques* have been used independently and/or in combination to *ameliorate or avoid intersymbol interference*" wherein such "modulation techniques that have been developed include the use of *Orthogonal Frequency Division Multiplexing (OFDM) to significantly increase the symbol time*" (emphasis added, see, for example, Ex. 1001 at 3:35-37, 3:62-64).

45. More specifically, the '369 Patent explains that for such known OFDM technology that "OFDM operates by *coding a series of bits into a set of modulated orthogonal sub-carriers*, thus producing a *symbol to be transmitted*" that "typically *includes a guard interval (GI)* that contains a *cyclic extension of the basic s*ymbol" which "is typically designed to be

longer than the expected multipath propagation delay spread of the channel" (emphasis added, see, for example, Ex. 1001 at 3:66-4:6).

46. In a section entitled "**Traditional Antenna Techniques for Dealing with Multipath Propagation Delays**", the '369 Patent admits as known in the art at the time of the alleged invention that "various *antenna designs* may be used to further *ameliorate the effects of multipath propagation and fading*" such as when "Certain systems, for example, employ what is commonly referred to as *spatial division techniques*" whereby "*transmitting antennas having narrow beam widths* are employed to *reduce multipath propagation* caused by reflections from various objects by *not illuminating those objects* in the first place" (emphasis added, see, for example, Ex. 1001 at 4:46-54).

47. More specifically, the '369 Patent explains that for such known spatial division technology that "*Spatial division techniques* may be *performed with single or multielement* transmitting and/or receiving *antennas*" wherein such "*multielement antennas*, for example, are also *referred to as phased array antennas*" which "are capable of providing *flexible antenna patterns* and *simultaneously transmitting and receiving in several directions* using the same antenna aperture" and thus "are very *helpful* in the reception and *amelioration of signals that are affected by multipath fading*" (emphasis added, see, for example, Ex. 1001 at 4:64-67, 5:9-15).

48. In a section entitled "**Conclusion Regarding Such Traditional Techniques**", the '369 Patent admits that such "*techniques described above greatly improve the capacity of a wireless system/network to carry information*" but still contends that such "techniques/systems *do not provide equalization for a large delay spread when the radio chipsets and associated physical layer standards do not include amelioration of these long delay spreads*" (emphasis added, see, for example, Ex. 1001 at 6:14-15, 6:64-67).

49. In a section entitled "**Introducing Novel Pre-Equalization Techniques**", the '369 Patent observes that "it is usually *preferred that any required additional processing complexity be implemented at* the node/location which is least subject to complexity restrictions, such as a *base station or the like* in a wireless communication system/network" and thus accordingly that "the *present invention equalization techniques* are provided for *use at a transmitting node* and configured to *perform pre-equalization that substantially reduces unwanted effects associated with multipath fading*, including retro-reflected propagation delays" (emphasis added, see, for example, Ex. 1001 at 7:10-20).

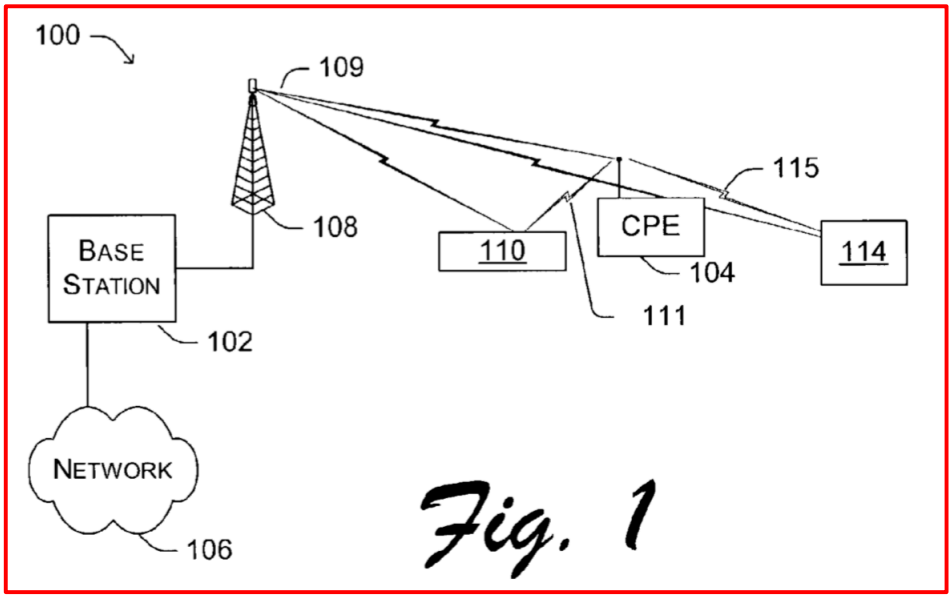
50. Additionally, the '369 Patent observes that as known in the art at the time of the alleged invention that "*reciprocity* can be used to *determine channel characteristics* that are used while *pre-equalizing a transmitted path*" wherein such "use of a *reciprocal channel* is very useful, for example, when *Time Division Duplex (TDD) channels are implemented*" and thus "*conventional techniques use OFDM signal sequences to correct for multipath effects* due to multipath delay spread shorter than the guard interval" (emphasis added, see, for example, Ex. 1001 at 7:30-34, 7:43-45).

51. The '369 Patent contends that its "exemplary *OFDM pre-equalization technique* basically *acts within the frequency band of OFDM sub-carriers* to *pre-equalize the multipath channel* to handle multipath *delay spread greater than the delay protection provided by conventional OFDM signal processing techniques*, such as, e.g., the OFDM GI" such that "the *receiver can still correct multipath effects* that are *less than the GI*" (emphasis added, see, for example, Ex. 1001 at 7:64-8:3).

52. The '369 Patent further contends that such "*pre-equalization techniques use training sequences*, which are contained within a *reverse link received OFDM burst*, to

specifically *adjust associated transmission signals/parameters applied to subsequent OFDM transmissions back towards that particular node*" wherein such "training sequences may or may not be *part of the header and equalization sequences provided for in a conventional chipset or standard*" (emphasis added, see, for example, Ex. 1001 at 8:4-11).

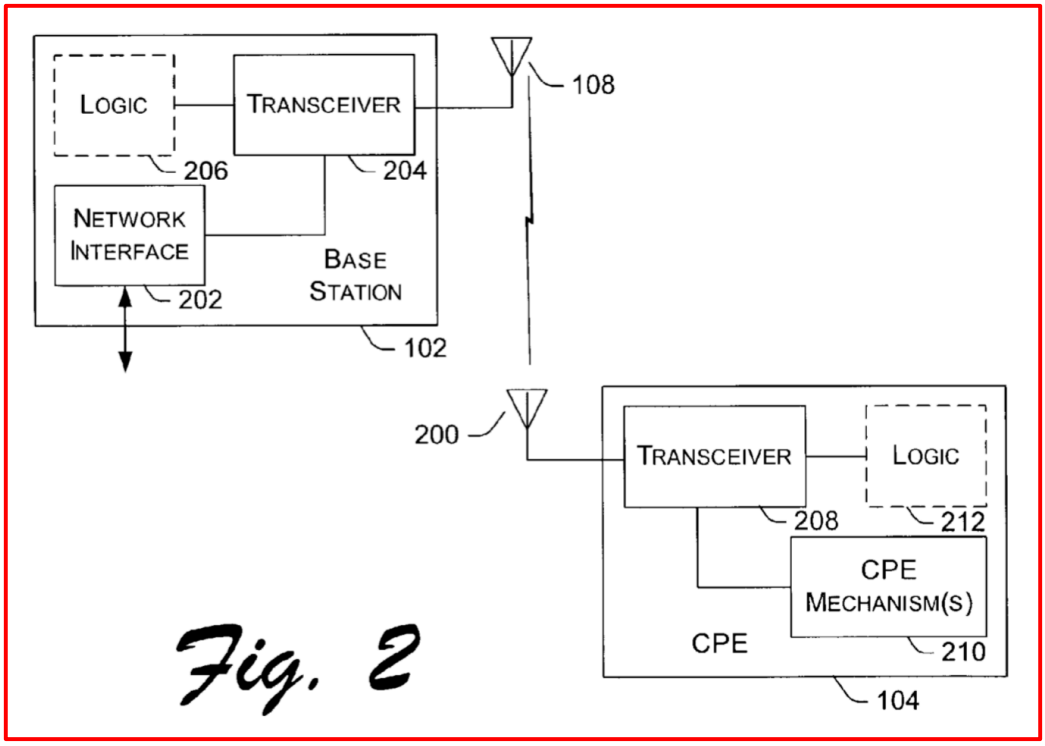
53. In a section entitled "**An Exemplary Multipath Environment**", the '369 Patent describes "FIG. 1" as a "a block diagram depicting an *exemplary communication system* **100** operating in a *multipath environment*" wherein "a *base station device* **102** is configured to *exchange data with at least one customer premise equipment (CPE) device* **104** through an *antenna* **108** and over a *wireless communication link*" while "in *reverse order*, *CPE device* **104** can *transmit data over a wireless communication link to base station* device **102** through antenna **108**" (emphasis added, see, for example, Ex. 1001 at 8:16-21, 8:28-30, FIG. 1 as reproduced below).



54. More specifically, the '369 Patent explains that "Transmission **109** takes a *direct path* to CPE device **104**" and "radiates and is *reflected or diffused*, for example, by one or more *objects* **110** that are *closer to antenna* **109**" which "causes a *multipath propagation signal* **111** to

be directed towards CPE device **104**" while also "*some of the electromagnetic energy* in transmission **109** can be *retro-reflected back towards CPE device* **104**, as multipath propagation signal **115**, by one or more *objects* **114** *located further away from antenna* **109**" (emphasis added, see, for example, Ex. 1001 at 8:34-43).

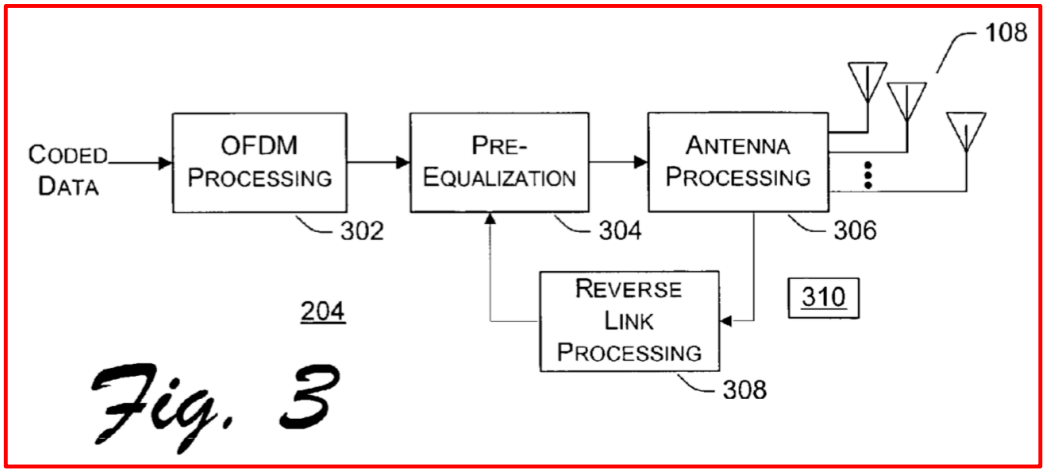
55. In a section entitled "**Exemplary Base Station and CPE Nodes**", the '369 Patent describes "FIG. 2" as a "block diagram depicting *functional units within base station device* **102** and *CPE device* **104**" (emphasis added, see, for example, Ex. 1001 at 8:54-55, FIG. 2 as reproduced below).



56. In reference to FIG. 2 shown above, the '369 Patent states that "*Transceiver* **204** is configured to *send and receive information in the form of data* to/from *network interface* **202** and/or *logic* **206**" as well as "to *send and receive information in the form of data to/from antenna* **108**" wherein such "antenna **108** is representative of *any number of transmitting and/or receiving elements* provided in any suitable type of *antenna configuration*" including "a *phased array*

antenna having a plurality of elements" (emphasis added, see, for example, Ex. 1001 at 8:62-9:4).

57. In a section entitled "**Providing a Pre-Equalization Capability at an Exemplary Base Station Node**", the '369 Patent describes "FIG. 3" as a "functional block diagram, wherein a *set of coded data to be transmitted from base station* device **102** *to CPE* device **104** is further *prepared, pre-equalized and eventually transmitted*" (emphasis added, see, for example, Ex. 1001 at 9:49-52, FIG. 3 as reproduced below).



58. In reference to FIG. 3 shown above, the '369 Patent states that "*OFDM processing block* **302** is configured to *generate corresponding Quadrature Phase Shift Keying (QPSK) modulation values* for each of forty-eight *OFDM sub-carriers*" that "may, for example, be *output by an OFDM IFFT* (not shown)" and "are then *provided to a pre-equalization block* **304**" (emphasis added, see, for example, Ex. 1001 at 9:56-62).

59. Additionally, the '369 Patent states that "*Pre-equalization block* **304** is configured to *modify one or more of the OFDM modulated sub-carriers based on information from a reverse link processing block* **308**" that "is basically configured to *identify multipath propagation*

delays and/or problems *for packets transmitted from CPE* device **104** *to base station* device **102**" (emphasis added, see, for example, Ex. 1001 at 9:63-10:1).

60. More specifically, the '369 Patent states that "One exemplary *way to recognize multipath delays* is to have *CPE* device **104** *transmit a known sequence of data/tones*" such that "The *received signal can then be compared or contrasted with the known sequence* and *differences detected*, the differences being at least partially *associated with the multipath communication environment*" and then these "differences, or information derived from such differences can then be *used within pre-equalization block* **304** to *modify*, in some manner, as applicable, *the OFDM modulated sub-carriers*" which "are then *provided to antenna processing block* **306**, wherein they are further processed and eventually *transmitted using one or more antennas* **108**" (emphasis added, see, for example, Ex. 1001 at 10:2-13).

61. However, the '369 Patent also admits that "*Those skilled in the art* will *recognize* that *reverse link processing block* **308** and *pre-equalization block* **304** may be *implemented in a variety of ways*" such as when "reverse link processing block **308** may include a *tapped transversal filter, or FFT/multipliers/IFFT filter of length on the order of the longest expected multipath delay*" (emphasis added, see, for example, Ex. 1001 at 10:14-20).

62. Accordingly, the '369 Patent states that "*pre-equalization block* **304** may be configured, in this example, to *invert the measured channel response so that the pre-equalization and the actual subsequently induced channel response errors substantially cancel out*" such that "transceiver **208** in the *receiving CPE* device will *receive a signal that is essentially significantly free of troublesome multipath signals* that are longer than the GI" (emphasis added, see, for example, Ex. 1001 at 10:31-37).

63. The '369 Patent also states that "the subsequent *multipath estimate* can then be *used to estimate antenna pointing* and/or determine the near-optimal summation of signals received by the two phased array antennas" so that "The *base station* device **102** *produces a directed signal to CPE* device **104** using *substantially the same antenna and pre-equalized settings/parameters*" (emphasis added, see, for example, Ex. 1001 at 10:61-67).

64. The '369 Patent further states that "When a *phased array antenna* **108** is used at the *base station* node to further *ameliorate the effect of multipath*, antenna element *coefficients may be determined* by evaluating, for example, the *discrete Fourier transform* (DFT) of the *signals received on the elements of the phased array*" such that "Knowing that the *channel is essentially reciprocal* allows a *pre-equalization of the signals to be applied to the phased array during subsequent forward path transmissions* from base station device **102** to CPE device **104**" (emphasis added, see, for example, Ex. 1001 at 11:40-44, 11:62-66).

65. Moreover, the '369 Patent notes that "In those systems where *only a few transmit antennas* are used, *transmit antenna diversity and like techniques* may also be *implemented in place of phased array transmission/processing*" such as when "transmit diversity may be implemented using *simultaneous transmission of coded user data on diversity antennas*" (emphasis added, see, for example, Ex. 1001 at 12:7-10, 12:24-26).

66. The '369 Patent observes that "known headers that may be used to support *training sequences can be found in the IEEE 802.11a standard*" including "*short and long sequences* totaling a duration of about 8 μs" and in a section entitled "**Some Exemplary Training Sequences**", the '369 Patent further recites that "*CPE device* **104** is configured to *transmit a signal or signals back to base station device* **102** over the *reverse link transmission path*" wherein "One or more of these transmissions may *include training sequences* that are

designed to *allow reverse link processing block* **308** (see FIG. 3) to *determine what if any changes need to be made in pre-equalizing the signals transmitted on the forward link transmission path* from base station device **102** to CPE device **104**" (emphasis added, see, for example, Ex. 1001 at 12:45-47, 12:63-13:4).

67. In a section entitled "**Exemplary Frequency Domain Pre-Equalization Techniques**", the '369 Patent recites that "the *pre-equalization techniques described herein* may, for example, *take advantage of frequency domain equalization techniques* such as those *described by Van Acker*, et al." as "adapted for use in pre-equalizing signals in the *transmitting portion of a base station* or like device/node" (emphasis added, see, for example, Ex. 1001 at 14:30-42).

68. More specifically, the '369 Patent describes for such "*frequency domain equalization techniques*" that this "essentially acts a *sub-band equalizer in the transmitting node* (here, the base station device)" wherein "*power may be set to be equal in each of the sub-bands*, allowing regulatory rules, such as FCC rules, to be satisfied" while "the power may be *substantially flattened over the spectrum*" (emphasis added, see, for example, Ex. 1001 at 15:21-29).

69. In a section entitled "**Using Reduced Spectral Power Density Transmissions**", the '369 Patent recites that in contrast to where "The *power in each sub-carrier* in the above example may be held *substantially constant*" that instead "A *modification to the system* involves the *determination of a worst case path loss over the OFDM tones*, for example, through the use of *reciprocal measurements*" such that "Then the *highest allowed power spectral density for that particular sub-carrier is used*, while the *power spectral density for other tones is reduced* to

allow the other tones to *sustain the same level of QAM, QPSK, BPSK, etc.*" (emphasis added, see, for example, Ex. 1001 at 15:31-39).

70. The '369 Patent contends that "By *reducing the power of the other tones*, an *improvement* may be had with respect to the *capacity of the system* as a result of *lower interference* being generated" and that "doing so could *allow the power amplifier to carry additional channels* for the same PEP level" (emphasis added, see, for example, Ex. 1001 at 15:39-43).

71. Additionally, the '369 Patent states that "The *requisite power spectral density needed to establish a level of QAM can be determined*, for example, by *path loss estimation* and the *knowledge of the reverse link power level* transmitted on the reverse link" wherein "One exemplary method involves establishing a reverse link, having the *CPE device provide information to the base station device regarding the power levels* being used on the reverse link" so that "Next, *reciprocal path loss measurements are made by the base station device* and a link budget for a particular QAM level is determined" (emphasis added, see, for example, Ex. 1001 at 15:44-54).

72. Accordingly, the '369 Patent also states that "Then *variations in channel path loss* can be used to *set/reset minimum/maximum power levels for a particular QAM level*, e.g., 16 QAM" so that "*Sub-carrier/channel equalization* is then *provided by the base station* device and the *signals are transmitted to the CPE* device" (emphasis added, see, for example, Ex. 1001 at 15:54-60).

B. Prosecution File History of the '369 Patent

73. I understand that on Apr. 25, 2002 that U.S. Patent Application No. 10/131,864 by William J. Crilly, Jr., entitled "Improved Multipath Communication Methods And Apparatuses" was filed (see, for example, Ex. 1002 at p. 3).

74. I understand the following to be original claims 1 and 42 of U.S. Patent Application No. 10/131,864 (from Ex. 1002 at pp. 37, 46):

> 1. A method comprising:
>
> identifying at least one multipath transmission delay within a reverse path data signal;
>
> determining at least one forward path pre-equalization parameter based on said at least one transmission delay; and
>
> modifying a forward path data signal based on said at least one forward path pre-equalization parameter.

> 42. The method as recited in Claim 1, wherein modifying said forward path data signal based on said at least one forward path pre-equalization parameter further includes:
>
> selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal based on said at least one forward path pre-equalization parameter.

75. I understand that in Dec. 2005 that the US PTO rejected all pending claims of U.S. Patent Application No. 10/131,864 wherein original claim 1 shown above was rejected as being unpatentable over U.S. Patent No. 6,870,515 ("Kitchener") in view of U.S. Patent Publication No. 2003/0058929 ("Cox") and wherein original claim 42 shown above was rejected as being unpatentable over Kitchner in view of Cox further in view of U.S. Patent Publication No. 2002/00191540 ("Fujii") (see, for example, Ex. 1002 at pp. 86, 106).

76. I understand that applicant provided amended claims for U.S. Patent Application No. 10/131,864 and remarks in response to the above noted rejection in Jun 2006 (see, for example, Ex. 1002 at pp. 124-163, amended claim 1 as shown below).

> **1. (currently amended)** A method comprising:
>
> identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device;
>
> determining at least one forward path pre-equalization parameter based on said at least one transmission delay; and
>
> modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter.

77. I understand that applicant informed the PTO regarding U.S. Patent Application No. 10/131,864 in the above noted Jun 2006 correspondence that "*Cox is only directed to a receiving device that equalizes a received signal and/or conserves power in the receiving device*, whereas Applicant describes and claims identifying a multipath transmission delay within a reverse path data signal received from a receiving device, determining a forward path pre-equalization parameter, and modifying a forward path data signal that is to be transmitted to the receiving device, as recited in claim 1" (emphasis added, see, for example, Ex. 1002 at p. 160).

78. I understand that in Sep. 2006 that the US PTO rejected at least then-pending claims 1-41 of U.S. Patent Application No. 10/131,864 wherein at least then-pending claim 1 shown above, as well as then-pending claims 2-5, 9, 12-15 and 28, were rejected as anticipated by U.S. Patent No. 6,252,914 ("Yamamoto") (see, for example, Ex. 1002 at pp. 211-215). For example, the examiner provided at least the following summary of how Yamamoto anticipates such claims (from Ex. 1002 at pp. 213-215):

As per claim 1, Yamamoto discloses a method and apparatus fig. 1 and 2 comprising estimating propagation path characteristics using circuit 32 (note that by estimating the propagation path characteristics, multipath transmission delay is inherently identified or recognized because the multipath is one of the component that affect characteristics of the communication path) within a reverse path data signal received from a receiving device 2 ; determining at least one forward path pre-equalization parameter (i. e coefficients see section 51) based on said propagation path characteristics (multipath transmission delay) and filtering (modifying) using section 52 a forward path data signal that is to be transmitted to the receiving device 2 based on said coefficients (forward path pre-equalization) supplied by circuit 51.

As per claim 2, the reverse path data signal is received over at least one reverse path 3 see fig. 1.

As per claim 3, the modified forward data signal (i.e. output of circuit 50) is transmitted over at least one forward transmission path 3 see fig. 1.

As per claim 4, Yamamoto teaches a QPSK modulation scheme is used at the forward path, the reverse path has to use the same type of modulation as well. see col. 4, lines 57-64.

As per claim 5, the forward path includes at least one type of data selected from QPSK see col. 4, lines 57-64.

As per claim 9, said reverse path data signal includes reference signal (identifiable training data) see col. 2, line8-10.

As per claim 12, the reverse path is the reciprocal of the forward path see col. 2, lines 35-49.

As per claim 13, the steps recited in claim 1 are performed at the transmitting device 1.

As per claim 14, the transmitting device includes a base station for use inherently in wireless transmission see fig. 1.

As per claim 15, the transmitting device 1 inherently includes an antenna coupled thereto to receive data signal from the receiving device 2.

As per claim 28, see claim 15.

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79. Additionally, I understand that in Sep. 2006 that the US PTO rejected at least then-pending claims 1-41 of U.S. Patent Application No. 10/131,864 wherein at least then-pending claims 6-7, 10, 19, 21, 32-33, 35-37 and 41 were rejected as obvious over Yamamoto, without view to additional named prior art (see, for example, Ex. 1002 at pp. 216-219). For example, the examiner provided at least the following summary of how Yamamoto alone renders obvious such claims (from Ex. 1002 at pp. 217-219):

> As per claim 6, as applied to claim 1 above, Yamamoto discloses every feature of the claimed invention but does not explicitly teach that the signal includes subcarrier pre-equalized OFDM data. However, modifying the signal to include subcarrier pre-equalized OFDM data would have been obvious to one of ordinary skill in the art and the motivation to do so would have been to provide compatibility with systems that uses OFDM modulation scheme.
>
> As per claim 7, it would have been obvious to use OFDM data to generate QPSK modulation values so as to provide compatibility with systems that uses QPSK modulation scheme.
>
> As per claim 10, it is known in the art to compare a received training sequence with a local training sequence so as to provide proper indication of transmission medium.
>
> As per claim 19, it would have been obvious to couple the device with a plurality of antenna to enhance signal detection.
>
> As per claim 21, it would have been obvious to one skill in the art to determine at least one angle of arrival of said reverse path with respect to said receive antenna so as to so as to detect delays associated with the received signal.
>
> As per claims 32 and 33, it would have been obvious to one skill in the art to set at least one antenna pointing parameter or phase array associated with said transmit antenna based on the pre-equalization parameter so as to improve signal detection.

As per claim 35, it would have been obvious to one skill in the art to select one antenna from a plurality of antenna to improve system flexibility.

As per claim 36, it would have been obvious to one skill in the art to selectively transmit a plurality of beam using at least two transmit antenna in order to improve signal detection.

As per claim 37 it would have been obvious to one skill in the art to adjust the plurality of beams in amplitude and in phase so as to improve signal detection.

As per claim 41, it would have been obvious to one skill in the art to subband equalize said forward path using corresponding reverse path data so as to remove interference.

80. However, I also understand that in Sep. 2006 that the US PTO notified applicant that at least then-pending claim 42 "would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims" (see, for example, Ex. 1002 at p. 223).

81. I understand that applicant provided amended claims for U.S. Patent Application No. 10/131,864 and remarks in response to the above noted rejection in Sep 2006 (see, for example, Ex. 1002 at pp. 228-249, amended claim 1 as shown below).

1. (Currently Amended) A method comprising:

identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device;

determining at least one forward path pre-equalization parameter based on said at least one transmission delay; and

modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter, where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal.

82. I note that applicant did not provide written correspondence to the US PTO that expressed any disagreement with examiner's above-excerpted descriptions of either disclosure in

Yamamoto of the additional limitations of at least then-pending claims 2-5, 9, 12-15 and 28 or obviousness to a POSITA of the additional limitations of at least then-pending claims 6-7, 10, 19, 21, 32-33, 35-37 and 41 (see, for example, Ex. 1002 at pp. 228, 247-249).

83. I understand that in Oct. 2006 that the US PTO notified the applicant of U.S. Patent Application No. 10/131,864 that then-pending claims were allowable (see, for example, Ex. 1002 at pp. 259-262).

84. I understand that U.S. Patent Application No. 10/131,864 issued as U.S. Patent No. 7,177,369 on Feb. 13, 2007 (see, for example, Ex. 1001 at [45]).

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C. Asserted Claims and Priority Date

85. The '369 Patent includes 91 claims. I understand that Claims 1-7, 9-10, 12-15, 19, 21, 28, 32-33, 35-37 and 41 of the '369 Patent are asserted in the District Court litigation (see, for example, Ex. 1013 at p. 2) and are subject to this *Inter Partes* Review petition. Accordingly, I may refer to Claims 1-7, 9-10, 12-15, 19, 21, 28, 32-33, 35-37 and 41 of the '369 Patent as the "challenged claims" herein.

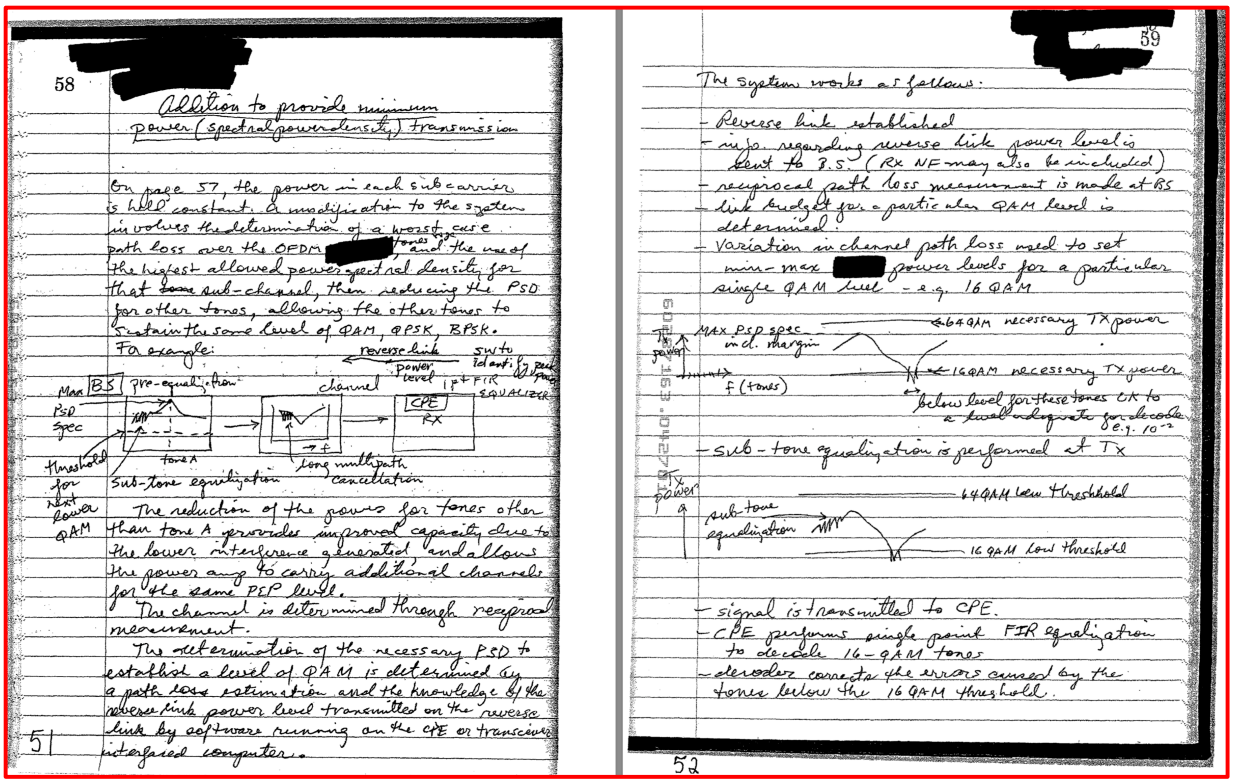
86. The '369 Patent was filed on Apr. 25, 2002 (see, for example, Ex. 1001 at [22]). However, I understand that in the District Court litigation that the Patent Owner alleges the priority date of at least the challenged claims of the '369 Patent to be Apr. 27, 2001 based upon US Provisional Patent Application No. 60/287,163 (the "'163 Application") to which the '369 Patent claims priority to (see, for example, Ex. 1001 at 1:6-10, Ex. 1013 at p.7).

87. In my opinion, at least the challenged claims of the '369 Patent should not be entitled to a priority date based on the '163 Application.

88. For example, challenged claim 1 recites at least "**modifying** a forward path data signal … **based on** said at least one **forward path pre-equalization parameter**" wherein "said **modifying includes selectively setting different transmission power levels** for at least two Orthogonal Frequency Division Multiplexing **(OFDM) tones**" but limited to where said "**forward path pre-equalization parameter**" is determined based on "at least one **multipath transmission delay**" that has been identified "within a **reverse path data signal**".

89. However, to the extent that the '163 Application may be alleged to show such "**modifying** a forward path data signal … **based on** said at least one **forward path pre-equalization parameter**" wherein "said **modifying includes selectively setting different**

transmission power levels for at least two Orthogonal Frequency Division Multiplexing **(OFDM) tones**", such disclosure is within the following excerpt (from Ex. 1003 at pp. 54-55):



90. Thus, the '163 Application at most discloses such "**modifying** a forward path data signal … **based on** said at least one **forward path pre-equalization parameter**" wherein "said **modifying includes selectively setting different transmission power levels** for at least two Orthogonal Frequency Division Multiplexing **(OFDM) tones**" wherein such "**forward path pre-equalization parameter**" is determined based on "info. regarding *reverse link power level*" that "is *sent to B.S.*" and "*reciprocal path loss measurement*" that "is *made at BS*" (emphasis added, see, for example, Ex. 1003 at p. 55).

91. However, a POSITA would not understand that disclosure of a pre-equalization procedure based upon "info. regarding *reverse link power level*" that "is *sent to B.S.*" and "*reciprocal path loss measurement*" that "is *made at BS*" constitutes disclosure of a "**forward**

path pre-equalization parameter" that is determined based on "at least one **multipath transmission delay**" that in turn has been identified "within a **reverse path data signal**" at least because neither such "*reverse link power level*" nor such "*reciprocal path loss measurement*" disclose such "**identifying at least one multipath transmission delay within a reverse path data signal**" from which "**determining at least one forward path pre-equalization parameter**" is "**based on**" as required for at least all of the challenged claims.

92. Accordingly, for purposes of this declaration, I have considered that either Apr. 27, 2001 or Apr. 25, 2002 may be the priority date of the '369 Patent.

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D. Objective Indicia of Non-obviousness

93. I understand that in the District Court litigation, Patent Owner has not yet provided any information regarding this topic. As of this writing, I am unaware of any information that would provide objective indicia of non-obviousness for any of the challenged claims of the '369 Patent. However, to the extent that Patent Owner (or its expert) provides opinions and/or analysis with respect to this topic, I reserve the right to supplement my opinions and analyses on this topic.

VI. CLAIM CONSTRUCTION

94. I understand that claim construction is a matter of law. I further understand that in a *Inter Partes* Review proceeding that the claims are to be given their ordinary and customary (or "plain and ordinary") meaning, as would be understood by a POSITA in the context of the entire disclosure and intrinsic record. I also understand that limitations from the specification of the patent are not to be read into the claims, and that conversely, not all claims necessarily encompass all material disclosed within the specification. The specification, however, can inform a POSITA as to the plain and ordinary meaning of the claims. In addition, I understand that a POSITA would look to statements made by the applicants during the prosecution file history to inform as to the plain and ordinary meaning of the claims.

95. I understand that at least indefiniteness and lack of written description and/or enablement are potential invalidity issues that cannot be addressed as part of an *Inter Partes* Review proceeding. Therefore, solely for the purposes of my prior art invalidity analyses herein as relevant to this *Inter Partes* Review proceeding, I have assumed claim constructions as appropriate for an *Inter Partes* Review proceeding even for such claims and/or claim elements that I may otherwise believe to be indefinite, lacking written description and/or non-enabled as may be set forth in the District Court litigation.

96. I understand that in the District Court litigation involving the Petitioner that Patent Owner has not, as of this writing, identified any claim terms alleged to require constructions nor proposed any claim constructions thereof for the '369 Patent. However, Patent Owner has provided an allegation of infringement for at least the challenged claims of the '369 Patent. Thus, Patent Owner appears to believe that the claim terms of the challenged claims of

the ‘369 Patent are at least as broad as would be necessary for such allegation of infringement to apply.

97. I have applied a plain and ordinary meaning to all claim terms for the purposes of this *Inter Partes* Review proceeding. In my opinion, my analyses of obviousness herein would apply to any reasonable construction of the claim terms as well.

98. In the event that one or more of these constructions is changed, or in the event that additional terms not specifically construed herein receive a proposed construction, I reserve the right to revisit my analysis under such additional construction(s).

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VII. STATE OF THE ART

99. As of the possible priority date of the '369 Patent, the state of the art in the field of wireless communications for OFDM systems already fully encompassed the elements of the asserted claims of the '369 Patent, as evidenced in even the small sample of the art described herein.

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A. Yamamoto (Ex. 1004)

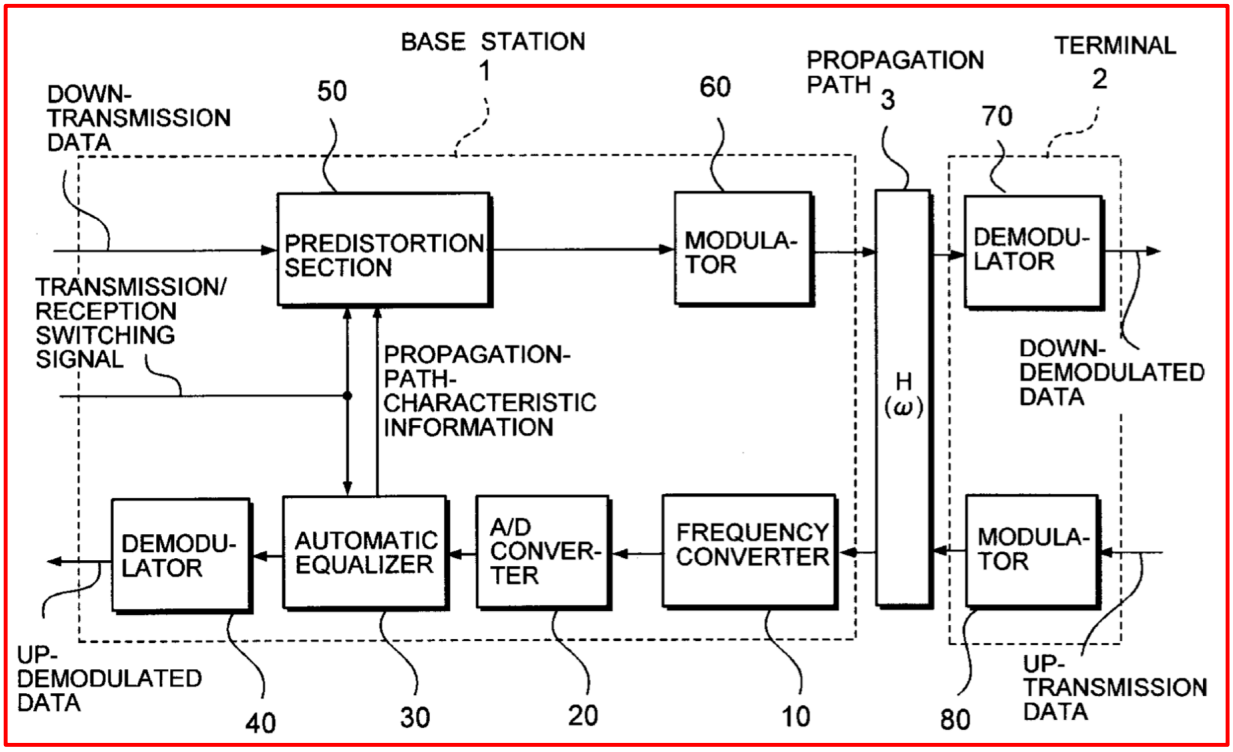
100. For example, amongst the numerous prior art references in this field, U.S. Patent No. 6,252,914 by Takeshi Yamamoto, entitled "Radio Communication System" ("Yamamoto") was filed on Jul. 20, 1999 and assigned to NEC (see, for example, Ex. 1004 at [10], [22], [73], [75]). Thus, I understand that Yamamoto qualifies as prior art to the '369 Patent at least under 35 U.S.C. § 102(e).

101. I note that Yamamoto was cited by the examiner during prosecution of the '369 Patent and that the examiner determined that Yamamoto either disclosed or rendered obvious all limitations in the challenged claims except for the limitation of "where said modifying includes **selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones** in said forward path data signal" (see, for example, ¶¶ 78-82 above).

102. Yamamoto "relates to a radio communication system, particularly to a radio communication *system capable of reducing deterioration of transmission quality due to multipath fading*" (emphasis added, see, for example, Ex. 1004 at 1:17-20).

103. According to Yamamoto, "FIG. 1" discloses "*terminal* **2** and a *base station* **1** connected each other through a *propagation path* **3**" wherein such "*base station* **1** is provided with a frequency converter **10** for frequency-converting the *up-data sent from the terminal* **2** *through the propagation path* **3** into a base band signal and outputting the signal, an A/D converter **20** serving as sample quantization means for sample-quantizing the base band signal outputted from the frequency converter **10**, an *automatic equalizer* **30** for *equalizing distortions of the propagation path* **3** about the base band signal sample-quantized by the A/D converter **20**, *estimating the characteristic of the propagation path* **3** in accordance with the base band signal

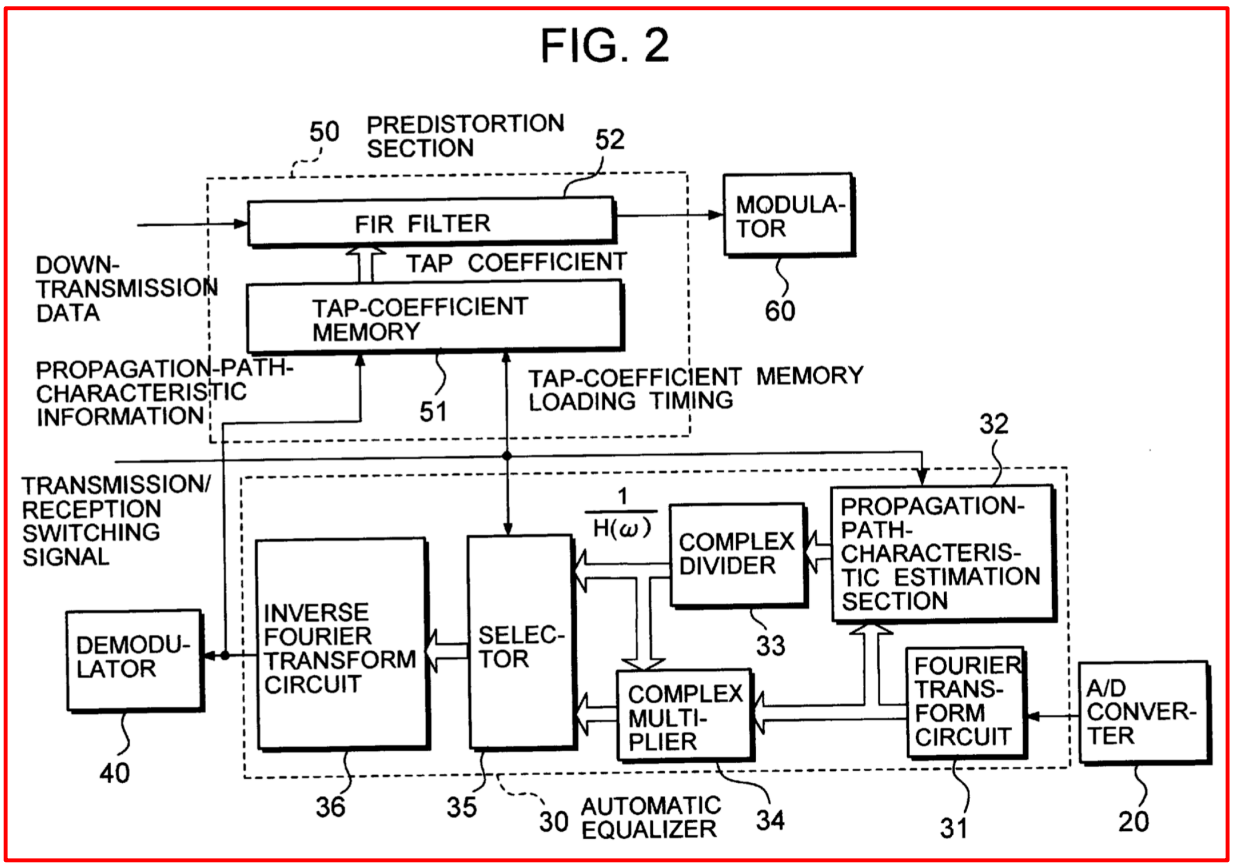
sample-quantized by the A/D converter **20**, and *outputting the estimation result as propagation-path-characteristic information*, a demodulator **40** for demodulating the base band signal whose distortions are equalized by the automatic equalizer **30**, a *predistortion section* **50** for *adding the inverse characteristic of the propagation path* **3** t*o down-transmission data in accordance with the propagation-path-characteristic information* outputted from the automatic equalizer **30**, and a *modulator* **60** for *modulating the down-transmission data to which the inverse characteristic of the propagation path* **3** is *added by the predistortion section* **50**" (emphasis added, see, for example, Ex. 1004 at 3:35-61, FIG. 1 as reproduced below).



104. Therefore, in my opinion, a POSITA would understand even before considering the detailed disclosure of Yamamoto to follow that Yamamoto is from the same field of endeavor as the '369 Patent and that Yamamoto is reasonably pertinent to the problem faced by the '369 Patent (see, for example, ¶¶ 40-41 above regarding the '369 Patent in comparison with

the above-summarized introduction to Yamamoto). Accordingly, Yamamoto is analogous art to the '369 Patent.

105. According to Yamamoto, "FIG. 2 is an illustration showing the configuration of the *automatic equalizer* **30** and the *predistortion section* **50** shown in FIG. 1" (emphasis added, see, for example, Ex. 1004 at 3:62-64, FIG. 2 as reproduced below).



106. In reference to FIG. 2 shown above, Yamamoto discloses a "*modulation method*" that "uses the *QPSK* method" and explains that "*In the base station* **1**, the *up-data sent from the terminal* **2** *through the propagation path* **3** is first frequency-*converted into a base band signal* by the frequency converter **10** and the base band signal outputted from the frequency converter **10** is *sample-quantized* by the A/D converter **20**" so that "Then, *in the Fourier transform circuit* **31** of the *automatic equalizer* **30**, the *base band signal* sample-quantized by the A/D converter

10 is *converted into a frequency-region signal* and *outputted to the propagation-path-characteristic estimation section* **32** and complex multiplier **34**" (emphasis added, see, for example, Ex. 1004 at 4:57-58, 5:5-14).

107. Additionally, Yamamoto explains that "Then, in the *propagation-path-characteristic estimation section* **32**, the *transfer function of the propagation path* **3** is *estimated in accordance with a reference signal* for estimating a known propagation path characteristic *regularly inserted into the up-data* sent from the terminal **2** and a *frequency-region signal corresponding to the reference signal* among the frequency-region signals *outputted from the Fourier transform circuit* **31** and thereby, the *propagation path characteristic* H(ω) of the propagation path **3** is *estimated*" (emphasis added, see, for example, Ex. 1004 at 5:16-25).

108. In continued reference to FIG. 2 shown above, Yamamoto also explains that "Then, in the *complex divider* **33**, the *propagation path characteristic* H(ω) estimated by the propagation-path-characteristic estimation section **32** is *complex-divided* and thereby, the *inverse characteristic* 1/H(ω) *of the propagation path* characteristic H(ω) estimated by the propagation-path-characteristic estimation section **32** *is computed*" and "*inputted to the selector* **35**" (emphasis added, see, for example, Ex. 1004 at 5:26-31, 5:39-42).

109. Additionally, Yamamoto explains that "In the selector **35**" that such "*inverse characteristic* 1/H(ω) of the *propagation path* **3** computed by the complex divider **33** is *outputted after receiving the up-data*, in accordance with a *transmission/reception switching signal* inputted from an external unit" so that subsequently such "*inverse characteristic* 1/H(ω) of the *propagation path* **3** is *inverse-Fourier-transformed* and thereby, an *impulse response is computed* and the computed impulse response is *outputted to the predistortion section* **50**" (emphasis added, see, for example, Ex. 1004 at 5:43-50, 5:58-63).

110. In further reference to FIG. 2 shown above, Yamamoto also explains that "Then, the *impulse response of the inverse characteristic* 1/H(ω) of the *propagation path* **3** outputted from the inverse Fourier transform circuit **36** is *stored in the tap-coefficient memory* **51** of the predistortion section **50**" so that "Then, *in the FIR filter* **52**, the *convolutional operation between the down-transmission data* to be transmitted to the terminal **2** and the *impulse response of the inverse characteristic* 1/H(ω) of the propagation path **3** is *performed by using the impulse response stored in the tap-coefficient memory* **51** as a tap coefficient and thereby, the *inverse characteristic of the propagation path* **3** is *added to the down-transmission data* and output to the converter **60**" (emphasis added, see, for example, Ex. 1004 at 5:64-6:11).

111. Accordingly, Yamamoto concludes that "As described above, in the case of this embodiment, the *propagation characteristic of the propagation path* **3** is *estimated by the automatic equalizer* **30** in the *base station* **1** and the *inverse characteristic of the propagation path* **3** is *added to the down-transmission data* to be transmitted to the terminal **2** in accordance with the estimation result" such that "*even when a distortion is produced due to a multipath in the propagation path* **3**, the *down-data transmitted from the base station* **1** is *correctly received by the terminal* **2** and thereby, *transmission quality is not deteriorated*" (emphasis added, see, for example, Ex. 1004 at 6:23-33).

112. I note that Yamamoto also recites 8 claims. Exemplary claims 6 and 7 are shown below (from Ex. 1005 at 8:59-9:36):

6. A radio communication system having a terminal and a base station connected to each other through a propagation path and capable of reducing deterioration of transmission quality between the terminal and the base station due to multipath fading in the propagation path, the base station comprising:

a predistortion section having an inverse characteristic adder for adding an inverse characteristic of the propagation path, the inverse characteristic computed by complex division and by inverse-Fourier-transformation, to data to be transmitted to the terminal at a time when the base station completes reception of the data transmitted from the terminal,

wherein the inverse characteristic adder adds the inverse characteristic of the propagation path to the data to be transmitted to the terminal by using the inverse characteristic of the propagation path as a tap coefficient, thereby performing a convolutional operation between the inverse characteristic of the propagation path and the data to be transmitted to the terminal.

7. A radio communication system having a terminal and a base station connected to each other through a propagation path and capable of reducing deterioration of transmission quality between the terminal and the base station due to multipath fading in the propagation path, the base station comprising:

a predistortion section having an inverse characteristic adder for adding an inverse characteristic of the propagation path, the inverse characteristic computed by complex division and by inverse-Fourier-transformation, to data to be transmitted to the terminal at a time when the base station completes reception of the data transmitted from the terminal,

wherein the predistortion section has a storage part for storing the inverse characteristic of the propagation path as a tap coefficient at the time when the base station completes the reception of the data transmitted from the terminal, and wherein the inverse characteristic adder performs the convolutional operation between the inverse characteristic of the propagation path stored in the storage part as a tap coefficient and the data to be transmitted to the terminal and adds the inverse characteristic of the propagation path to the data to be transmitted to the terminal.

B. Wong (Ex. 1005)

113. For example, amongst the numerous prior art references in this field, "Multiuser OFDM with Adaptive Subcarrier, Bit, and Power Allocation" by C. Y. Wong et al. was published in the *IEEE Journal on Selected Areas in Communications* at pp. 1747-1758 of Vol. 17, No. 10, Oct. 1999 ("Wong") (see, for example, Ex. 1005 at p. 1747). Thus, I understand that Wong qualifies as prior art to the '369 Patent at least under 35 U.S.C. §§ 102(a) and 102(b).

114. In its "**Abstract**" section, Wong proposes for "Multiuser *orthogonal frequency division multiplexing* (OFDM)" a "multiuser *OFDM subcarrier, bit, and power allocation algorithm* to minimize the total transmit power" based upon "*Assuming knowledge of the instantaneous channel gains* for all users" (emphasis added, see, for example, Ex. 1005 at p. 1747).

115. More specifically, Wong teaches that this "*power allocation algorithm*" is "done by *assigning each user a set of subcarriers* and by *determining the number of bits and the transmit power level for each subcarrier*" (emphasis added, see, for example, Ex. 1005 at p. 1747).

116. In its "**Introduction**" section, Wong observes that "Recently, *intense interest* has focused on *modulation techniques* which can provide broadband *transmission over wireless channels* for applications including wireless multimedia, *wireless Internet access*, and future-generation *mobile communication systems*" (emphasis added, see, for example, Ex. 1005 at p. 1747).

117. More specifically, Wong notes that "One of the *main requirements* on the modulation technique is the *ability to combat intersymbol interference (ISI)*, a major problem in wideband transmission *over multipath fading channels*" and that even though "There are many

methods proposed to combat the ISI" that "Multicarrier modulation techniques, including *orthogonal frequency division multiplex (OFDM)*" are "among the *more promising solutions* to this problem" (emphasis added, see, for example, Ex. 1005 at p. 1747).

118. Wong further observes that "*Assuming that the transmitter knows the instantaneous channel transfer functions* of all users" then prior art papers "have demonstrated that *significant performance improvement can be achieved if adaptive modulation is used* with OFDM" because "*subcarriers with large channel gains employ higher order modulation* to carry more bits/OFDM symbol, while *subcarriers in deep fade carry one or even zero bits/symbol*" (emphasis added, see, for example, Ex. 1005 at p. 1747).

119. Accordingly, Wong concludes as known from survey of the prior art that "As *different subcarriers experience different fades* and *transmit different numbers of bits*, the *transmit power levels must be changed accordingly*" (emphasis added, see, for example, Ex. 1005 at p. 1747).

120. Therefore, in my opinion, a POSITA would understand even before considering the detailed disclosure of Wong to follow that Wong is from the same field of endeavor as the '369 Patent and that Wong is reasonably pertinent to the problem faced by the '369 Patent (see, for example, ¶¶ 69-72 above regarding the '369 Patent in comparison with the above-summarized Abstract and Introduction to Wong). Accordingly, Wong is analogous art to the '369 Patent.

121. Wong teaches that "*In this paper*, we formulate the *multiuser subcarrier, bit, and power allocation problem*" so that "the bit and *power allocation* algorithm can be *applied to each user on its allocated subcarriers*" as "can be applied, for instance, to the *downlink*

transmission in a time division duplex (TDD) wireless communication system to improve the downlink capacity" (emphasis added, see, for example, Ex. 1005 at pp. 1747-1748).

122. More specifically, Wong specifically teaches for such a "*time division duplex (TDD) wireless communication system*" that "the *base station (BS)* can *estimate the instantaneous channel characteristics* of all the BS-to-mobile links *based on the received uplink transmissions*" such that "The multiuser *subcarrier*, bit, and *power allocation can then be used*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

123. Wong observes that "there is a *certain amount of transmission overhead* as the BS has to inform the mobiles about their *allocated subcarriers* and the *number of bits assigned to each subcarrier*" even in a "*TDD system*" where "the *power level used does not need to be transmitted* to the receiver" (in contrast to "FDD systems") but Wong also teaches that "this *overhead can be relatively small*, especially if the *channels vary slowly* (e.g., in an *indoor low mobility environment*), and the *assignment* is done once *every many OFDM symbols*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

124. Wong further teaches that "To *further reduce the overhead*, we can *assign a contiguous band of subcarriers with similar fading characteristics as a group*, instead of *assigning each individual subcarrier*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

125. In its "**System Model**" section, Wong states that "The configuration of our *multiuser adaptive OFDM system* is shown in Fig. 1" which shows "that the *system* has *K users* and the k^{th} user has a *data rate* equal to R_k *bit per OFDM symbol*" (emphasis added, see, for example, Ex. 1005 at pp. 1748-1749, Fig. 1 as reproduced below).

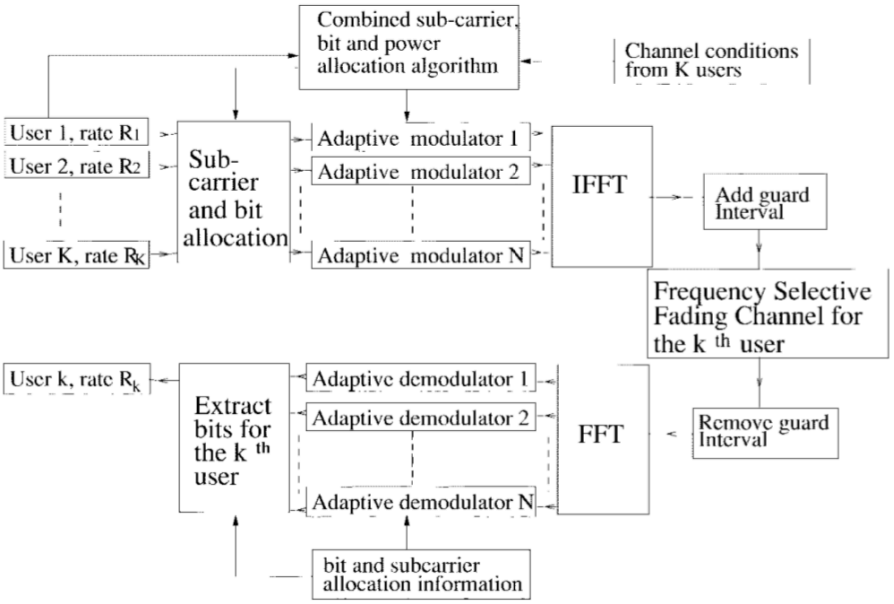


Fig. 1. Block diagram of a multiuser OFDM system with subcarrier, bit, and power allocation.

126. In reference to Fig. 1 shown above, Wong explains that "In the *transmitter*, the *serial data* from the *K users are fed into the subcarrier and bit allocation block* which *allocates bits from different users to different subcarriers*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

127. Wong explains that under the assumption that "*each subcarrier* has a *bandwidth* that is *much smaller than the coherence bandwidth of the channel* and that the *instantaneous channel gains on all the subcarriers of all the users are known to the transmitter*" then by "*Using the channel information*, the *transmitter applies* the combined *subcarrier, bit, and power allocation algorithm* to *assign different subcarriers to different users* and the *number of bits/OFDM symbol to be transmitted on each subcarrier*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

128. More specifically, Wong teaches that "Depending on the *number of bits assigned to a subcarrier*, the adaptive modulator will use a *corresponding modulation scheme*, and the

transmit power level will be adjusted according to the combined subcarrier, bit, and power allocation algorithm" (emphasis added, see, for example, Ex. 1005 at p. 1748).

129. Also, in this "**System Model**" section, Wong defines "$c_{k,n}$ to be the *number of bits* of the k^{th} *user* that are *assigned to* the n^{th} *subcarrier*" wherein "for each n, if $c_{k',n} \neq 0, c_{k,n} = 0$ for all $k \neq k'$" because Wong does "*not allow more than one user to share a subcarrier*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

130. Wong further assumes that "the *adaptive modulator* allows $c_{k,n}$ to *take values in the set* $\boldsymbol{D} = \{0,1,2,\dots,M\}$ where M is the *maximum number of information bits/OFDM symbol* that can be *transmitted by each subcarrier*" (emphasis added, see, for example, Ex. 1005 at p. 1748).

131. In further reference to Fig. 1 shown above, Wong explains that "The *complex symbols at the output of the modulators* are *transformed into the time domain samples* by inverse fast Fourier transform (IFFT)" and "*Cyclic extension* of the time domain samples, known as the guard interval, is *then added*" so that "The *transmit signal* is then *passed through different frequency selective fading channels* to different users" (emphasis added, see, for example, Ex. 1005 at p. 1748).

132. Additionally, Wong explains that "In the *frequency selective fading channel*, *different subcarriers will experience different channel gains*" but "the *single-sided noise power* spectral density (PSD) level N_0 is *equal to unity* (i.e., $N_0 = 1$), *for all subcarriers* and is the *same for all users*" (emphasis added, see, for example, Ex. 1005 at pp. 1748-1749).

133. More specifically, Wong also defines "$\alpha_{k,n}$" as "the *magnitude of the channel gain* (assuming coherent reception) of the n^{th} *subcarrier* as seen by the k^{th} *user*" and "$f_k(c)$" as "the *required received power* (in energy per symbol) *in a subcarrier for reliable reception* of c

information bits/symbol *when the channel gain is equal to unity*" (emphasis added, see, for example, Ex. 1005 at pp. 1748-1749).

134. Wong notes that "$f_k(c)$ depends on k, and this *allows different users to have different quality-of-service (QoS) requirements* and/or *different coding and modulation schemes*" (emphasis added, see, for example, Ex. 1005 at p. 1749).

135. Accordingly, Wong teaches in view of the above that "In order to *maintain the required QoS* at the receiver, the *transmit power*, allocated to the n^{th} *subcarrier* by the k^{th} *user must equal*" the value of "$P_{k,n}$" given in the expression of Eq. (1) (emphasis added, see, for example, Ex. 1005 at p. 1749, Eq. (1) as reproduced below).

$$P_{k,n} = \frac{f_k(c_{k,n})}{\alpha_{k,n}^2} \qquad (1)$$

136. Thus, Wong concludes that "*Using these transmit power levels*, the *receiver* can demodulate the modulated symbols at the output of the FFT processor and *achieve the desired QoS's of all users*" (emphasis added, see, for example, Ex. 1005 at p. 1749).

137. Wong also teaches that "The goal of the *combined subcarrier, bit, and power allocation algorithm* is then to *find the best assignment* of $c_{k,n}$ so that the *overall transmit power*" (or "P_T^*"), which is given by "the *sum of* $P_{k,n}$ *over all subcarriers and all users*", is "*minimized for given transmission rates of the users* and *given QoS requirements*" as "specified through $f_k(c), k = 1, \ldots, K$" (emphasis added, see, for example, Ex. 1005 at p. 1749).

138. More specifically, Wong teaches in its "**Bit Allocation Algorithm for Single User Channel**" and "**Multiuser Subcarrier and Bit Allocation**" sections specific methodologies for how "to *find the best assignment* of $c_{k,n}$", or hence how to selectively set "$P_{k,n}$ *over all subcarriers and all users*" in view of all corresponding "$\alpha_{k,n}$" as "the *magnitude of*

the channel gain (assuming coherent reception) of the n^{th} *subcarrier* as seen by the k^{th} *user*" (emphasis added, see, for example, Ex. 1005 at pp. 1748-1752).

139. For example, Wong describes the "*optimization problem*" for the "*single-user case*" wherein Wong has "dropped the subscript k" as being given by Eq. (5) subject to "*minimization*" as "*under the constraint*" of Eq. (6) (emphasis added, see, for example, Ex. 1005 at pp. 1749-1750, Eq. (5) and Eq. (6) as reproduced below).

$$P_T^* = \min_{c_n \in \boldsymbol{D}} \sum_{n=1}^{N} \frac{1}{\alpha_n^2} f(c_n) \qquad (5)$$

$$R = \sum_{n=1}^{N} c_n \qquad (6)$$

140. In reference to Eq. (5) and Eq. (6) shown above, Wong teaches that "a *greedy approach is optimal*" wherein such "greedy algorithm *assigns bits to the subcarriers one bit at a time*, and in *each assignment*, the *subcarrier that requires the least additional power* is *selected*" such that "The bit allocation *process* will be *completed when all R bits are assigned*" (emphasis added, see, for example, Ex. 1005 at p. 1750).

141. More specifically, Wong recites from other prior art references that this algorithm can be described as shown in the excerpt below (see, for example, Ex. 1005 at p. 1750, excerpt as reproduced below).

Initialization:
For all n, let $c_n = 0$ and $\Delta P_n = [f(1) - f(0)]/\alpha_n^2$;
Bit Assignment Iterations:
Repeat the following R times:
$\hat{n} = \arg\min_n \Delta P_n$;
$c_{\hat{n}} = c_{\hat{n}} + 1$;
$\Delta P_{\hat{n}} = [f(c_{\hat{n}} + 1) - f(c_{\hat{n}})]/\alpha_{\hat{n}}^2$;
End;
Finish:
$\{c_n\}_{n=1}^N$ is the final bit allocation solution.

142. In reference to the algorithm excerpt shown above, Wong explains that "The initialization stage computes, *for each subcarrier*, the *additional power needed to transmit an additional bit*" and then "For *each bit assignment iteration*, the *subcarrier that needs the minimum additional power is assigned one more bit*, and the *new additional power for that subcarrier is updated*" such that "After *R* iterations, the *final bit assignment gives the optimal bit allocation* for each subcarrier" (emphasis added, see, for example, Ex. 1005 at p. 1750).

143. In its "**Performance Comparison**" section, Wong compares "the *performance of the MAO scheme* with *other static subcarrier allocation schemes*" wherein "*MAO*" refers to "*multiuser adaptive OFDM*" as described by the "*combined subcarrier, bit, and power allocation algorithm*" taught in previous sections of Wong (emphasis added, see, for example, Ex. 1005 at p. 1752).

144. More specifically, Wong considers "a system that employs *M-ary quadrature amplitude modulation (MQAM)* with $\boldsymbol{D} = \{0,2,4,6\}$" and "*Square signal constellations (4-QAM, 16-QAM, and 64-QAM)*" that "are used to carry two, four, or six bits/symbol" within "an *OFDM system with 128 subcarriers over a 5 MHz band*" simulated for operation in "five-path *frequency selective Rayleigh fading channels* with an exponential power delay profile" and an "*RMS delay*

spread" in the range of "100 ns" to "1000 ns" across certain examples (emphasis added, see, for example, Ex. 1005 at pp. 1752-1753).

145. Additionally, Wong describes that in this example that "the *required power* for supporting *c bits/symbol* at a *given BER* P_e is" given the equations as shown in the excerpt below (emphasis added, see, for example, Ex. 1005 at p. 1752, excerpt as reproduced below).

$$f(c) = \frac{N_0}{3}\left[Q^{-1}\left(\frac{P_e}{4}\right)\right]^2 (2^c - 1)$$

where we recall that

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty e^{-t^2/2}\, dt.$$

146. In its "**Conclusion**" section, Wong summarizes its "**Performance Comparison**" section by observing that "the *overall required transmit power* can be *reduced* by about 5–10 dB from the *conventional OFDM without adaptive modulation*" or alternatively "the *transmit power* can be *reduced* by about 3–5 dB from the *conventional OFDM with adaptive modulation and adaptive bit allocation*, but *without adaptive subcarrier allocation*" (emphasis added, see, for example, Ex. 1005 at p. 1757).

147. Finally, Wong reports that "The results in this paper *assume perfect channel estimation*" but "channel estimation in *wireless fading channels* is in general *not very accurate*", and accordingly Wong states that "the effect of *nonideal channel information* on the *performance* of our proposed MAO scheme is a *very important issue*" even though Wong also has "preliminary results" that "have indicated that *the MAO scheme is not very sensitive to channel estimation errors*" (emphasis added, see, for example, Ex. 1005 at p. 1757).

C. Minn (Ex. 1006)

148. For example, amongst the numerous prior art references in this field, "An Investigation into Time-Domain Approach for OFDM Channel Estimation" by H. Minn et al. was published in the *IEEE Transactions on Broadcasting* at pp. 240-248 of Vol. 46, No. 4, Dec. 2000 ("Minn") (see, for example, Ex. 1006 at p. 240). Thus, I understand that Minn qualifies as prior art to the '369 Patent at least under 35 U.S.C. §§ 102(a) and/or 102(b).

149. In its "**Abstract**" section, Minn states that "A *time-domain based channel estimation for OFDM system* with pilot-data multiplexed scheme is investigated" wherein "intra-symbol time-averaging and *most significant channel taps selection* are applied" (emphasis added, see, for example, Ex. 1006 at p. 240).

150. In its "**Introduction**" section, Minn observes that "*Orthogonal frequency division multiplexing* (OFDM)" has "recently achieved much *popularity due to its desirable properties* such as its *robustness to multipath delay spread* and impulse noise, its *high data rate* transmission capability with *high bandwidth efficiency*, and its *feasibility* in application of *adaptive modulation and power allocation across the subcarriers according to the channel conditions*" (emphasis added, see, for example, Ex. 1006 at p. 240).

151. More specifically, Minn notes that OFDM "has been *adopted*" for at least "*high rate wireless LAN standards* such as *ETSI HiperLAN 2 and IEEE 802.11(a)*, and *multimedia wireless services* such as Japanese MMAC (Multimedia Mobile Access Communications)" (emphasis added, see, for example, Ex. 1006 at p. 240).

152. Minn explains that "If *coherent OFDM system* is adopted, *channel estimation becomes a requirement* and usually *pilot tones are used for channel (frequency response) estimation*" wherein "Pilot tones can be *inserted in all subcarriers of a particular OFDM symbol*

forming an *OFDM training symbol*, in which case training symbols are *transmitted at an appropriate regular rate* determined by the *time varying nature of the wireless channel*" (emphasis added, see, for example, Ex. 1006 at p. 240).

153. Minn notes that many prior art "*channel estimation* approaches may be viewed as *DFT-based* approaches" and are based at least upon "*LS (Least square)* channel (*frequency response*) estimates" (emphasis added, see, for example, Ex. 1006 at p. 240).

154. However, Minn proposes that "In this paper, we investigate a *time-domain channel estimation approach*, namely *FPTA (Frequency Pilot Time Average)*", as previously disclosed in the prior art Yeh reference, which "applies *intra-symbol time-domain averaging of identical parts of the pilot signal*" (emphasis added, see, for example, Ex. 1006 at p. 240).

155. Therefore, in my opinion, a POSITA would understand even before considering the detailed disclosure of Minn to follow that Minn is from the same field of endeavor as the '369 Patent and that Minn is reasonably pertinent to the problem faced by the '369 Patent (see, for example, ¶¶ 59-61 above regarding the '369 Patent in comparison with the above-summarized Abstract and Introduction to Minn). Accordingly, Minn is analogous art to the '369 Patent.

156. In its "**System Description**" section, Minn describes that "*pilot tones* $P[k]$ are *multiplexed with data* $D[k]$ in all OFDM symbols at a *pilot ratio* $1/K$ (ratio of the number of pilot tones to the total number of subcarriers) where k is *subcarrier index* $(0,1,\dots,N-1)$ with N being the *total number of subcarriers*, and $P[k]$ and $D[k]$ are *zeros except at their corresponding subcarriers*" (emphasis added, see, for example, Ex. 1006 at p. 240).

157. Accordingly, Minn states that "Then the *transmitted OFDM signal in discrete-time domain*, excluding guard-interval, can be expressed as" shown in Eq. (1) "where $IFFT_n\{\}$ is

N-point *inverse Fast Fourier transform* and n in the *time-domain index* $(0, 1, \cdots, N-1)$ of an OFDM symbol" (emphasis added, see, for example, Ex. 1006 at pp. 240-241, Eq. (1) as reproduced below).

$$s[n] = IFFT_N\{P[k]\} + IFFT_N\{D[k]\}$$
$$= p[n] + d[n] \qquad (1)$$

158. Additionally, Minn describes that "the *wireless channel has a discrete-time impulse response* given by" Eq. (2) "where α_l is *complex path gain* of lth path, τ_l is the *delay* of lth path, and L is the *total number of channel paths*" (emphasis added, see, for example, Ex. 1006 at p. 241, Eq. (2) as reproduced below).

$$h[n] = \sum_{l=0}^{L-1} \alpha_l \delta[n - \tau_l]) \qquad (2)$$

159. Accordingly, Minn observes that "After *passing through a multipath wireless channel*, the *time-domain received samples* of an OFDM symbol, if appropriate cyclic prefix guard samples are used, is given by" Eq. (3) "where $\otimes$ represents N-point *circular convolution*, $\{w[n]\}$ are *independent and identically distributed (iid) AWGN samples* with zero mean and variance of σ_t^2" (emphasis added, see, for example, Ex. 1006 at p. 241, Eq. (3) as reproduced below).

$$r[n] = s[n] \otimes h[n] + w[n] \qquad (3)$$

160. Minn further notes that "the FFT output frequency-domain subcarrier symbols can be expressed as" Eq. (4) "where $W[k] = FFT_N\{w[n]\}$ is frequency-domain AWGN noise samples with zero mean and variance $\sigma_f^2 = N\sigma_t^2$" (emphasis added, see, for example, Ex. 1006 at p. 241, Eq. (4) as reproduced below).

$$R[k] = FFT_N\{r[n]\} = H[k]P[k]$$

$$+H[k]D[k] + W[k] \qquad (4)$$

161. Also, Minn explains that "the *channel frequency response* at the pilot tones can be *estimated* by" Eq. (5) "where m is the *subcarrier index for pilot tones*" (emphasis added, see, for example, Ex. 1006 at p. 241, Eq. (5) as reproduced below).

$$\widehat{H}[m] = \frac{R[m]}{P[m]} = H[m] + \frac{W[m]}{P[m]} \qquad (5)$$

162. Minn defines that such "*channel estimate*" $\widehat{H}[m]$ from Eq. (5) shown above "is called *LS (least square) estimate*" and Minn notes that "The *channel responses at other subcarriers* can be obtained by *interpolation*" (emphasis added, see, for example, Ex. 1006 at p. 241).

163. In its "**Most Significant Taps Approach**" section, Minn teaches that "For *practical multipath wireless channels*, there are *not so many channel paths with significant energy* (if compared to the FFT size N)" and "Hence, among N *samples (taps) of the channel impulse response estimate*, *many samples (taps) will have little or no energy* at all except noise perturbation" (emphasis added, see, for example, Ex. 1006 at p. 242).

164. Accordingly, Minn further teaches that "*Neglecting those nonsignificant channel taps in channel estimation* may introduce some performance degradation if some of the channel energy is missed, but at the same time it will *eliminate the noise perturbation from those taps*" and because "*Usually* total *noise perturbation from those neglected channel estimate taps* is *much higher than the multipath energy contained in them*, especially for low SNR values" then "neglecting those nonsignificant channel estimate taps can *improve the channel estimation performance significantly* and this fact is *applied in the proposed method* as shown in Fig. 1" (emphasis added, see, for example, Ex. 1006 at p. 242, Fig. 1 as reproduced below).

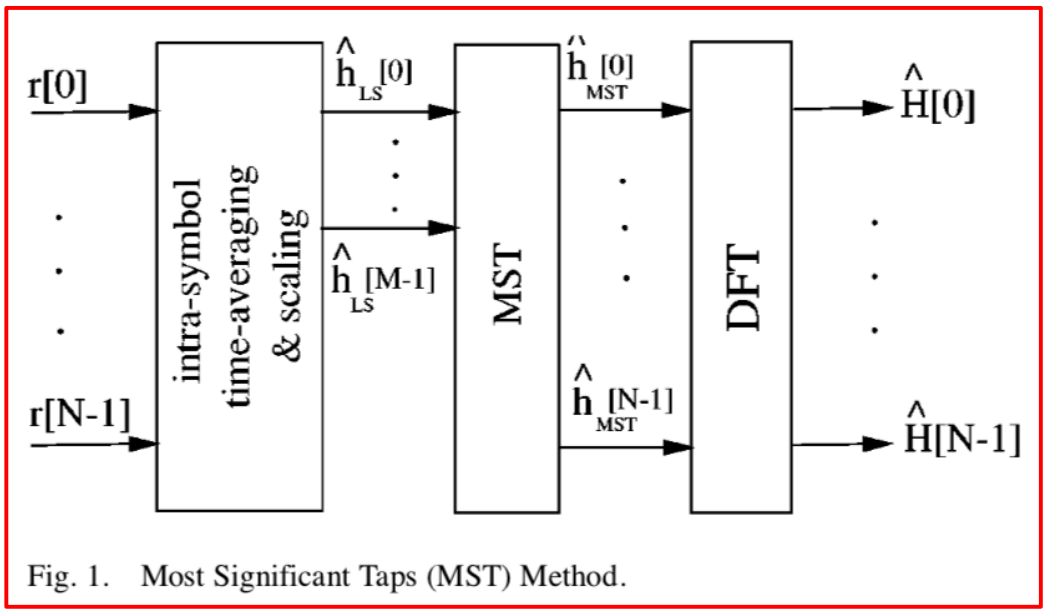


Fig. 1. Most Significant Taps (MST) Method.

165. In reference to Fig. 1 shown above, Minn explains that, consistent with the "**System Description**" section summarized above, "*pilot tones are multiplexed with data in each OFDM symbol at a pilot ratio* of $1/K$" wherein "The *pilot tone used in the proposed MST approach* is" given by Eq. (18) where "A is *pilot amplitude*", "$M = N/K$ is an integer" and "$0 \leq m \leq M-1$" (emphasis added, see, for example, Ex. 1006 at pp. 241-242, Eq. (18) as reproduced below).

$$P[k] = \sum_{m=0}^{M-1} A\delta[k - mK], \qquad k = 0, 1, \cdots, N-1 \qquad (18)$$

166. Additionally, Minn explains in reference to "$P[k]$" in Eq. (18) shown above that "the *corresponding time-domain samples* contain K *identical parts* and are given by" Eq. (19) (emphasis added, see, for example, Ex. 1006 at p. 242, Eq. (19) as reproduced below).

$$p[n] = \sum_{m=0}^{M-1} \frac{A}{K}\delta[n - mM], \qquad n = 0, 1, \cdots, N-1 \qquad (19)$$

167. For this "**Most Significant Taps Approach**", Minn specifically teaches that "If the *maximum channel delay spread is less than the length of an identical part*, which can be designed to satisfy this, then the *time-domain received samples* corresponding to the time-domain pilot samples contain K parts, each representing a *scaled channel impulse response for the respective part* corrupted by AWGN" and thus "If the *channel path gains remain essentially the same over an OFDM symbol interval*, which is usually the case since OFDM systems are usually designed to satisfy this in order to maintain orthogonality among subcarriers, then the *received samples corresponding to time-domain pilot samples contain* K *repeated version of scaled channel impulse response which are independently corrupted by AWGN*" (emphasis added, see, for example, Ex. 1006 at pp. 242-243).

168. Accordingly, Minn further teaches that this means that "In order to *choose most significant channel taps*, those K *parts can be averaged* so that the *noise variance is reduced* by K times and *more reliable most significant channel taps can be obtained*" wherein because "The *mean of data part after averaging is zero*" then "After averaging, we have the *noise-corrupted scaled channel impulse response*" given by Eq. (21) and further "Then the *raw channel impulse response estimate* is given by" Eq. (22) (emphasis added, see, for example, Ex. 1006 at p. 243, Eq. (21) and Eq. (22) as reproduced below, but note that "M" should obviously be "N").

$$r_{avg}[n] = \frac{A}{K}h[n] + w_{avg}[n], \qquad n = 0, 1, \cdots, M-1 \qquad (21)$$

$$\hat{h}_{LS}[n] = \frac{K}{A}r_{avg}[n] = h[n] + \frac{K}{A}w_{avg}[n],$$

$$n = 0, 1, \cdots, M-1 \qquad (22)$$

169. Next, for this "**Most Significant Taps Approach**", Minn specifically teaches that "the *most significant* J *channel taps* are *chosen as the largest amplitude channel taps*" wherein

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"the *channel tap indexes* for those most significant J taps" are "denoted by $n_0, n_1, \cdots, n_{J-1}$" and thus "the *time-domain channel impulse response estimate of proposed MST method* is obtained by *setting the other channel tap gains to zero* as shown" in Eq. (23) (emphasis added, see, for example, Ex. 1006 at p. 243, Eq. (23) as reproduced below).

$$\hat{h}_{MST}[n] = \sum_{i=0}^{J-1} \hat{h}_{LS}[n_i]\, \delta[n - n_i],$$

$$n = 0, 1, \cdots, N-1 \qquad (23)$$

170. Finally, for this "**Most Significant Taps Approach**", Minn teaches that "*channel frequency response estimate* is *directly obtained by applying* FFT to $\{\hat{h}_{MST}[n]\}$" in the form given by "$\hat{H}_{MST}[k] = FFT_N\{\hat{h}_{MST}[n]\}, k = 0, 1, \cdots, N-1$" as also described by Eq. (24) (emphasis added, see, for example, Ex. 1006 at p. 243).

171. Minn observes that "By using *suitable number of most significant taps*" that "the *channel estimation error* is mostly dominant (or totally caused) by the *noise term*" such that the "*mean square error* (mse) of channel estimate" has a "*performance gain* of proposed *MST method over LS method*", such "*LS method*" being a prior art frequency domain channel estimation method as summarized above, that "is ideally N/JK" although "The actual mse *performance gain would be less than this amount due to the interference from data part* and some (if any) *excluded channel taps of nonsignificant energy*" (emphasis added, see, for example, Ex. 1006 at pp. 242-243).

172. Accordingly, Minn further teaches that "the *number of most significant taps*" should be "chosen *larger than* the (designed) *number of multipaths* in order to *prevent channel estimation error* caused by missed channel taps" because "The *channel estimation error caused*

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by the noise from an additional tap in channel estimation is *much less than that caused by missing one of the multipaths*" (emphasis added, see, for example, Ex. 1006 at p. 243).

173. For example, Minn suggests that "A *suitable choice* for *J* may be *two times or more* of the (designed) *number of multipaths*" but "Another *MST tap selection approach* can be implemented by *selecting the channel taps whose energy is above a threshold*" (emphasis added, see, for example, Ex. 1006 at p. 243).

174. In its "**Similar Approaches in DFT-Based Methods**" section, Minn teaches that "due to the *one-to-one relationship of DFT and IDFT*, the *MST method can be related to DFT-based approach* as shown in Fig. 2" (emphasis added, see, for example, Ex. 1006 at p. 243, Fig. 2 as reproduced below).

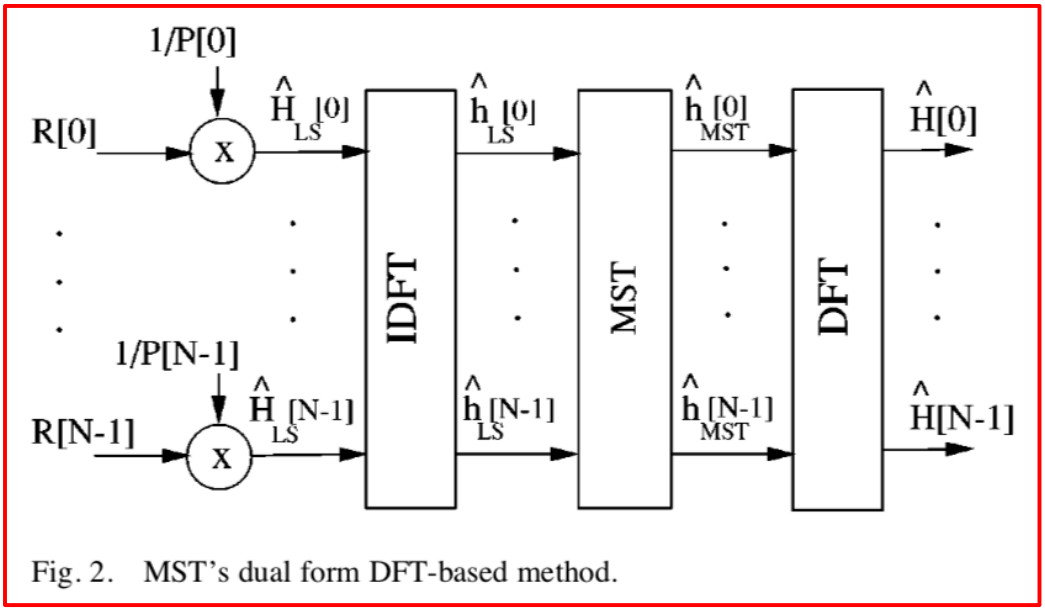


Fig. 2. MST's dual form DFT-based method.

175. For these "**DFT-Based Methods**", Minn explains in reference to Fig. 2 shown above that for a "*system with training symbol* (i.e., *pilot tones on all subcarriers*)" then "First, *LS estimates are obtained* and then *input to IFFT block resulting in N* samples LS *estimate of*

channel impulse response", which is seen in Fig. 2 as "$\hat{h}_{LS}[0] \cdots \hat{h}_{LS}[N-1]$" (emphasis added, see, for example, Ex. 1006 at p. 243).

176. Accordingly, Minn explains that next "The *largest amplitude* J *channel taps* among the N samples (taps) are *chosen* as J *most significant channel taps* and the *other taps are set to zero*", which is seen in Fig. 2 as "$\hat{h}_{MST}[0] \cdots \hat{h}_{MST}[N-1]$", so that "The *resulting MST channel impulse response estimate* is *input to FFT block* to *get the MST channel frequency response estimate*", which is seen in Fig. 2 as "$\hat{H}[0] \cdots \hat{H}[N-1]$" (emphasis added, see, for example, Ex. 1006 at pp. 243-244).

177. Minn observes that "The *difference* between *proposed MST approach* and its *dual form DFT-based approach* is that *MST uses pilot-data multiplexed approach* while its *dual form DFT based approaches use training symbol approach*" (emphasis added, see, for example, Ex. 1006 at p. 244).

178. However, Minn explains that "the *potential gain of the latter approach* is N/J" while "Using *total pilot power* of NA^2" whereas "*MST achieves potential gain* of $N/(JK)$ with *total pilot power* of NA^2/K; hence, on the *basis of the same total pilot power*, *both methods have the same potential gain* for channel estimation" (emphasis added, see, for example, Ex. 1006 at p. 244).

179. Minn also observes that "Another *difference* is the *complexity*" because "In *MST approach*, operations involved are *time-averaging*, *most significant channel taps selection* and *one FFT operation* whereas its *dual form DFT-based approach* requires *LS estimation*, *one IFFT operation*, *most significant channel taps selection* and *one FFT operation*" and "Hence, the *proposed MST approach saves some complexity*" (emphasis added, see, for example, Ex. 1006 at p. 244).

D. Yeh (Ex. 1007)

180. For example, amongst the numerous prior art references in this field, "Channel Estimation Using Pilot Tones in OFDM Systems" by C. Yeh et al. was published in the *IEEE Transactions on Broadcasting* at pp. 400-409 of Vol. 45, No. 4, Dec. 1999 ("Yeh") (see, for example, Ex. 1007 at p. 400). Thus, I understand that Yeh qualifies as prior art to the '369 Patent at least under 35 U.S.C. §§ 102(a) and 102(b).

181. In its "**Abstract**" section, Yeh states that "*Channel estimation techniques using pilot tones in OFDM systems* are investigated" wherein "Based on theoretical analysis and computer simulation, for a *channel with multipath distortion* and AWGN, the proposed *time-domain channel estimation schemes perform better than the conventional frequency domain channel estimation techniques*" (emphasis added, see, for example, Ex. 1007 at p. 400).

182. In its "**Introduction**" section, Yeh observes that "In an *OFDM system*, the incoming signal is *transmitted using N equally spaced carriers* with a carrier spacing of l/(NT) Hz, where T is the input data bit period" but subject to "*Multipath*" that "causes the *channel transfer function to have variation* in both *spectral magnitude* and spectral phase linearity" such that "The effect of *multipath distortion* is then reduced to *amplitude attenuation and phase rotation of data in each carrier*, and the channel equalization is reduced to a complex multiplication bank in front of the decision circuit at the receiver" (emphasis added, see, for example, Ex. 1007 at p. 400).

183. Additionally, Yeh observes that "In the *OFDM system*, the *estimation of the channel response uses in-band pilot tones inserted into each symbol* with a pilot ratio PR =1/R" as "referred to as *scheme A*, as depicted in Fig. la" and also "An *alternative is to insert pilot tones into all of the carriers* in an OFDM symbol with a period of R, as depicted in Fig. 1b" as

"referred to as *scheme B*" (emphasis added, see, for example, Ex. 1007 at p. 400, Figure 1 as reproduced below).

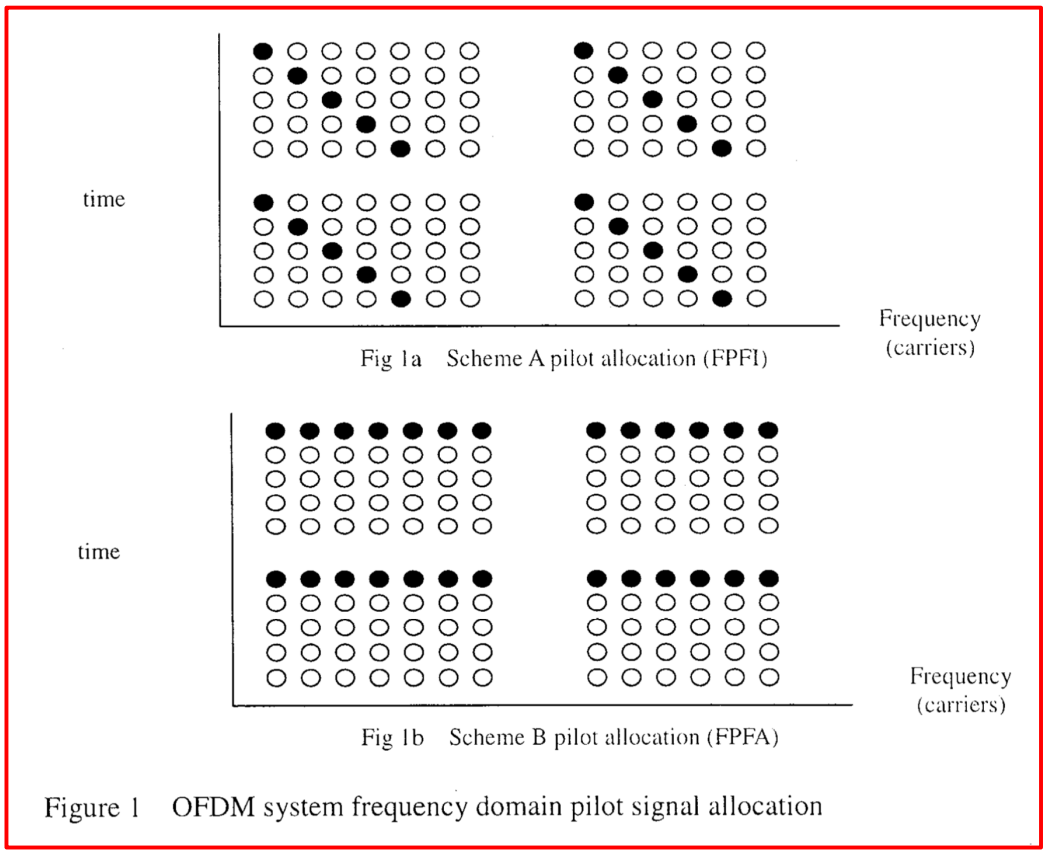


Figure 1 OFDM system frequency domain pilot signal allocation

184. In its "**Proposed Channel Estimation Techniques**" section, Yeh states that "A *typical OFDM system* is depicted in Fig. 2", which illustrates conventional "*Channel model estimation of frequency pilot in the frequency domain*" (emphasis added, see, for example, Ex. 1007 at p. 400, Figure 2 as reproduced below).

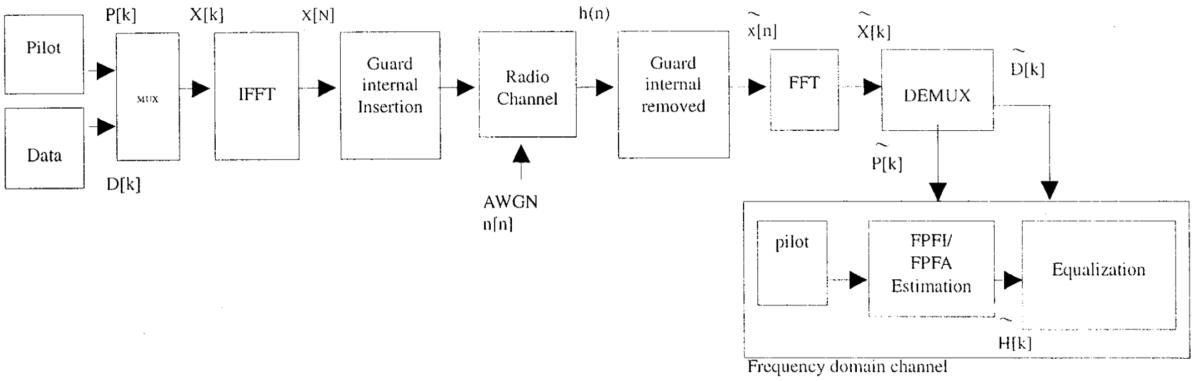


Figure 2 Channel model estimation of frequency pilot in the frequency domain

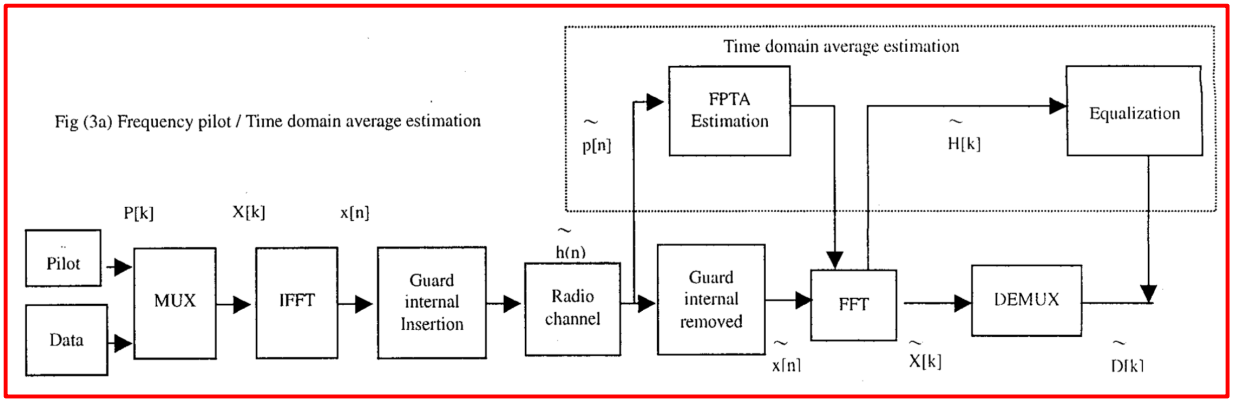
185. In reference to Figure 2 shown above, Yeh explains that "*Pilot tones* are modulated with a PN sequence *in the frequency domain and are inserted into each OFDM symbol* with a ratio PR =1/R using *scheme A*" so that then "The *channel response is estimated in the frequency domain* using FFT processing and comparing received pilots with the locally stored reference pilots" wherein "This is referred to as the *Frequency Pilot Frequency Interpolation (FPFI) technique* since the channel response is obtained via frequency interpolation" (emphasis added, see, for example, Ex. 1007 at p. 401).

186. Additionally, in reference to Figure 2 shown above, Yeh explains that "The *pilot tones* can also be *inserted into the OFDM symbols using scheme B*" so that "In this scheme, all pilot tones are inserted in the first OFDM symbol (pilot symbol) of a data frame" and then "The *channel response is obtained by averaging several consecutive pilot symbols* and comparing the average with a locally stored reference symbol" wherein "This technique is referred to as the *Frequency Pilot Frequency Average (FPFA) technique*" (emphasis added, see, for example, Ex. 1007 at p. 401).

187. However, as Yeh previously noted, "In this paper, *channel estimation* conducted in the *time domain is proposed*" and "In *one* of the two *proposed techniques*, instead of the PN

sequence the *positive and negative polarization pilot signals are alternatively inserted into OFDM symbols in the frequency domain* using FPFI" (emphasis added, see, for example, Ex. 1007 at p. 401).

188. For this first "*time domain*" technique, Yeh further explains that "An *OFDM symbol* can be *regarded as several time slots*, with *each* time slot *having a pilot*" and thus "Assuming that the *impulse response of each time slot is identical*, one can *obtain the channel response in the time domain by averaging these time slots*" wherein "This technique is referred to as the *Frequency Pilot Time Average (FPTA) technique*, as depicted in Fig. 3a" (emphasis added, see, for example, Ex. 1007 at p. 401, Fig. 3a as reproduced below).



189. Additionally, for the second "*time domain*" technique, Yeh explains that "a *PN sequence is periodically inserted into the OFDM symbol in the time domain*, and the *channel response* can be *obtained via correlation in the time domain*" wherein "This technique is referred to as the *Time Pilot Time Correlation (TPTC) technique*, as depicted in Fig. 3b" (emphasis added, see, for example, Ex. 1007 at p. 401, Fig. 3b as reproduced below).

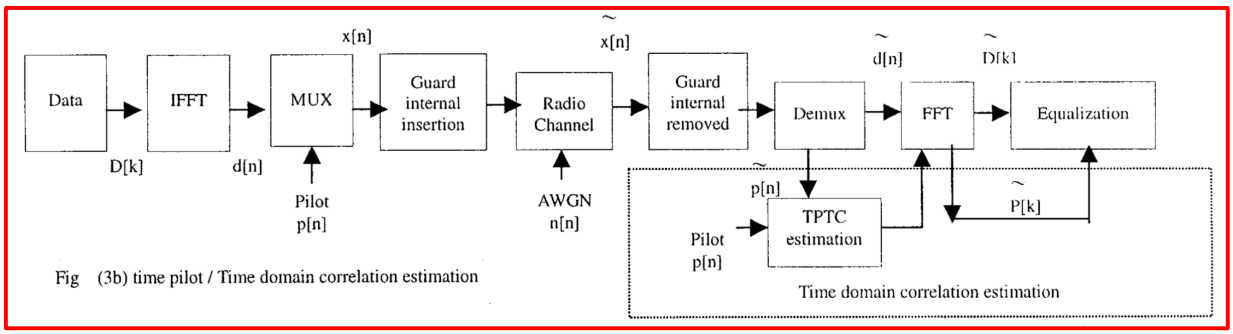


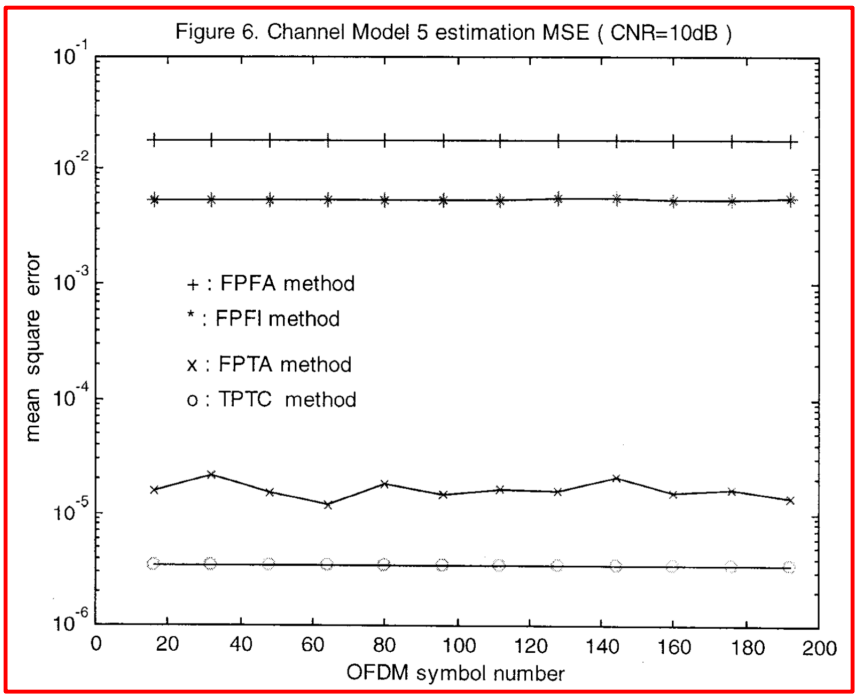
Fig (3b) time pilot / Time domain correlation estimation

190. In reference to Fig. 3b shown above, Yeh explains that "In this technique the *channel response is estimated using the correlation of received pilot signal and the locally stored PN sequence*" with "*length of the PN sequence*" equal to "K" such that "If the transmitted pilot signal $p[n]$ is a PN sequence, the *received pilot signal* $\tilde{p}[n]$ can be expressed as $\tilde{p}[n] = p[n] \otimes h[n]$ in the *time domain*" and "Thus the *channel response can be estimated* using" the expression "$h[n] = \frac{1}{K}\sum_i \tilde{p}[n] \cdot p[n+i]^*$ in the *time domain*" (emphasis added, see, for example, Ex. 1007 at p. 401).

191. In its "**Pilot to Noise (P/N) Ratio**" section, Yeh analyses the above described "*Frequency Pilot Frequency Interpolation (FPFI)*", "*Frequency Pilot Frequency Average (FPFA)*" and "*Frequency Pilot Time Average (FPTA)*" techniques to determine that theoretically "The *FPTA estimation performance is better than the FPFA and FPFI*" due to an "*improvement*" in the "*pilot to noise*" ratio, or alternatively the "*gain of the time domain … over the frequency domain*", by a factor of "$\sqrt{\frac{N}{R}}$" where N is the "*Number of carriers*" and exemplary values for R are given as 8 or 32 (emphasis added, see, for example, Ex. 1007 at pp. 401-403).

192. In its "**Channel Estimation Accuracy**" section, Yeh reports that "the *mean square error between estimated response and real channel response* was also compared to *demonstrate the superiority of the time-domain estimation techniques*" wherein "the results are

illustrated in Fig. 6" (emphasis added, see, for example, Ex. 1007 at p. 404, Fig. 6 as reproduced below).



193. In its "**Summary**" section, Yeh concludes that "In this paper the *channel estimation techniques (FPTA and TPTC) in the time domain* using pilot tones for the OFDM system are presented" because "a *higher P/N ratio can be obtained in the time domain*" such that "the proposed estimation techniques *outperform the conventional estimation techniques (FPFI and FPFA) in which the channel response is estimated in the frequency domain*" (emphasis added, see, for example, Ex. 1007 at p. 404).

E. Heiskala (Ex. 1008)

194. For example, amongst the numerous prior art references in this field, *OFDM Wireless LANs: A Theoretical and Practical Guide*, by J. Heiskala and J. Terry, ISBN: 0672321572, Sams Publishing ("Heiskala") was published in a "First Printing: Dec. 2001" (see, for example, Ex. 1008 at p. ii). Thus, I understand that Heiskala is either contemporaneous art to the '369 Patent or may qualify as prior art to the '369 Patent at least under § 102(a).

195. Heiskala observes that "The *Discrete Fourier Transform (DFT)* is, arguably, the *most widely used design and analysis tool in electrical engineering*" because "For many situations, *frequency-domain analysis of discrete-time signals* and systems *provide insights* into their characteristics that are *not easily ascertainable in the time-domain*" (emphasis added, see, for example, Ex. 1008 at p. 11).

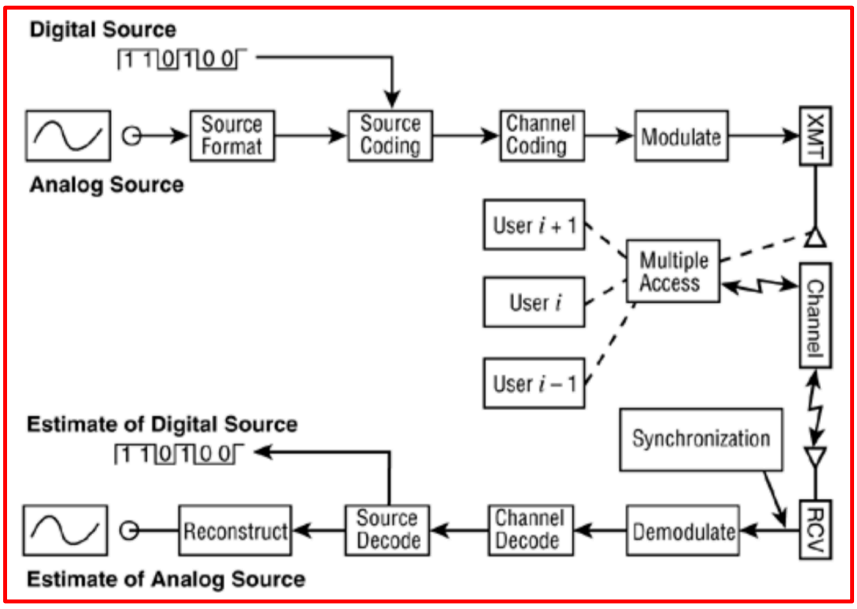
196. For example, Heiskala writes that "The *N-point DFT of a finite length sequence* $x(n)$ is defined as" Eq. (1.30) (emphasis added, see, for example, Ex. 1008 at p. 11, Eq. (1.30) as reproduced below).

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{-j2\pi kn/N} \qquad (1.30)$$

197. Similarly, Heiskala observes that "The *DFT has an inverse transformation* called the *inverse DFT (IDFT)*" which "provides a means of *recovering the finite length sequence* $x(n)$ through the following relationship" given as Eq. (1.33) (emphasis added, see, for example, Ex. 1008 at p. 11, Eq. (1.33) as reproduced below).

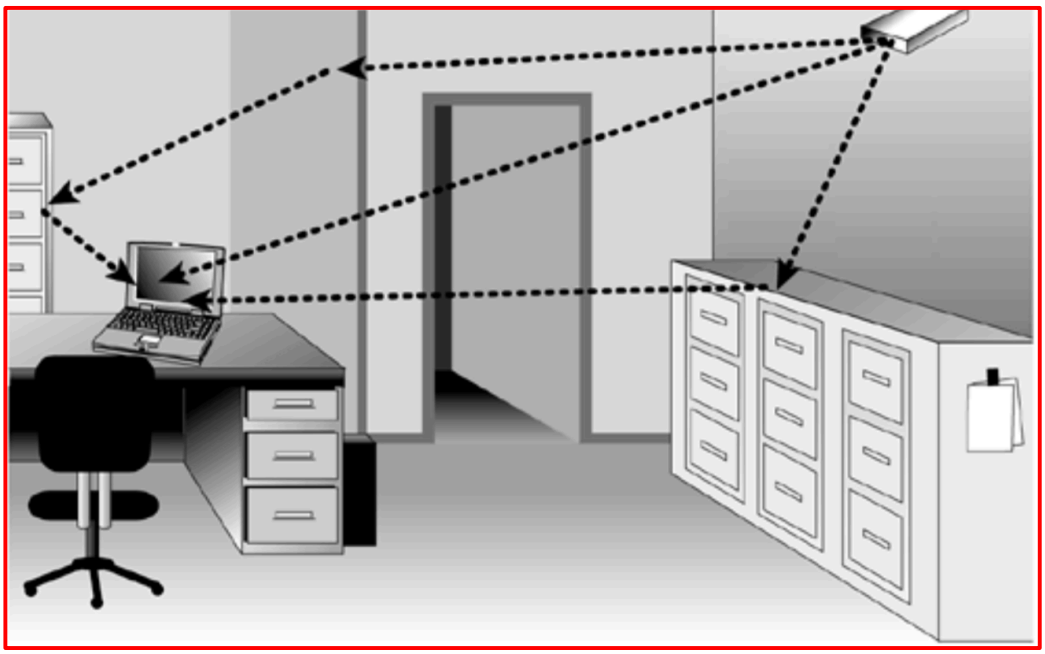
$$x(n) = \frac{1}{N} \sum_{n=0}^{N-1} X(k) e^{j2\pi kn/N} \qquad (1.33)$$

198. Heiskala provides Figure 1.2 as the "*Basic elements of a digital communication system*" (emphasis added, see, for example, Ex. 1008 at p. 13, Figure 1.2 as reproduced below).



199. In reference to Figure 1.2 shown above, Heiskala explains that "*Multiple access* refers to the *remote sharing of a fixed communication resource (CR)*, such as a *wireless channel*, by a *group of users*" wherein "For wireless communications, the CR can be thought of as a hyperplane *in frequency and time*" and wherein "The goal of multiple access is *to allow users to share the CR without creating unmanageable interferences with each other*" (emphasis added, see, for example, Ex. 1008 at p. 25).

200. Heiskala explains that "In *mobile wireless communications*, the *information signals are subjected to distortions* caused by *reflections and diffractions* generated by the *signals interacting with obstacles and terrain conditions* as depicted in Figure 1.11", which depicts "*Multipath scattering in mobile communications*" (emphasis added, see, for example, Ex. 1008 at p. 28, Figure 1.11 as reproduced below).



201. In reference to Figure 1.11 shown above, Heiskala explains that "*Multipath* is a term used to describe the *reception of multiple transmission paths to the receiver*" wherein "the channel can be accurately *described by a random process*; hence, the *state of the channel* will be *characterized by its channel correlation function*" (emphasis added, see, for example, Ex. 1008 at p. 28).

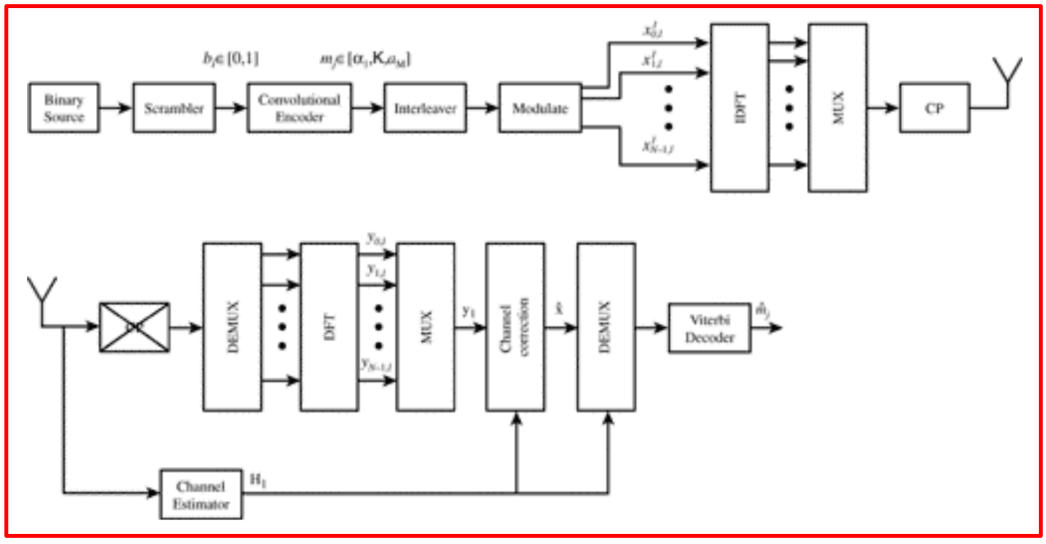
202. Heiskala observes that "*Orthogonal frequency division multiplexing (OFDM)* is a promising technique for *achieving high data rate and combating multipath fading in wireless communications*" wherein "*Orthogonality* amongst the carriers is achieved by *separating the carriers by an integer multiples of the inverse of symbol duration* of the parallel bit streams" such that "With OFDM, *all the orthogonal carriers are transmitted simultaneously*" or "In other words, the *entire allocated channel* is occupied through the *aggregated sum of the narrow orthogonal subbands*" (emphasis added, see, for example, Ex. 1008 at p. 31).

203. Heiskala notes, specifically for around the time of the alleged invention of the '369 Patent, that "Currently, there are *three approved world WLAN standards that utilize OFDM*

for their physical layer specifications, which are listed in Table 1.3, where *HiperLAN/2 stands for High Performance Local Area Network type 2* and *MMAC stands for Mobile Multimedia Access Communications*" (emphasis added, see, for example, Ex. 1008 at p. 32, Table 1.3 as reproduced below).

Standard	***Region of Operation***
IEEE 802.11a	Europe and North America
HiperLAN/2	Europe and North America
MMAC	Japan

204. Heiskala also explains that "The *physical layers of all the standards are very similar* and are based on an *OFDM baseband modulation*" that "was selected to *combat frequency selective fading* and to *randomize the burst errors caused by a wideband fading channel*" wherein "A *simplified block diagram* of the *IEEE 802.11a transceiver*" is given by Figure 1.17 (emphasis added, see, for example, Ex. 1008 at p. 36, Figure 1.17 as reproduced below).



205. In reference to Figure 1.17 shown above, Heiskala explains that "Since *OFDM is a frequency domain modulation technique*, it is essential to have *accurate estimates of the frequency offset*, caused by oscillator instability, at the receiver" and "*channel estimation is*

needed as well to demodulate the symbols" such that "*Training sequences are provided* in the preamble for these specific functions" (emphasis added, see, for example, Ex. 1008 at p. 38).

206. More specifically, Heiskala explains that "To reduced the uncertainty in the *channel estimation*, *two OFDM symbols containing training sequences are provided*: short training and long training" wherein "The *short training* is used to provide *coarse and fine estimation of time and frequency errors*" while "The *long training sequence* is used to *estimate the channel impulse response or channel state information (CSI)*" (emphasis added, see, for example, Ex. 1008 at p. 38).

207. In a chapter entitled "**Synchronization**", Heiskala describes in detail at least the topics of "*Timing Estimation*", "*Frequency Synchronization*" and "*Channel Estimation*" and notes that such "*OFDM synchronization functions* can be *performed either in time- or frequency-domain*" but "The main *assumption* usually made when WLAN systems are designed is that the *channel impulse response does not change significantly during one data burst*" and thus "most of the *synchronization for WLAN receivers is done during the preamble* and need not be changed during the packet" (emphasis added, see, for example, Ex. 1008 at pp. 47-49).

208. More specifically, Heiskala describes that "*Channel estimation* is the task of *estimating the frequency response of the radio channel the transmitted signal travels before reaching the receiver antenna*" wherein the "*impulse response*" of the "radio channel" is usually "*represented as a discrete time FIR filter*" as shown in Eq. (2.67) for "WLAN applications" where "α_n is the *attenuation factor for the signal received* on the nth path" and "τ_n is the *propagation delay* for the nth path" (emphasis added, see, for example, Ex. 1008 at pp. 29, 77, Eq. (2.67) as reproduced below).

$$h(\tau) = \sum_n \alpha_n e^{-j2\pi f_c \tau_n} \delta(\tau - \tau_n) \qquad (2.67)$$

209. Additionally, Heiskala describes that "Then the *discrete time frequency response* of the channel is the *Fourier transform of the channel impulse response*" shown in Eq. (2.67) above as given by Eq. (2.68) (emphasis added, see, for example, Ex. 1008 at p. 77, Eq. (2.68) as reproduced below).

$$H_k = DFT\{h_n\} \qquad (2.68)$$

210. Moreover, Heiskala notes that "*Channel estimation is mandatory for OFDM systems* that employ *coherent modulation* schemes" (such as the "*WLAN standards that utilize OFDM*" as described above) because "*Otherwise correct demodulation would not be possible*" and thus "the *channel estimation process outputs* the $\widehat{H}_k$, an *estimate of the channel frequency response for each subcarrier*" (emphasis added, see, for example, Ex. 1008 at p. 77).

211. Heiskala notes in the "**Frequency Domain Approach for Channel Estimation**" section that "The *long training symbols* in the WLAN preamble … facilitate an easy and *efficient estimate of the channel frequency response for all the subcarriers*" wherein because "The contents of the *two long training symbols are identical*" then "*averaging them* can be used to *improve* to *quality of the channel estimate*" such that "only *one DFT operation is needed* to calculate the channel estimate" (emphasis added, see, for example, Ex. 1008 at pp. 77-78).

212. More specifically, Heiskala describes that "*After the DFT* processing, the *received training symbols* $R_{1,k}$ and $R_{2,k}$ are a *product of the training symbols* X_k and the *channel* H_k *plus additive noise*" and "Thus the *channel estimate can be calculated* as" given by Eq. (2.70) (emphasis added, see, for example, Ex. 1008 at p. 78, Eq. (2.70) as reproduced below).

$$\widehat{H}_k = \frac{1}{2}\left(R_{1,k} + R_{2,k}\right)X_k^* \qquad (2.70)$$

213. Heiskala further notes in the "**Time Domain Approach for Channel Estimation**" section that "The *channel estimation* can also be *performed using the time domain*

approach, *before DFT processing* of the training symbols" such that "In this case, the *channel impulse response*, *instead of the channel frequency response*, is *estimated*" (emphasis added, see, for example, Ex. 1008 at p. 79).

214. More specifically, Heiskala describes when "the *channel estimator* uses IEEE 802.11a *standard training symbols* as an example" that the "*received time domain signal* during the two long training symbols" can be "*expressed*" as a "*convolution*" by Eq. (2.78) (emphasis added, see, for example, Ex. 1008 at p. 79, Eq. (2.78) as reproduced below).

$$r_{l,n} = h * x_n + w_{l,n} = Xh + w_l \qquad (2.78)$$

215. As shown in Eq. (2.78) above, Heiskala explains that this "*time domain convolution* can be expressed as a *matrix vector multiplication*" wherein "*The circular convolution matrix* is formed from the *training data* as" given in Eq. (2.76) where "The parameter L *defines the maximum length of the impulse response that can be estimated*, and X is in general a *rectangular matrix*" and wherein "The *channel impulse response vector* is" shown in Eq. (2.77) (emphasis added, see, for example, Ex. 1008 at p. 79, Eq. (2.76) and Eq. (2.77) as reproduced below).

$$X = \begin{bmatrix} x_1 & x_{64} & x_{63} & \cdots & x_{64-L+2} \\ x_2 & x_1 & x_{64} & & x_{64-L+3} \\ \vdots & & \vdots & & \vdots \\ x_{63} & x_{62} & & & x_{64-L} \\ x_{64} & x_{63} & & \cdots & x_{64-L+1} \end{bmatrix} \qquad h = \begin{bmatrix} h_1 \\ h_2 \\ h_3 \\ \vdots \\ h_L \end{bmatrix}$$

216. Accordingly, Heiskala describes that "The *channel impulse response estimate* can then be formed by" Eq. (2.79) where "$X^{\dagger}$ denotes *Moore-Penrose generalized inverse* of X" and further that "The *channel frequency response estimate* is then formed by *calculating the DFT of*

the impulse response estimate" as given by Eq. (2.83) (emphasis added, see, for example, Ex. 1008 at p. 80, Eq. (2.79) and Eq. (2.83) as reproduced below).

$$\hat{h} = \frac{1}{2} X^{\dagger}\left(r_{1,n} + r_{2,n}\right) \qquad (2.79)$$

$$\hat{H} = DFT\{\hat{h}\} \qquad (2.83)$$

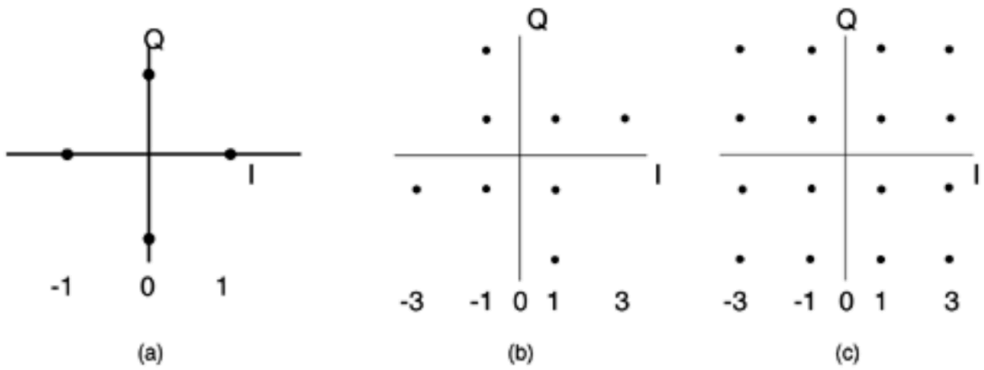
217. Heiskala also explains in the "**Analysis of the Time Domain and Frequency Domain Approaches for Channel Estimation**" section that "The *advantage of the time domain approach is improved performance*, when the *maximum length of the impulse response* can be *limited to a number significantly less than the number of subcarriers*" because "the *frequency domain estimator has to simultaneously estimate all the subcarriers*, whereas the *time domain estimator needs to estimate only the taps of the impulse response*" (emphasis added, see, for example, Ex. 1008 at p. 80).

218. Accordingly, Heiskala further explains that "*When the number of subcarriers is large compared to the number of channel taps*, the *signal energy used to estimate* each H_k is *significantly less than the signal energy used to estimate* each h_n" but "The *drawback of the time domain method* is that *additional computations* are required" because Eq. (2.79) shown above requires "$64 \cdot L$ *multiplications*, which are *not needed at all in the frequency domain estimator*", or thus "the usual *engineering trade-off*; *better performance* usually implies *higher costs* in one form or another" (emphasis added, see, for example, Ex. 1008 at pp. 80-81).

219. Heiskala also explains that "*channel estimation*" that uses "*training data transmitted on every subcarrier*" is generally applicable to "*WLAN systems*" while "*channel estimation*" that uses "*training information that is transmitted on a subset of the subcarriers*" is generally applicable to "*broadcast OFDM systems*" (emphasis added, see, for example, Ex. 1008 at p. 77).

220. Heiskala notes for OFDM that "*Quadrature Amplitude Modulation (QAM)* changes both the amplitude and phase of the carrier" wherein "Figure 3.4 shows *three QAM constellations*: (a) *4-QAM or QPSK*, (b) *8-QAM*, and (c) *16-QAM*" and further notes that "Especially *QPSK and 16-QAM* are *very common* modulations" (emphasis added, see, for example, Ex. 1008 at pp. 94-95, Figure 3.4 as reproduced below).

Figure 3.4. QAM constellations, (a) QPSK, (b) 8-QAM, (c) 16-QAM.



221. In a chapter entitled "**Antenna Diversity**", Heiskala notes that "Recent information theoretic results suggest that there is *tremendous capacity potential for wireless communication systems using antenna diversity*" as "*multiple independent channels* between transmitters and receivers" such as "antenna diversity or polarization discrimination" that "occurs when the *independent paths are spatial in nature*" because "there is *sufficient spacing between the antenna elements* at the transmitters and receivers such that there is *no or very little correlation amongst their respective signals*" and accordingly, such "*antenna diversity* can be used to either *improve the link performance* of a signal or *increase data throughput*", and Heiskala further notes with reference to a 1998 publication that "*OFDM systems* are *particularly well-suited* for enhanced capacity using *antenna diversity techniques*" (emphasis added, see, for example, Ex. 1008 at p. 124, Ex. 1014 at § 6.2).

222. More specifically, Heiskala describes that "*When the channel is* not AWGN but rather *fading*, *diversity can be employed at the receiver*" such that "It can be shown that *multiple reception from a single transmitter can increase capacity*" (emphasis added, see, for example, Ex. 1008 at p. 126).

223. For example, Heiskala explains that "At the receiver, a *linear combination of the antenna outputs* are performed such that *information contained in the input signal is maximized*" by an "algorithm" that "is called the *maximal ratio combining (MRC)*" or "Another receive diversity technique, which is commonly used but not optimum, is *selection diversity*" that "*selects the receive antenna with the highest SNR*" (emphasis added, see, for example, Ex. 1008 at pp. 126-127).

224. More generally, Heiskala observes that "*Spectral diversity is effective* when the *fading is frequency-selective*" as "can be exploited when the available bandwidth for transmission is large enough that *individual multipath components can begin to be resolved*" such as in "*OFDM systems*" but "*Even in situations where the fading channel is nonselective*" Heiskala explains that "*spatial diversity can be used to provide substantial improvement in system performance*" through "the use of *multiple antennas sufficiently well-separated* at the receiver and/or the transmitter that the *individual transmission paths experience effectively independent fading*" (emphasis added, see, for example, Ex. 1008 at p. 131).

225. Additionally, Heiskala explains that "*receive diversity can be impractical* in a number of applications" but "In such scenarios, the *use of multiple antennas at the transmitter*, which is referred to as *transmit diversity*, is *significantly more attractive*" and thus "*Multiple element transmitter antenna arrays* have an increasingly *important role* to play in emerging

wireless LAN networks, particularly at the AP" where "such *arrays* can *dramatically enhance performance*" (emphasis added, see, for example, Ex. 1008 at p. 136).

226. More specifically, Heiskala explains that the "design criteria for *transmit diversity schemes*" will "*depend heavily on how much is known about the channel* at the transmitter and receiver" (emphasis added, see, for example, Ex. 1008 at p. 136).

227. For example, Heiskala observes that "In general, a *wireless communication system* is comprised of N *transmit antennas* and M *receive antennas*" such that "The *information data is encoded* using a channel code" and such "*encoded data stream is split* into N *parallel streams, each* of which is modulated and then *transmitted using separate antennas*" and thus if "*Each path for the separate antennas* is assumed *i.i.d.* and quasi-static" ("*i.i.d.*" means "independent identical distributed") then the system is defined by "the *complex gains of the paths*" that should be "*constant over each data frame*" (emphasis added, see, for example, Ex. 1008 at p. 136).

F. Sindhushayana (Ex. 1009)

228. For example, amongst the numerous prior art references in this field, U.S. Patent No. 6,594,318 by N. Sindhushayana, entitled "Method and apparatus for computing soft decision input metrics to a turbo decoder" ("Sindhushayana") was filed on Mar. 8, 2000, and issued on Jul. 15, 2003 (see, for example, Ex. 1009 at (22), (45)). Thus, I understand that Sindhushayana qualifies as prior art to the '369 Patent at least under 35 U.S.C. § 102(e).

229. Sindhushayana discloses that "In a *typical communication system* **400**, as illustrated in FIG. 8", "code *symbols* are blocked together and *mapped to a point on a signal constellation* by a signal mapping module **404**, thereby generating a sequence x_n of *complex-valued, modulation symbols*" which are "*applied to a modulator* **406**, which generates a continuous-time waveform, which is *transmitted over a channel* **408**" (emphasis added, see, for example, Ex. 1009 at 19:40-49, FIG. 8 as reproduced below).

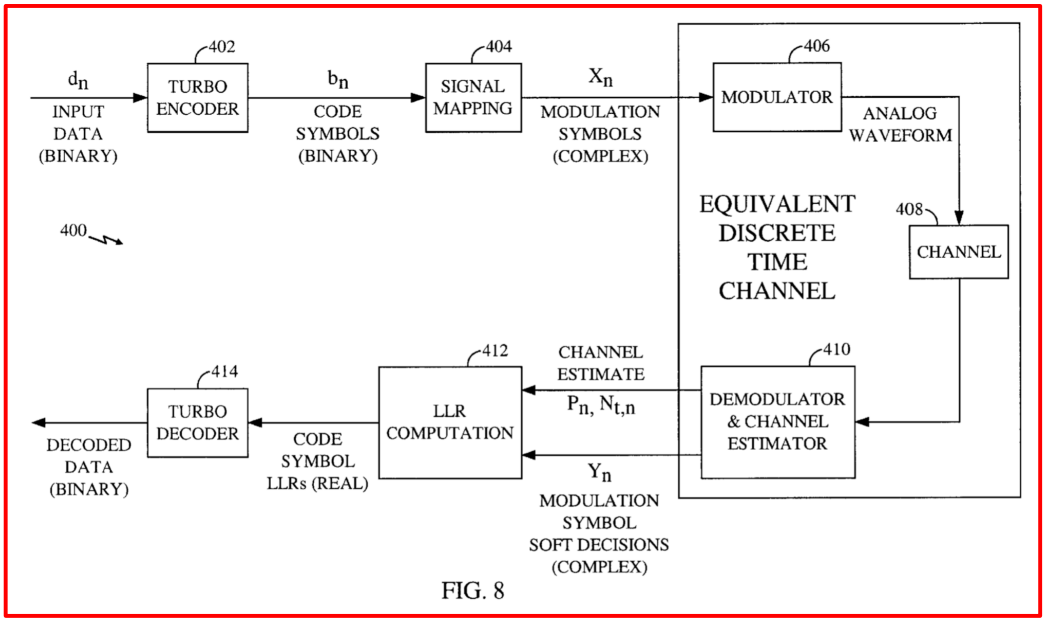


FIG. 8

230. More specifically, Sindhushayana discloses that "The *square QAM constellation* with index m is *defined to be* a signal constellation with 4^m *points*" wherein this "signal

constellation for $m = 1$ is *depicted in FIG. 9*" (emphasis added, see, for example, Ex. 1009 at 19:61-63, 20:57-58, FIG. 9 as reproduced below).

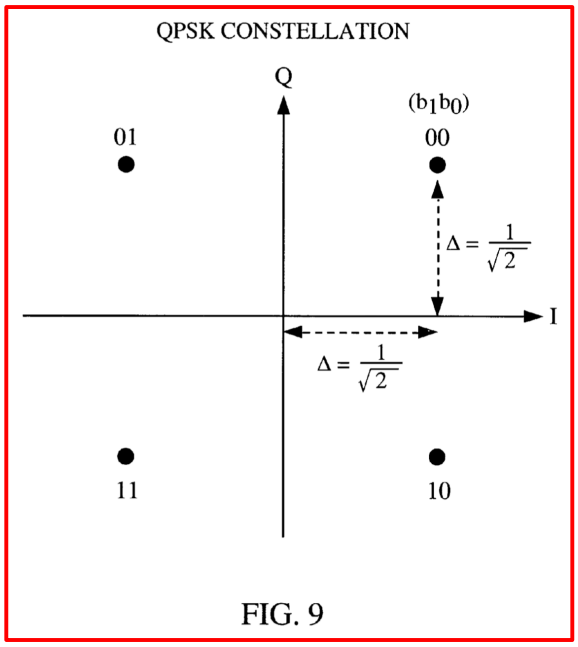


FIG. 9

231. Sindhushayana further discloses that "For $m = 2$, the 2^m−PSK *constellation coincides with the 4QAM constellation* shown in FIG. 9, and is more *commonly known as a QPSK constellation*" (emphasis added, see, for example, Ex. 1009 at 21:29-31).

G. Lehne (Ex. 1010)

232. For example, amongst the numerous prior art references in this field, "An Overview of Smart Antenna Technology for Mobile Communications Systems", *IEEE Communications Surveys*, 4th Quarter, 1999, Vol. 2, No. 4 by Per H. Lehne and Magne Pettersen ("Lehne") was published in 1999 (see, for example, Ex. 1010 at p. 1). Thus, I understand that Lehne qualifies as prior art to the '369 Patent at least under 35 U.S.C. §§ 102(a) and 102(b).

233. Lehne states that "The technology of *smart or adaptive antennas* for *mobile communications* has received *enormous interest worldwide in recent years*" such as for a "*cellular system*" wherein "*the radio communication is between the user and a* ***base station***, which provides *radio coverage within a certain area*, which is *called a* ***cell***" (bold italic emphasis in original, other emphasis added, see, for example, Ex. 1010 at p. 2).

234. Lehne notes that "The *theory behind smart antennas is not new*" because "The technique has *for many years been used in electronic warfare* (EWF) as a countermeasure to electronic jamming" while "In *military radar systems similar techniques* were already *used during World War II*" but "the technology almost exclusively suggested *for land-based mobile and personal communications systems* is ***array antennas***" wherein "By *maximizing the antenna gain in the desired direction* and *simultaneously placing minimal radiation pattern in the directions of the interferers*, the *quality of the communication link* can be *significantly improved*" (bold italic emphasis in original, other emphasis added, see, for example, Ex. 1010 at p. 3).

235. Lehne further notes that although "Several *different definitions for smart antennas are used in the literature*" that a "*consistent definition* can be that the *difference between a smart/adaptive antenna* and a *"dumb"/fixed antenna* is the *property of having an adaptive and fixed lobe-pattern, respectively*" (emphasis added, see, for example, Ex. 1010 at p. 4).

236. Lehne explains that "Normally, the term "*antenna*" comprises only" the "*radiating element*" but "In the context of *smart antennas*, the term "antenna" has an *extended meaning*" of a "*complete transceiver concept*" that includes "a *number of radiating elements*, a *combining/dividing network* and a *control unit*" that "controls feeder *parameters of the antenna*, based on *several inputs*, in order to *optimize the communications link*" (italic emphasis in original, other emphasis added, see, for example, Ex. 1010 at p. 4).

237. Additionally, Lehne explains that "*Switched lobe* (SL)" or "*switched beam*" is "the *simplest technique*" (or one of the "*levels of intelligence*") as it "comprises only a basic switching function between separate directive antennas or *predefined beams of an array*" as "illustrated in Fig. 3" wherein a "*setting that gives the best performance*, usually in terms of *received power*, is *chosen*" (emphasis added, see, for example, Ex. 1010 at p. 4, Figure 3 as reproduced below).

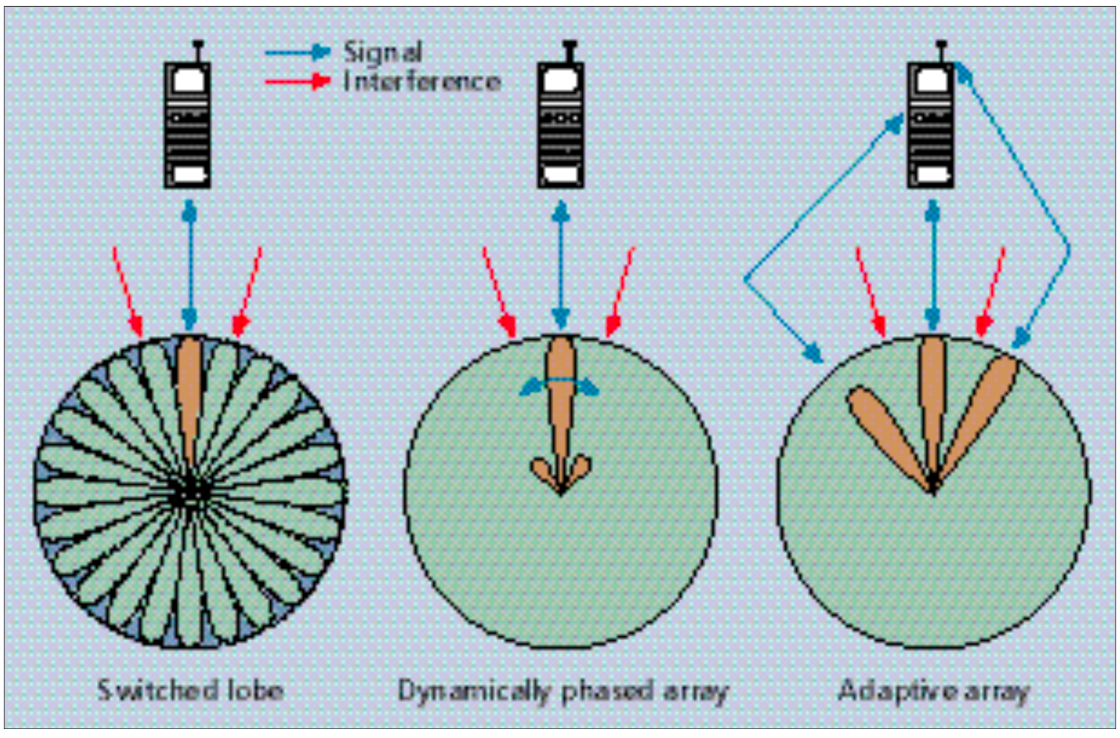


FIGURE 3. *Different smart antenna concepts.*

238. In reference to Figure 3 shown above, Lehne also explains for the "*Dynamically phased array* (PA)" that "By including a *direction of arrival (DoA) algorithm* for the *signal received from the user*, *continuous tracking can be achieved* and it can be viewed as a *generalization of the switched lobe concept*" wherein "the received *power is maximized*", and accordingly "*phased arrays* will have a *greater gain potential than switched lobe* antennas because *all elements* can be *used for diversity combining*" (emphasis added, see, for example, Ex. 1010 at p. 4).

239. Additionally, Lehne describes for the "*Adaptive array* (AA)" that "In this case, a *DoA algorithm* for *determining the direction toward interference sources* (e.g., other users) is added" such that "The radiation *pattern can then be adjusted to null out the interferers*" and further that with "*space diversity techniques*, the radiation *pattern can be adapted to receive multipath signals which can be combined*" in order to "maximize the *signal to interference ratio* (SIR)" such that "an *additional increase in capacity* is achieved by allowing *more users per carrier*" (italic emphasis in original, other emphasis added, see, for example, Ex. 1010 at p. 4).

240. Lehne teaches that with respectively increased capability from these "*Switched lobe* (SL)", "*phased array* (PA)" and "*Adaptive array* (AA)" approaches that "the *benefits of using smart antennas are many*, there are also *drawbacks and cost factors*" (emphasis added, see, for example, Ex. 1010 at p. 5).

241. For example, Lehne observes for the "*Switched lobe* (SL)" approach that "Such an antenna will be *easier to implement in existing cell structures* than the more sophisticated adaptive arrays, but it gives a *limited improvement*" (emphasis added, see, for example, Ex. 1010 at p. 4).

242. For example, Lehne notes for at least the "*phased array* (PA)" and "*Adaptive array* (AA)" approaches the need for "*separate transceiver chains* for *each of the array antenna elements* and accurate *real-time calibration* of each of them" wherein such "*arrays*" typically consist of "*six to 10 horizontally separated elements*", and further for the "*Adaptive array* (AA)" approach there is a "*computationally intensive process*" associated with the "*beamforming*" such that "*base stations*" that use these increasingly complex "*smart antenna*" approaches will be "much *more expensive* than conventional base stations" (emphasis added, see, for example, Ex. 1010 at pp. 5-6).

243. Additionally, Lehne notes that "efficient algorithms for real-time optimizing and signal tracking" are needed as well as "new demands on network functions such as resource and mobility management" for such "*base stations*" that use these "*smart antenna*" approaches (emphasis added, see, for example, Ex. 1010 at p. 5).

244. Therefore, in my opinion, a POSITA would understand even before considering the detailed disclosure of Lehne to follow that Lehne is from the same field of endeavor as the '369 Patent and that Lehne is reasonably pertinent to the problem faced by the '369 Patent (see, for example, ¶¶ 63-65 above regarding the '369 Patent in comparison with the above-summarized material from Lehne). Accordingly, Lehne is analogous art to the '369 Patent.

245. Lehne discloses that "*Electronically steerable antenna patterns* are most often generated using *array antennas*" that are "consisting of a *number of antenna elements* on which the *signal is divided or combined* in *both phase and amplitude*" such that "By using a *narrow antenna beam at the base station* the *multipath propagation* can be somewhat *reduced*" (emphasis added, see, for example, Ex. 1010 at pp. 5-6).

246. For example, Lehne discloses that "Figure 12 shows schematically the elements of the *reception part of a smart antenna*" for an "*antenna array*" that "*contains N elements*" wherein "The N signals are being *combined into one signal*, which is the *input to the rest of the receiver* (channel decoding, etc.)" (emphasis added, see, for example, Ex. 1010 at p. 8, Figure 12 as reproduced below).

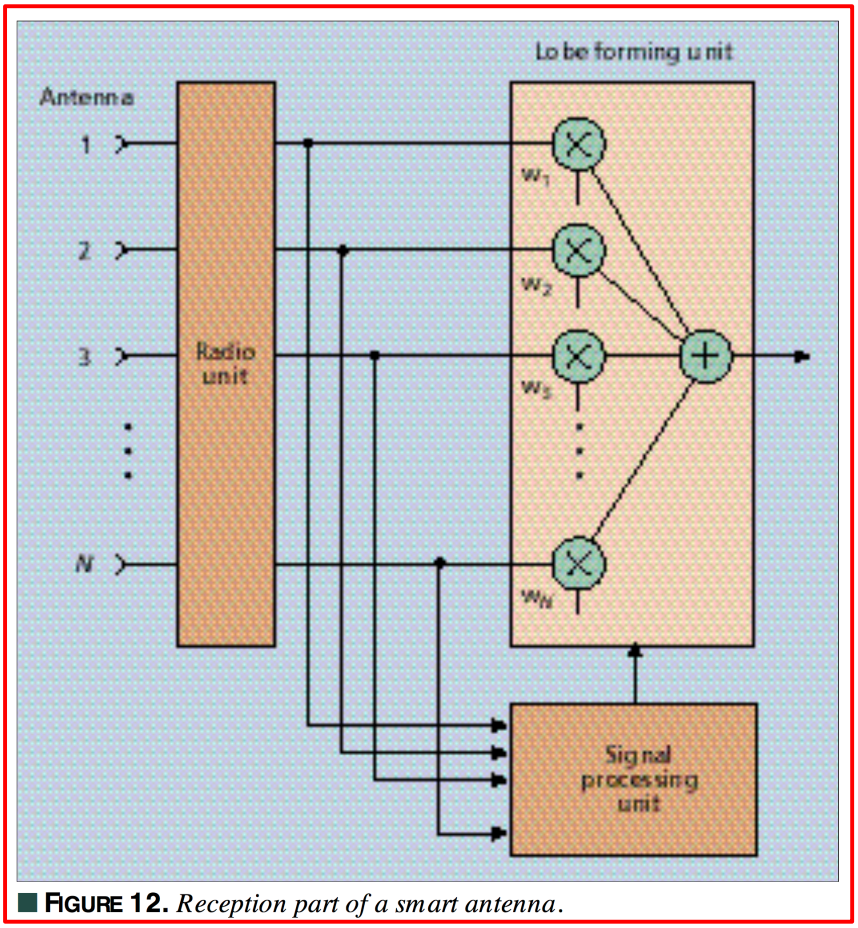


FIGURE 12. *Reception part of a smart antenna.*

247. In reference to Figure 12 shown above, Lehne explains that "The *radio unit* consists of *down-conversion chains* and (complex) *analog-to-digital conversion* (A/D)" wherein "There must be *N down-conversion chains*, *one for each of the array elements*" (emphasis added, see, for example, Ex. 1010 at p. 9).

248. Lehne also notes that "When the *lobe forming is done digitally* (after A/D) the *lobe forming* and *signal processing* units will normally be *integrated in the same unit*" and thus "The separation in Fig. 12 is done to clarify the functionality" and Lehne further notes that "It is also *possible to perform the lobe forming in hardware at radio frequency* (RF)" (emphasis added, see, for example, Ex. 1010 at p. 10).

249. More specifically, Lehne explains that "The signal processing unit will, *based on the received signal*, *calculate the complex weights* $w_1 - w_N$ with which the *received signal from each of the array elements is multiplied*" wherein for the "*switched lobe or phased array*" techniques, these "*weights can be optimized*" for the "*maximization of received signal from the desired user*" (emphasis added, see, for example, Ex. 1010 at p. 9).

250. Accordingly, Lehne teaches that "For the *base station* to be able to *estimate the radio channel*, a *reference or training sequence* is normally necessary, i.e., a known bit sequence must be *transmitted periodically*" because to "*maximize the SIR*" will "*require knowledge of the instantaneous channel response*" which means that "the *training sequence* must be *unique for each user*" (emphasis added, see, for example, Ex. 1010 at p. 10).

251. Lehne further teaches that "The method for *calculating the weights will differ depending on the type of optimization criterion*" such as "When ***switched lobe*** (SL) is used the receiver will *test all the pre-defined weight vectors* (corresponding to the lobe set) and *choose the one giving the strongest received signal level*" but "If the ***phased array*** approach (PA) is used, which consists of *directing a maximum gain beam* toward the strongest signal component, the *direction-of-arrival* (DoA) is first estimated and then the *weights are calculated*" with the "*amplitude and phase in accordance with the desired steering angle*" wherein "*well documented methods exist for estimating the DoA*", and for the "***adaptive array*** approach (AA)" then

"***optimum combining***" is used that "*directs nulls toward the strongest interference source*" (bold italic emphasis in original, other emphasis added, see, for example, Ex. 1010 at pp. 9-10).

252. For example, Lehne discloses that "The *transmission part of the smart antenna* will be schematically very *similar to the reception part*" as "shown in Fig. 16" wherein "The signal is split into N branches, which are *weighted by the complex weights* $z_1 - z_N$ in the *lobe forming unit*" and these "*weights*, which decide the *radiation pattern in the downlink direction*, are calculated by the *signal processing unit*" (emphasis added, see, for example, Ex. 1010 at p. 10, Figure 16 as reproduced below).

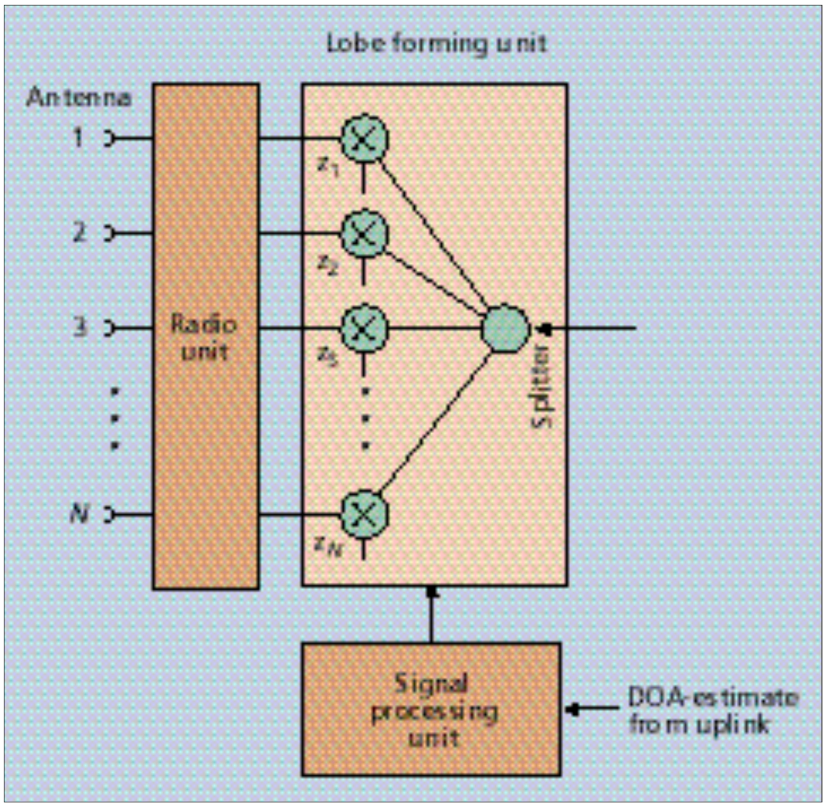


FIGURE 16. *Transmission part of a smart antenna.*

253. Lehne teaches in reference to FIG. 16 shown above that "In a *time division duplex (TDD) system the mobile station and base station use the same carrier frequency* only separated in time" such that "In this case the *weights calculated on uplink will be optimal on downlink* if

the *channel does not change during the period from uplink to downlink transmission*" (emphasis added, see, for example, Ex. 1010 at p. 10).

254. Lehne further explains that "The principle *reason* for the growing *interest in smart antennas is the capacity increase*" because "In densely populated areas *mobile systems are normally interference-limited*, meaning that interference from other users is the main source of noise in the system" but "*Smart antennas* will on average, by simultaneously *increasing the useful received signal level* and *lowering the interference level*, increase the SIR" (emphasis added, see, for example, Ex. 1010 at p. 5).

255. For example, Lehne reports that for then existing "TDMA systems", "a *capacity increase of 300 percent* can be expected", while for then newer systems "such as IS-95 or UMTS" that "the *expected capacity gain is even larger*" and "A *fivefold capacity gain* has been reported" (emphasis added, see, for example, Ex. 1010 at p. 5).

256. Lehne notes that while "*Smart antennas for mobile communications* are *not yet available commercially*" at the time this paper was written (likely in early 1999) that "In the *autumn of 1998* the Ericsson/Mannesmann trial became the *first trial to demonstrate commercial traffic* through base stations equipped with *smart antennas*" for "*GSM1800*" (a "*time division duplex (TDD) system*") using "*six-element stacked dipoles*" wherein "The *combining on uplink* was based on *maximal ratio combining*, while the *downlink beam forming* was based on *switching between eight lobes*" (emphasis added, see, for example, Ex. 1010 at p. 12).

257. Additionally, Lehne notes that "The U.S. company Arraycomm has developed *smart antenna solutions for the GSM standard* and for the *Japanese Personal Handyphone System* (PHS)" (each a "*time division duplex (TDD) system*") with "*Field trials*" performed in the USA (emphasis added, see, for example, Ex. 1010 at p. 12).

VIII. OBVIOUSNESS OF THE '369 PATENT UNDER 35 U.S.C. § 103 DUE TO WONG, MINN AND/OR LEHNE

258. In my opinion, Wong renders obvious at least Claims 1-7, 9-10, 12-15, 28 and 41 of the '369 Patent for at least the reasons described herein.

259. In my opinion, Wong in view of Minn renders obvious at least Claims 1-7, 9-10, 12-15, 28 and 41 of the '369 Patent for at least the reasons described herein.

260. In my opinion, Wong in view of Lehne renders obvious at least Claims 1-7, 9-10, 12-15, 19, 21, 28, 32-33, 35-37 and 41 (i.e. all of the challenged claims) of the '369 Patent for at least the reasons described herein.

261. In my opinion, Wong in view of Minn further in view of Lehne renders obvious at least Claims 1-7, 9-10, 12-15, 19, 21, 28, 32-33, 35-37 and 41 (i.e. all of the challenged claims) of the '369 Patent for at least the reasons described herein.

262. Wong is analogous art to the '369 Patent (see ¶ 120 above). Similarly, Minn is also analogous art to the '369 Patent (see ¶ 155 above). Additionally, Lehne is analogous art to the '369 Patent (see ¶ 244 above).

263. A general overview of Wong is given at ¶¶ 113-147 above.

264. A general overview of Minn is given at ¶¶ 148-179 above.

265. A general overview of Lehne is given at ¶¶ 232-257 above.

266. My specific analyses of Wong in view of Minn, Lehne and/or the knowledge of a POSITA, with respect to the challenged claims of the '369 Patent is given herein.

267. Note that for purposes of my analysis herein that I have provided subsection headings for claim elements in the form "1(a)", "1(b)", etc. for the convenience of the reader even though such headings do not exist in the actual '369 Patent claims themselves.

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‘369 Patent: Claim 1

> 1. A method comprising:
> a) identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device;
> determining at least one forward path pre-equalization parameter based on said at least one transmission delay; and
> b) modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter, where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal.

1. A method comprising:

268. In my opinion, this preamble claim element expresses no limitations.

269. However, I have considered that this preamble claim element may be limiting.

270. For example, Wong discloses a “multiuser *OFDM subcarrier, bit, and power allocation algorithm* to minimize the total transmit power” based upon “*Assuming knowledge of the instantaneous channel gains* for all users” and then “by *assigning each user a set of subcarriers* and by *determining the number of bits and the transmit power level for each subcarrier*” (see, for example, ¶¶ 114-115 above).

271. In my opinion, a POSITA would understand that Wong’s disclosure of procedures associated with this “***OFDM subcarrier, bit, and power allocation algorithm***” as summarized herein would at least constitute a “**method**”.

272. Thus, Wong discloses a “**method**” (for example, the procedures associated with the “***OFDM subcarrier, bit, and power allocation algorithm***” of Wong).

273. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, if any.

274. For example, Minn discloses “A *time-domain based channel estimation for OFDM system* with pilot-data multiplexed scheme is investigated” wherein “intra-symbol time-averaging and *most significant channel taps selection* are applied” as part of a “*Most Significant*

Taps (MST) Method" or its "*MST dual form DFT-based method*" (see, for example, ¶¶ 149, 164 and 174 above).

275. In my opinion, a POSITA would understand that Minn's description of a "***Most Significant Taps (MST) Method***" or a "***MST dual form DFT-based method***" as summarized herein would at least constitute a "**method**".

276. Thus, Minn discloses a "**method**" (for example, the "***Most Significant Taps (MST) Method***" or "***MST dual form DFT-based method***" of Minn).

277. In my opinion, a POSITA would have been highly motivated to combine Wong with Minn to adapt the procedures associated with the "***OFDM subcarrier, bit, and power allocation algorithm***" of Wong to include at least the "***MST dual form DFT-based method***" of Minn as I summarized at ¶¶ 346-356 below.

278. Therefore, in my opinion, Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element, if any.

279. At least because each of Wong and Minn discloses the limitations of this claim element, if any, then either of Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element, if any.

1(a) identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device;

determining at least one forward path pre-equalization parameter based on said at least one transmission delay;

280. A POSITA would understand that the plain, ordinary meanings of the terms "**forward path**" and "**reverse path**" for wireless communications systems at the time of the alleged invention of the '369 Patent were consistent with the usage of such terms in the specification of the '369 Patent.

281. For example, the '369 Patent uses the term "**forward path**" in the context of "*forward path transmissions* from base station device **102** to CPE device **104**" (see, for example, ¶ 64 above), which is consistent with the plain, ordinary meaning of "**forward path**" as the "downlink" communications path in a wireless system from a central "base station" or "access point" to a "subscriber", "mobile", "user" or "customer premise".

282. Similarly, the '369 Patent uses the term "**reverse path**" in the context of "in *reverse order*, *CPE device* **104** can *transmit data over a wireless communication link to base station* device **102**", which is consistent with the plain, ordinary meaning of "**reverse path**" as the "uplink" communications path in a wireless system from a "subscriber", "mobile", "user" or "customer premise" to a central "base station" or "access point".

283. A POSITA would also understand that the plain, ordinary meaning of the term "**data signal**", whether applied to the "**forward path**" or the "**reverse path**", for wireless communications systems at the time of the alleged invention of the '369 Patent to include at least a "**signal**" exchanged within a wireless communications system in order to convey "**data**". Although the exact term "**data signal**" does not appear in the specification of the '369 Patent except in the claims and summary, usage of the term "**data**" in context with terms such as "**exchange**", "**transmit**" and/or "**receive**" within the '369 Patent (see, for example, ¶¶ 53, 56-57,

60 and 65 above) confirms the applicability of this plain, ordinary meaning for the term "**data signal**".

284. A POSITA would further understand that the plain, ordinary meaning of the term "**forward path pre-equalization**" for wireless communications systems at the time of the alleged invention of the '369 Patent to mean at least that a signal to be transmitted in a "**forward path**" is modified in some way that accounts for the properties of the propagation path(s) between the "transmitter" at the "base station" or "access point" and the "receiver" at the "subscriber", "mobile", "user" or "customer premise". Although the '369 Patent does not explicitly define the term "**pre-equalization**", a POSITA would understand that usage of the term such as in "*pre-equalization that substantially reduces unwanted effects associated with multipath fading*" or "*pre-equalization block* **304** to *modify*, in some manner, as applicable, *the OFDM modulated sub-carriers*" which "are then *provided to antenna processing block* **306**, wherein they are further processed and eventually *transmitted using one or more antennas* **108**" (see, for example, ¶¶ 49 or 60 above) within the '369 Patent is consistent with this plain, ordinary meaning.

285. Accordingly, a POSITA would also understand that the plain, ordinary meaning of the term "**forward path pre-equalization parameter**" for wireless communications systems at the time of the alleged invention of the '369 Patent is then simply a "**parameter**" used for any part in performing "**forward path pre-equalization**" as also consistent with the specification of the '369 Patent (see, for example, ¶ 52 above).

286. A POSITA would understand that the plain, ordinary meaning of the term "**delay**" for wireless communications systems at the time of the alleged invention of the '369 Patent refers at least to an amount of time duration between subsequent events such as transmission and

reception, and this plain, ordinary meaning is consistent with the usage of the term within the '369 Patent (see, for example, ¶¶ 45, 48-51 and 59-61 above).

287. Also, a POSITA would understand that the plain, ordinary meaning of the term "**multipath transmission**" for wireless communications systems at the time of the alleged invention of the '369 Patent includes at least the concept of multiple propagation paths between transmitter and receiver due to scattering, reflections and/or diffraction with physical objects in the vicinity of the transmitter and/or receiver (see, for example, ¶¶ 200-201 above), and this plain, ordinary meaning is consistent with the usage of the term within the '369 Patent (see, for example, ¶¶ 42 and 54 above).

288. Accordingly, a POSITA would understand that the plain, ordinary meaning of the term "**multipath transmission delay**" for wireless communications systems at the time of the alleged invention of the '369 Patent refers to an amount of time duration or variance thereof associated with such multiple propagation paths between transmitter and receiver. In other words, because these multiple propagation paths each traverse a different distance from transmitter to receiver (see, for example, ¶¶ 53 and 200 above) then even though the speed of the propagation is extremely fast (equal to the speed of light in air, or about 186,000 miles per second) these different distances corresponding to different multiple propagation paths each also have a different corresponding "**multipath transmission delay**" as measured in some unit of time (i.e. in seconds or some number of fractional seconds).

289. Thus, a POSITA would understand that "**identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device**" expresses limitations that require the "**method**" of Claim 1 to include identifying at least one measure of time associated with one or more propagation paths among multiple such propagation

paths taken by signals that convey data and are sent in a reverse path or uplink such as from a "subscriber", "mobile", "user" or "customer premise" to a central "base station" or "access point".

290. Similarly, a POSITA would understand that "**determining at least one forward path pre-equalization parameter based on said at least one transmission delay**" expresses limitations that require the "**method**" to include determining at least one parameter used to modify the signals that convey data and that are to be sent in a forward path or downlink from the "base station" or "access point" to the "subscriber", "mobile", "user" or "customer premise" in some way that accounts for the properties of the propagation path(s) between the "base station" or "access point" and the "subscriber", "mobile", "user" or "customer premise" wherein such parameter is determined from at least the identified measure of time noted above.

291. Wong is directed to "broadband *transmission over wireless channels* for applications including wireless multimedia, *wireless Internet access*, and future-generation *mobile communication systems*" and Wong notes that "One of the *main requirements* on the modulation technique is the *ability to combat intersymbol interference (ISI)*, a major problem in wideband transmission *over multipath fading channels*" wherein "Multicarrier modulation techniques, including *orthogonal frequency division multiplex (OFDM)*" are "among the *more promising solutions* to this problem" (see, for example, ¶¶ 116-117 above).

292. Wong describes that a "*multiuser adaptive OFDM system* is shown in Fig. 1" which shows "that the *system* has K *users* and the k^{th} user has a *data rate* equal to R_k *bit per OFDM symbol*" and also shows data to be transmitted to such "*users are fed into the subcarrier and bit allocation block* which *allocates bits from different users to different subcarriers*" (see, for example, ¶¶ 125-126 above, annotated Fig. 1 as shown below).

Example of "identifying at least one multipath transmission [*channel condition*] within a reverse path data signal received from a receiving device" and "determining at least one forward path pre-equalization parameter based on said at least one transmission [*channel condition*]"

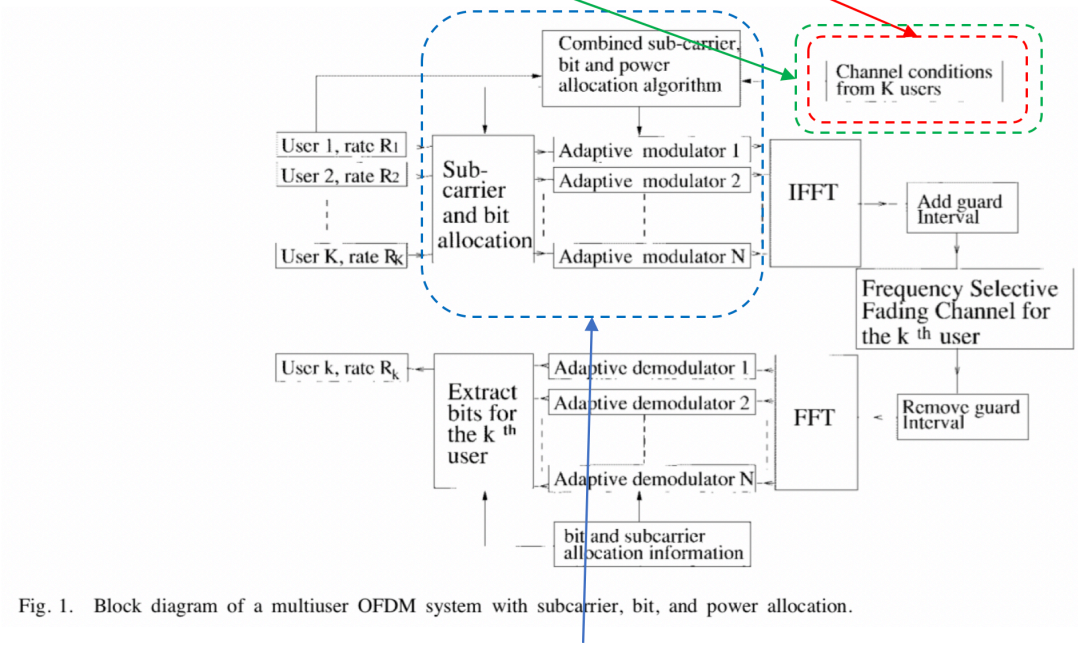


Fig. 1. Block diagram of a multiuser OFDM system with subcarrier, bit, and power allocation.

Example of "modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter, where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal"

293. Consistent with Fig. 1 shown above, Wong teaches that "*In this paper*, we formulate the *multiuser subcarrier, bit, and power allocation problem*" so that "the bit and *power allocation* algorithm can be *applied to each user on its allocated subcarriers*" as "can be applied, for instance, to the *downlink transmission in a time division duplex (TDD) wireless communication system to improve the downlink capacity*" (see, for example, ¶ 121 above).

294. As I explain in greater detail for claim element 1(b) herein, Wong discloses "**modifying a forward path data signal that is to be transmitted to the receiving device**" via

Wong's "*power allocation* algorithm" that is "*applied to each user on its allocated subcarriers*" wherein such "**modifying**" is based at least upon "*channel information*" that includes the "*instantaneous channel gains on all the subcarriers of all the users*" as "*known to the transmitter*" (see, for example, ¶ 127 above and my analysis for Wong and claim element 1(b) herein).

295. More specifically, with respect to this "*channel information*" that includes the "*instantaneous channel gains on all the subcarriers of all the users*", Wong defines at least one "**forward path pre-equalization parameter**" in the form of "$\alpha_{k,n}$" as "the *magnitude of the channel gain* (assuming coherent reception) of the n^{th} *subcarrier* as seen by the k^{th} *user*" (see, for example, ¶¶ 132-135 above and my analysis for Wong and claim element 1(b) herein).

296. Additionally, Wong specifically teaches for such a "*time division duplex (TDD) wireless communication system*" that "the *base station (BS)* can *estimate the instantaneous channel characteristics* of all the BS-to-mobile links *based on the received uplink transmissions*" such that "The multiuser *subcarrier*, bit, and *power allocation can then be used*" (see, for example, ¶ 122 above).

297. Accordingly, a POSITA would understand that Wong discloses to "***estimate the instantaneous channel characteristics***" that include "***magnitude of the channel gain***" (i.e. "**determining at least one forward path pre-equalization parameter**") based upon "***channel conditions***" from the "***users***" as derived from the "***received uplink transmissions***" over "***multipath fading channels***" (i.e. "**identifying at least one multipath transmission [*channel condition*] within a reverse path data signal received from a receiving device**" as well as "**determining at least one forward path pre-equalization parameter based on said at least one transmission [*channel condition*]**").

298. Thus, a POSITA would understand that Wong discloses this claim element 1(a) in its entirety except that Wong does not explicitly disclose whether such identified "***channel conditions***" from the "***users***" for the "***multipath fading channels***" include "**at least one multipath transmission delay**" upon which the "**determining at least one forward path pre-equalization parameter**" is "**based**" as required by the limitations of claim element 1(a).

299. In my opinion, a POSITA would have found "**identifying**" such "***channel conditions***" from the "***users***" for the "***multipath fading channels***" to include "**at least one multipath transmission delay**" upon which the "**determining at least one forward path pre-equalization parameter**" is "**based**" to be obvious in view of the methods taught by Wong and the knowledge of a POSITA for at least the following reasons.

300. First, a POSITA would have known based on Wong that "**identifying**" such "***channel conditions***" from the "***users***" for the "***multipath fading channels***" in order to "***estimate the instantaneous channel characteristics***" for the "***BS-to-mobile links***" that include "***magnitude of the channel gain***" for each "n^{th} ***subcarrier*** as seen by the k^{th} ***user***" based upon the "***received uplink transmissions***" for a "***time division duplex (TDD) wireless communication system***" that uses "***orthogonal frequency division multiplex (OFDM)***" would be performed using at least one of (see, for example, ¶¶ 195-197 and 207-209 above) a "***time domain***" approach (see, for example, ¶¶ 167-170, 174-176, 188-190 and 213-216 above) or a "***frequency domain***" approach (see, for example, ¶¶ 153, 161-162, 184-186 and 211-212 above).

301. Additionally, a POSITA would have known based on Wong's disclosure of a "***time division duplex (TDD) wireless communication system***" that uses "***orthogonal frequency division multiplex (OFDM)***" and is comprised of a "***base station (BS)***" (or "***access point***") as well as multiple "***users***" that such "***received uplink transmissions***" would also normally use

"***orthogonal frequency division multiplex (OFDM)***" at least because all of the known OFDM wireless standards applicable to such a system at the time of the alleged invention of the '369 Patent used OFDM for "***uplink transmissions***" (see, for example, ¶¶ 66, 151, 203 and 214 above).

302. For example, a POSITA would have known generally that for signal processing in digital wireless communications systems that discrete signals represented as a sequence of time domain samples are transformable to a sequence of frequency domain samples or vice versa by application of the "***Discrete Fourier Transform (DFT)***" (or the "***Fast Fourier transform***" or "***FFT***") for transformation from time to frequency or by application of the "***inverse Discrete Fourier Transform (IDFT)***" (or the "***inverse Fast Fourier transform***" or "***IFFT***") for transformation from frequency to time (see, for example, ¶¶ 157, 160 and 195-197 above).

303. For example, a POSITA would have known that a discrete signal form for such "***channel conditions***" for the "***multipath fading channels***" would be modeled by at least a "***channel impulse response***" (see, for example, ¶¶ 157-158 and 208 above) typically in the form shown below "where α_l is ***complex path gain*** of lth path, τ_l is the ***delay*** of lth path, and L is the ***total number of channel paths***" and "n" is "the ***time-domain index*** $(0, 1, \cdots, N-1)$ of an OFDM symbol" (excerpted from ¶ 158 above).

$$h[n] = \sum_{l=0}^{L-1} \alpha_l \delta[n - \tau_l]$$

304. Similarly, a POSITA also would have known that a discrete signal form for such "***channel conditions***" for the "***multipath fading channels***" would be also modeled by at least a "***channel frequency response***" from which the "***magnitude of the channel gain***" for the methods described in Wong can be directly determined as the magnitude of this "***channel***

frequency response" that is typically in the form of "$H[k] = FFT_N\{h[n]\}$" where "k is ***subcarrier index*** $(0,1, \ldots, N-1)$ with N being the ***total number of subcarriers***" and "$FFT_N\{\}$" is the "N-point ***Fast Fourier transform***" (see, for example, ¶¶ 156-157, 161, 170, 176, 209-211 and 216 above).

305. Thus, at least because a POSITA would have known that channel estimation in OFDM sufficient to determine the "***magnitude of the channel gain***" for the methods described in Wong would be performed using at least one of the "***time domain***" approach or the "***frequency domain***", then it would have been at least obvious to try the "***time domain***" approach given that there were only two viable choices.

306. Second, a POSITA would have known that application of the known prior art "***time domain***" approaches to such channel estimation in OFDM at a base station (BS) with multiple users for subcarrier power allocation as described in Wong as part of "**identifying at least one multipath transmission [*channel condition*] within a reverse path data signal received from a receiving device**" would show that such "***channel condition***" would include "**at least one multipath transmission <u>delay</u>**" and further that the "**determining at least one forward path pre-equalization parameter based on said at least one transmission [*channel condition*]**" in Wong would also show that such "***channel condition***" would include "**<u>said</u> at least one multipath transmission <u>delay</u>**".

307. For example, a POSITA would have known that multiple "***time domain***" approaches applicable for such channel estimation in OFDM at a base station (BS) with multiple users were known in the prior art including at least the "***Most Significant Taps Approach (MST)***" (see, for example, ¶¶ 167-173 above), the "***MST dual form DFT-based method***" (see, for example, ¶¶ 174-176 above), the "***Frequency Pilot Time Average (FPTA) technique***" (see,

for example, ¶¶ 154 and 188 above), the "***Time Pilot Time Correlation (TPTC) technique***" (see, for example, ¶¶ 189-190 above), and the "***Time Domain Convolution approach***" (see, for example, ¶¶ 213-216 above).

308. Based at least on the descriptions of these "***time domain***" approaches referenced above, a POSITA would have further known that for each of the 5 exemplary "***time domain***" approaches that at least one step in performing such channel estimation in OFDM would include estimating the "***channel impulse response***" in the form of "$h[n]$" (or commonly "$\hat{h}[n]$" to signify that it is an "***estimate***" only) where "n" is a "***time-domain index***" (see, for example, ¶¶ 169, 176, 188, 190 and 216 above).

309. Additionally, a POSITA would have known that this "***time-domain index***" or "n" (i.e. a number of samples each of fractional second duration, see ¶ 288 above) that identifies each "***tap***" within the estimated "***channel impulse response***" accordingly discloses the "**at least one multipath transmission <u>delay</u>**" recited for this claim element.

310. Similarly, a POSITA would have known that for each of the 5 exemplary "***time domain***" approaches summarized above that a subsequent step after estimating the "***channel impulse response***" is estimating the "***channel frequency response***" in the form of "$H[k]$" (or commonly "$\widehat{H}[k]$" to signify that it is an "***estimate***" only), where "k" is a "***subcarrier index***", by performing a "***DFT***" or "***FFT***" operation on the estimated "***channel impulse response***" (see, for example, ¶¶ 170, 176, 188-189 and 216 above).

311. And similarly, a POSITA would have known that "$H[k]$" or "$\widehat{H}[k]$" specifies, directly or indirectly, an **<u>amplitude term</u>** and a **<u>phase term</u>** for such "***channel frequency response***" specific to each "***subcarrier index***" or "k", and thus the "***magnitude of the channel gain***" as used in the methods described in Wong is simply this **<u>amplitude term</u>** within this

estimated "***channel frequency response***", or thus in the context of Wong, estimating the "***channel frequency response***" in the form of "$H[k]$" or "$\widehat{H}[k]$" discloses the "**at least one forward path pre-equalization parameter**" recited for this claim element.

312. Thus, a POSITA would have known that application of known "***time domain***" channel estimation approaches in OFDM in combination with the methods described in Wong would disclose all of the limitations of this claim element including "**identifying at least one multipath transmission delay within a reverse path data signal received from a receiving device**" and "**determining at least one forward path pre-equalization parameter based on said at least one transmission delay**".

313. Third, a POSITA would have known that application of the known prior art "***time domain***" approaches to such channel estimation in OFDM at a base station (BS) with multiple users for subcarrier power allocation as described in Wong would reduce channel estimation errors, or hence produce more accurate determinations of the "***magnitude of the channel gain***", compared to conventional "***frequency domain***" approaches.

314. For example, a POSITA would have known from the prior art that the "***Most Significant Taps Approach (MST)***" (see, for example, ¶¶ 167-173 above), the "***MST dual form DFT-based method***" (see, for example, ¶¶ 174-176 above) both provide a "***performance gain***" in terms of reducing the "***mean square error (mse) of channel estimate***" that is ideally "N/J" on a "***basis of the same total pilot power***" when such "***time domain***" approaches are compared to conventional "***frequency domain***" approaches (see, for example, ¶¶ 171-172 and 178 above).

315. Since the prior art also teaches that "N" is "***the total number of subcarriers***" and "***the most significant J channel taps are chosen as the largest amplitude channel taps***" wherein "***A suitable choice for J may be two times or more of the (designed) number of multipaths***"

(see, for example, ¶¶ 156, 169 and 173 above), a POSITA would have also known that these particular "***time domain***" approaches when applied to the specific examples in Wong would have $N = 128$ and would have J range from 4 to 40 based on a 200 ns time domain sample duration (corresponding to the disclosed "***5 MHz band***") and an "***RMS delay spread***" in the range of "100 ns" to "1000 ns" (thereby indicating that the "***(designed) number of multipaths***" which is equal to typically the number of time domain samples in the guard interval or cyclic prefix of around 4 times the length of the "***RMS delay spread***" expressed in samples, i.e. 2 to 20 samples) (see, for example, ¶ 144 above).

316. Accordingly, a POSITA would have expected that using these particular "***time domain***" approaches when applied to the specific examples in Wong would have provided a "***performance gain***" compared to conventional "***frequency domain***" approaches in terms of reducing the "***mean square error (mse) of channel estimate***" on a "***magnitude***" basis by a factor of approximately 1.7 to 5.5 depending upon the severity of the "***multipath fading channels***" being designed for as measured by the length of the "***RMS delay spread***".

317. For example, a POSITA would have known from the prior art that the "***Frequency Pilot Time Average (FPTA) technique***" (see, for example, ¶¶ 154 and 188 above), the "***Time Pilot Time Correlation (TPTC) technique***" (see, for example, ¶¶ 189-190 above) have been described as improving "***pilot to noise***" ratio, or alternatively the "***gain of the time domain … over the frequency domain***", by a factor of "$\sqrt{\frac{N}{R}}$" in order reduce the "***mean square error between estimated response and real channel response***" (see, for example, ¶¶ 191-192 above).

318. Accordingly, since the prior art also teaches that N is the "<u>*Number of carriers*</u>" and exemplary values for R are 8 or 32, a POSITA would have also known that these particular

"***time domain***" approaches when applied to the specific examples in Wong where $N = 128$ would have provided a "***gain of the time domain … over the frequency domain***" with respect to the "***mean square error between estimated response and real channel response***" by a factor of approximately 2 to 4.

319. For example, a POSITA would have known from the prior art regarding the "***Time Domain Convolution approach***" (see, for example, ¶¶ 213-216 above) that "The ***advantage of the time domain approach is improved performance***, when the ***maximum length of the impulse response*** can be ***limited to a number significantly less than the number of subcarriers***" because "the ***frequency domain estimator has to simultaneously estimate all the subcarriers***, whereas the ***time domain estimator needs to estimate only the taps of the impulse response***" and thus "***When the number of subcarriers is large compared to the number of channel taps***, the ***signal energy used to estimate*** each H_k is ***significantly less than the signal energy used to estimate*** each h_n" (see, for example, ¶¶ 217-218 above).

320. Accordingly, a POSITA would have also known that this particular "***time domain***" approach when applied to the specific examples in Wong, where the "***number of subcarriers***" is $N = 128$ and the "***maximum length of the impulse response***" would be by design the number of time domain samples in the guard interval or cyclic prefix of around 4 times the length of the "***RMS delay spread***" expressed in samples, i.e. 2 to 20 samples, would have provided "***improved performance***" in the "***signal energy***" per "***channel tap***" as compared to conventional "***frequency domain***" approaches by a factor of approximately 6 to 60, or alternatively a factor of approximately 2.5 to 8 with respect to the "***mean square error (mse) of channel estimate***" on a "***magnitude***" basis, depending upon the severity of the "***multipath fading channels***" being designed for as measured by the length of the "***RMS delay spread***".

321. Thus, a POSITA would have known that application of the known prior art "***time domain***" approaches to channel estimation in OFDM at a base station (BS) with multiple users for subcarrier power allocation as described in Wong would reduce channel estimation errors, or hence produce more accurate determinations of the "***magnitude of the channel gain***", compared to conventional "***frequency domain***" approaches by significant margins as summarized above.

322. Fourth, a POSITA would have been highly motivated to implement one or more of these known prior art "***time domain***" approaches to channel estimation in OFDM at the base station (BS) of Wong at least because such improved channel estimation would improve the reception sensitivity for the base station regarding "**a reverse path data signal received from a receiving device**", whether for "**forward path pre-equalization**" purposes or otherwise.

323. For example, a POSITA would have known that the prior art teaches that the "***advantage of the time domain approach is improved performance***" in view of the fact that "***Channel estimation is mandatory for OFDM systems*** that employ ***coherent modulation*** schemes" (such as the "***WLAN standards that utilize OFDM***" that were commonly known at the time of the alleged invention of the '369 Patent and discussed in the specification of the '369 Patent) because "***Otherwise correct demodulation would not be possible***" (see, for example, ¶¶ 66, 151-152, 203, 210 and 214 above).

324. Fifth, a POSITA would have been highly motivated to implement one or more of these known prior art "***time domain***" approaches to channel estimation in OFDM at the base station (BS) of Wong at least because such improved channel estimation was specifically important to the "***power allocation algorithm***" that is "***applied to each user on its allocated subcarriers***" that is the core technology disclosure of Wong.

325. For example, Wong reports significant performance advantages due to its "***power allocation algorithm***" compared to "***conventional OFDM without adaptive modulation***" (see, for example, ¶ 146 above). However, Wong also reports that "The results in this paper ***assume perfect channel estimation***" but "channel estimation in ***wireless fading channels*** is in general ***not very accurate***", and accordingly Wong states that "the effect of ***nonideal channel information*** on the ***performance*** of our proposed MAO scheme is a ***very important issue***" (see, for example, ¶ 147 above).

326. Thus, at least because Wong highlights that the benefits of the "***power allocation algorithm***" described in Wong "***assume perfect channel estimation***" but Wong also reports that channel estimation errors (or "***nonideal channel information***") are a "***very important issue***", a POSITA would have been highly motivated to implement channel estimation using one or more of these known prior art "***time domain***" approaches that were known to provide reduced channel estimation errors compared to conventional "***frequency domain***" approaches.

327. Sixth, a POSITA would have an expectation of success when implementing one or more of these known prior art "***time domain***" approaches to channel estimation in OFDM at the base station (BS) of Wong because at least 3 of these known approaches were taught to be specifically applicable to system architectures such as the OFDM base station of Wong.

328. For example, the prior art teaches that the advantageous "***MST dual form DFT-based method***" (see, for example, ¶¶ 174-176 above) is specifically applicable for a "***system with training symbol*** (i.e., ***pilot tones on all subcarriers***)" (see, for example, ¶¶ 175 and 177 above) such as would be expected for an OFDM base station such as Wong in view of the known OFDM wireless standards at the time of the alleged invention of the '369 Patent (see, for example, ¶¶ 66, 151, 203-204, 211, 214 and 219 above).

329. For example, the prior art teaches that the advantageous "***Time Pilot Time Correlation (TPTC) technique***" (see, for example, ¶¶ 189-190 above) is specifically applicable when a "***sequence is periodically inserted into the OFDM symbol in the time domain***" in order to "***insert pilot tones into all of the carriers in an OFDM symbol***" (see, for example, ¶¶ 183 and 189 above) such as would be expected for an OFDM base station such as Wong in view of the known OFDM wireless standards at the time of the alleged invention of the '369 Patent (see, for example, ¶¶ 66, 151, 203-204, 211, 214 and 219 above).

330. For example, the prior art teaches that the advantageous "***Time Domain Convolution approach***" (see, for example, ¶¶ 213-216 above) is specifically applicable for "IEEE 802.11a ***standard training symbols*** as an example" wherein the "***received time domain signal***" includes the "***two long training symbols***" (see, for example, ¶ 214 above) such as would be expected for an OFDM base station such as Wong in view of the known OFDM wireless standards at the time of the alleged invention of the '369 Patent (see, for example, ¶¶ 66, 151, 203-204, 211, 214 and 219 above).

331. Accordingly, a POSITA would have an expectation of success when implementing one or more of these known prior art "***time domain***" approaches to channel estimation in OFDM at the base station (BS) of Wong.

332. Thus, Wong in view of the knowledge of a POSITA renders obvious "**identifying at least one multipath transmission delay**" (for example, by performing channel estimation with a known prior art time domain approach that identifies a channel impulse response including at least a time-domain index for one or more channel taps) that is "**within a reverse path data signal received from a receiving device**" (for example, the received uplink transmissions from the users to the base station of Wong as also shown in annotated Fig. 1 of

Wong) and "**determining at least one forward path pre-equalization parameter**" (for example, the determination of the channel frequency response that includes the magnitude of the channel gain as used for the power allocation algorithm of Wong) that is "**based on said at least one transmission delay**" (for example, when such channel frequency response is determined from a prior art time domain approach that identifies the channel impulse response).

333. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

334. Minn proposes "*time-domain based channel estimation for OFDM system*" based upon application of "*most significant channel taps selection*" (see, for example, ¶ 149 above).

335. Minn observes that "*Orthogonal frequency division multiplexing* (OFDM)" has "recently achieved much *popularity due to its desirable properties* such as its *robustness to multipath delay spread* and impulse noise, its *high data rate* transmission capability with *high bandwidth efficiency*" (see, for example, ¶ 150 above).

336. Minn explains that "If *coherent OFDM system* is adopted, *channel estimation becomes a requirement* and usually *pilot tones are used for channel (frequency response) estimation*" wherein "Pilot tones can be *inserted in all subcarriers of a particular OFDM symbol* forming an *OFDM training symbol*, in which case training symbols are *transmitted at an appropriate regular rate* determined by the *time varying nature of the wireless channel*" (see, for example, ¶ 152 above).

337. Minn teaches that "For *practical multipath wireless channels*, there are *not so many channel paths with significant energy* (if compared to the FFT size N)" and "Hence, among N *samples (taps) of the channel impulse response estimate*, *many samples (taps) will have little or no energy* at all except noise perturbation" (see, for example, ¶ 163 above).

338. Minn further teaches that "*Neglecting those nonsignificant channel taps in channel estimation* may introduce some performance degradation if some of the channel energy is missed, but at the same time it will *eliminate the noise perturbation from those taps*" and because "*Usually* total *noise perturbation from those neglected channel estimate taps* is *much higher than the multipath energy contained in them*, especially for low SNR values" then "neglecting those nonsignificant channel estimate taps can *improve the channel estimation performance significantly*" (see, for example, ¶ 164 above).

339. Accordingly, Minn introduces the "***Most Significant Taps Approach (MST)***" to "***time-domain based channel estimation for OFDM system***" in a first form that uses "***intra-symbol time-averaging***" and a second form, referred to as the "***MST dual form DFT-based method***", that uses the "***one-to-one relationship of DFT and IDFT***" such that the "***MST method can be related to DFT-based approach***" as shown in Fig. 2 (see, for example, ¶¶ 149, 164 and 174 above, annotated Fig. 2 as shown below).

Example of "identifying at least one multipath transmission *delay* within a reverse path data signal received from a receiving device"

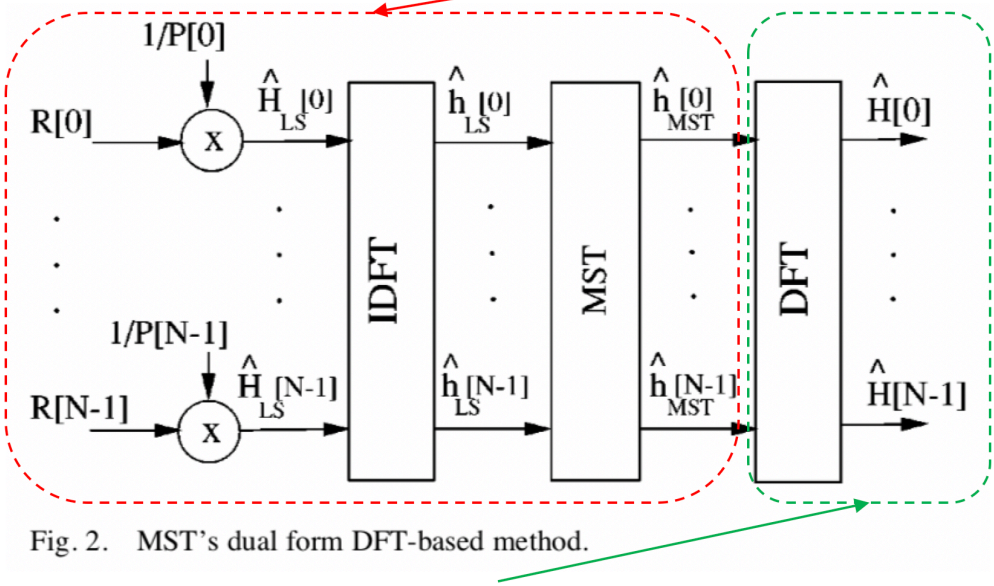


Fig. 2. MST's dual form DFT-based method.

Example of "determining at least one forward path pre-equalization parameter based on said at least one transmission *delay*"

340. For either of the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" as a "***time-domain based channel estimation for OFDM system***", Minn teaches to perform first a "*raw channel impulse response estimate*" denoted as "$\hat{h}_{LS}[n]$" (see, for example, ¶¶ 168 and 174 above, and also the output of the "***IDFT***" block in annotated Fig. 2 as shown above) and then second an "*MST channel impulse response estimate*" denoted as "$\hat{h}_{MST}[n]$" and derived from the "*raw channel impulse response estimate*" denoted as "$\hat{h}_{LS}[n]$" according to Eq. (23) (see, for example, ¶¶ 169, 174 and 176 above, and also the output of the "***MST***" block in annotated Fig. 2 as shown above as well as Eq. (23) as reproduced below).

$$\hat{h}_{MST}[n] = \sum_{i=0}^{J-1} \hat{h}_{LS}[n_i]\,\delta[n-n_i],$$

$$n = 0, 1, \cdots, N-1 \qquad (23)$$

341. Additionally, in reference to Eq. (23) shown above which describes the operation of the "***MST***" block in annotated Fig. 2 as shown above, Minn explains that "The *largest amplitude* J *channel taps* among the N samples (taps) are *chosen* as J *most significant channel taps* and the *other taps are set to zero*" wherein "the *channel tap indexes* for those most significant J taps" are "n_i" in Eq. (23) shown above as "denoted by $n_0, n_1, \cdots, n_{J-1}$" or as shown as the output of the "***MST***" block in annotated Fig. 2 (see, for example, ¶¶ 169 and 176 above).

342. A POSITA would have known that this "***channel tap index***" or "n_i" of Minn (i.e. a "***time-domain index***" as a number of samples each of fractional second duration, see ¶ 288 above) identifies these "***most significant channel taps***" within the "***MST channel impulse response estimate***" and accordingly discloses the "**at least one multipath transmission delay**" recited for this claim element.

343. Finally, for either of the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" as a "***time-domain based channel estimation for OFDM system***", Minn teaches that "The *resulting MST channel impulse response estimate* is *input to FFT block* to *get the MST channel frequency response estimate*", which is seen in annotated Fig. 2 above as "$\widehat{H}[0] \cdots \widehat{H}[N-1]$" based on the operation "$\widehat{H}_{MST}[k] = FFT_N\{\hat{h}_{MST}[n]\}, k = 0, 1, \cdots, N-1$" as also described by Eq. (24) (see, for example, ¶¶ 170 and 176 above).

344. A POSITA would have known that "$\widehat{H}_{MST}[k]$" specifies, directly or indirectly, an **amplitude term** and a **phase term** for such "***channel frequency response***" specific to each "***subcarrier index***" or "k", and thus the "***magnitude of the channel gain***" as used in the methods described in Wong is simply this **amplitude term** within the estimated "***channel frequency response***", or thus in the context of Wong, estimating the "***channel frequency response***" in the

form of "$\widehat{H}_{MST}[k]$" in Minn discloses the "**at least one forward path pre-equalization parameter**" recited for this claim element.

345. Thus, for either of the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" as a "***time-domain based channel estimation for OFDM system***", a POSITA would understand that Minn discloses "**identifying at least one multipath transmission delay**" at least in the form of the "***channel tap indexes***" or "n_i" for the "***MST channel impulse response estimate***" corresponding to the "***largest amplitude J channel taps***" that at least for the "***received uplink transmissions***" over "***multipath fading channels***" per Wong is "**within a reverse path data signal received from a receiving device**", and further a POSITA would understand that Minn discloses determining the "***MST channel frequency response estimate***" which includes the "***magnitude of the channel gain***" per Wong (or hence "**determining at least one forward path pre-equalization parameter**") that is "**based on said at least one transmission delay**" (i.e. the "***channel tap indexes***" or "n_i" for the "***MST channel impulse response estimate***" corresponding to the "***largest amplitude J channel taps***").

346. In my opinion, a POSITA would have been highly motivated to combine Wong in view of Minn and the knowledge of a POSITA in a manner that would render obvious all of the limitations of this claim element for at least the following reasons.

347. First, a POSITA would understand that Wong discloses a "***multiuser OFDM subcarrier, bit, and power allocation algorithm***" at a "***base station (BS)***" for "***assigning each user a set of subcarriers***" and "***determining the number of bits and the transmit power level for each subcarrier***" based upon the assumption that "***the transmitter knows the instantaneous channel transfer functions of all users***" and further would understand that Wong teaches that the "***base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-***

mobile links based on the received uplink transmissions" in a "***time division duplex (TDD) wireless communication system***" (such as IEEE 802.11a at the time of the alleged invention of the '369 Patent) (see, for example, ¶¶ 114-115, 118 and 122 above).

348. However, a POSITA implementing an OFDM subcarrier power allocation method based upon the teaching of Wong would understand that a problem remains because Wong does not specifically disclose a method for how the "***base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions***".

349. A POSITA would understand that Minn discloses methods for how Wong's "***base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions***" at least in the form of the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" as a "***time-domain based channel estimation for OFDM system***" as described above.

350. Accordingly, a POSITA would have been highly motivated to consider the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" as a "***time-domain based channel estimation for OFDM system***" of Minn as a solution to the problem of how the "***base station (BS) can estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions***" when implementing an OFDM subcarrier power allocation method based upon the teaching of Wong.

351. Second, as I noted above, Wong is specifically directed to a "***multiuser OFDM subcarrier, bit, and power allocation algorithm***" at a "***base station (BS)***" for "***assigning each user a set of subcarriers***" and "***determining the number of bits and the transmit power level for***

each subcarrier" based upon "***instantaneous channel characteristics***" of "***received uplink transmissions***" over "***multipath fading channels***".

352. Minn not only provides a methodology for determining such "***instantaneous channel characteristics***" of "***received uplink transmissions***" over "***multipath fading channels***" as needed in Wong, but Minn recites that its teachings are directed specifically to "***Orthogonal frequency division multiplexing (OFDM)***" with "***adaptive modulation and power allocation across the subcarriers according to the channel conditions***" (see, for example, ¶ 150 above).

353. Accordingly, since Minn not only provides a solution to the problem faced by Wong (i.e. how to "***estimate the instantaneous channel characteristics of all the BS-to-mobile links based on the received uplink transmissions***") but Minn also specifically teaches applicability of its solutions to OFDM with "***adaptive modulation and power allocation across the subcarriers according to the channel conditions***" (i.e. exact same application as Wong), then a POSITA would have been highly motivated to specifically combine Minn, in preference to other viable prior art solutions for such channel estimation, with Wong.

354. Third, as I have noted above, a POSITA would understand that Minn teaches that either of the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" as a "***time-domain based channel estimation for OFDM system***" provides a significant "***performance gain***" compared to conventional "***frequency domain***" approaches in terms of reducing the "***mean square error (mse) of channel estimate***" on a "***magnitude***" basis by a factor of approximately 1.7 to 5.5 depending upon the severity of the "***multipath fading channels***" being designed for as measured by the length of the "***RMS delay spread***" per the examples in Wong (see, for example, ¶¶ 314-316 above).

355. Fourth, as I have noted above, a POSITA would have been highly motivated to implement either of the "***Most Significant Taps Approach (MST)***" or the "***MST dual form DFT-based method***" of Minn for channel estimation in OFDM at the base station (BS) of Wong at least because such improved channel estimation would improve the reception sensitivity for the base station regarding "**a reverse path data signal received from a receiving device**", whether for "**forward path pre-equalization**" purposes or otherwise, and because such improved channel estimation was specifically important to the "***power allocation algorithm***" that is "***applied to each user on its allocated subcarriers***" that is the core technology disclosure of Wong (see, for example, ¶¶ 322-326 above).

356. Fifth, as I have also noted above, a POSITA would have an expectation of success when implementing at least the "***MST dual form DFT-based method***" of Minn for channel estimation in OFDM at the base station (BS) of Wong at least because Minn specifically teaches that the "***MST dual form DFT-based method***" is applicable for a "***system with training symbol*** (i.e., ***pilot tones on all subcarriers***)" (see, for example, ¶¶ 175 and 177 above) such as would be expected for an OFDM base station such as Wong in view of the known OFDM wireless standards at the time of the alleged invention of the '369 Patent (see, for example, ¶¶ 66, 151, 203-204, 211, 214 and 219 above).

357. Thus, Wong in view of Minn and the knowledge of a POSITA renders obvious "**identifying at least one multipath transmission delay**" (for example, by performing channel estimation using the MST dual form DFT-based method of Minn that identifies a channel impulse response including at least a time-domain index for one or more channel taps) that is "**within a reverse path data signal received from a receiving device**" (for example, the received uplink transmissions from the users to the base station of Wong as also shown in

annotated Fig. 1 of Wong) and "**determining at least one forward path pre-equalization parameter**" (for example, the determination of the channel frequency response using the MST dual form DFT-based method of Minn that includes the magnitude of the channel gain as used for the power allocation algorithm of Wong) that is "**based on said at least one transmission delay**" (for example, when such channel frequency response is determined using the MST dual form DFT-based method of Minn that identifies the channel impulse response).

358. Therefore, in my opinion, Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element.

359. At least because each of Wong and the knowledge of a POSITA and Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element, then either of Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

1(b) modifying a forward path data signal that is to be transmitted to the receiving device based on said at least one forward path pre-equalization parameter, where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal.

360. See ¶¶ 280-285 above regarding at least the terms "**forward path**", "**data signal**", "**pre-equalization**" and "**parameter**".

361. Additionally, a POSITA would understand that the plain, ordinary meaning of the term "**selectively setting**" in the context of "**selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones**" is to differentiate from other possible forms of "**setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones**" such as, but not limited to, "**accidentally setting**", "**coincidentally setting**", "**unintentionally setting**" or "**randomly setting**" as also consistent with the specification of the '369 Patent (see, for example, ¶ 69 above).

362. For example, a POSITA would understand that for 16 QAM modulation (see, for example, ¶¶ 72 and 220 above) that there are 3 possible amplitude levels or thus 3 possible instantaneous power levels for a given symbol on a given subcarrier (or "**tone**"). However, to the extent that in a given symbol period that one particular subcarrier within an OFDM ensemble with all subcarriers allocated equal "**transmission power levels**" might have one of 3 possible instantaneous power levels for this given symbol while another particular subcarrier has a different one of these 3 possibilities, a POSITA would understand that this is merely an example of "**accidentally setting**", "**coincidentally setting**", "**unintentionally setting**" or "**randomly setting**", as opposed to the recited "**selectively setting**", of "**different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones**".

363. Wong discloses "Multiuser *orthogonal frequency division multiplexing* (OFDM)" wherein a "multiuser *OFDM subcarrier, bit, and power allocation algorithm* to minimize the total transmit power" is "done by *assigning each user a set of subcarriers* and by *determining the number of bits and the transmit power level for each subcarrier*" (see, for example, ¶¶ 114-115 above).

364. Wong observes that prior art papers "have demonstrated that *significant performance improvement can be achieved if adaptive modulation is used* with OFDM" because "*subcarriers with large channel gains employ higher order modulation* to carry more bits/OFDM symbol, while *subcarriers in deep fade carry one or even zero bits/symbol*" and accordingly concludes that "As *different subcarriers experience different fades* and *transmit different numbers of bits*, the *transmit power levels must be changed accordingly*" (see, for example, ¶¶ 118-119 above).

365. See at least ¶¶ 291-293 and 296 above for claim element 1(a) regarding the system architecture of Wong as illustrated in annotated Fig. 1, which I incorporate herein for this claim element 1(b).

366. Also, in reference to annotated Fig. 1 shown above, Wong explains that "The *complex symbols at the output of the modulators* are *transformed into the time domain samples* by inverse fast Fourier transform (IFFT)" and "*Cyclic extension* of the time domain samples, known as the guard interval, is *then added*" so that "The *transmit signal* is then *passed through different frequency selective fading channels* to different users" (see, for example, ¶ 131 above).

367. Accordingly, a POSITA would understand that Wong's description of this "***transmit signal***" to the "***different users***" with respect to annotated Fig. 1 shown above discloses "**a forward path data signal that is to be transmitted to the receiving device**".

368. Additionally, a POSITA would understand that Wong's teaching to apply a "***multiuser OFDM subcarrier, bit, and power allocation algorithm***" by "***assigning each user a set of subcarriers***" and by "***determining the number of bits and the transmit power level for each subcarrier***" is also an exemplary disclosure of "**modifying a forward path data signal that is to be transmitted to the receiving device**".

369. Wong explains that under the assumption that "*each subcarrier* has a *bandwidth* that is *much smaller than the coherence bandwidth of the channel* and that the *instantaneous channel gains on all the subcarriers of all the users are known to the transmitter*" then by "*Using the channel information*, the *transmitter applies* the combined *subcarrier, bit, and power allocation algorithm* to *assign different subcarriers to different users* and the *number of bits/OFDM symbol to be transmitted on each subcarrier*" such that "the *transmit power level will be adjusted according to the combined subcarrier, bit, and power allocation algorithm*" (see, for example, ¶¶ 127-128 above).

370. More specifically, Wong defines "$c_{k,n}$ to be the *number of bits* of the k^{th} *user* that are *assigned to* the n^{th} *subcarrier*" wherein "for each n, if $c_{k',n} \neq 0, c_{k,n} = 0$ for all $k \neq k'$" because Wong does "*not allow more than one user to share a subcarrier*" and Wong assumes that "the *adaptive modulator* allows $c_{k,n}$ to *take values in the set* $\boldsymbol{D} = \{0,1,2,\dots,M\}$ where M is the *maximum number of information bits/OFDM symbol* that can be *transmitted by each subcarrier*" and that "In the *frequency selective fading channel*, *different subcarriers will experience different channel gains*" (see, for example, ¶¶ 129-130 and 132 above).

371. Wong also defines "$\alpha_{k,n}$" as "the *magnitude of the channel gain* (assuming coherent reception) of the n^{th} *subcarrier* as seen by the k^{th} *user*" and "$f_k(c)$" as "the *required received power* (in energy per symbol) *in a subcarrier for reliable reception* of c information

bits/symbol *when the channel gain is equal to unity*" and Wong notes that "$f_k(c)$ depends on k, and this *allows different users to have different quality-of-service (QoS) requirements* and/or *different coding and modulation schemes*" (see, for example, ¶¶ 133-134 above).

372. Accordingly, Wong teaches in view of the above that "In order to *maintain the required QoS* at the receiver, the *transmit power*, allocated to the n^{th} *subcarrier* by the k^{th} *user must equal*" the value of "$P_{k,n}$" given in the expression reproduced below (see, for example, ¶ 135 above).

$$P_{k,n} = \frac{f_k(c_{k,n})}{\alpha_{k,n}^2}$$

373. Additionally, Wong discloses methodologies for how "to *find the best assignment* of $c_{k,n}$", or hence how to selectively set "$P_{k,n}$ *over all subcarriers and all users*" in view of all corresponding "$\alpha_{k,n}$" as "the *magnitude of the channel gain* (assuming coherent reception) of the n^{th} *subcarrier* as seen by the k^{th} *user*" by using a "*greedy algorithm*" that "*assigns bits to the subcarriers one bit at a time*, and in *each assignment*, the *subcarrier that requires the least additional power* is *selected*" (see, for example, ¶¶ 138-141 above).

374. For example, Wong explains for this "***greedy algorithm***" by the "***additional power***" for each "***subcarrier***" is "***selected***" that "For *each bit assignment iteration*, the *subcarrier that needs the minimum additional power is assigned one more bit*, and the *new additional power for that subcarrier is updated*" (see, for example, ¶ 142 above).

375. A POSITA would understand that Wong's "***transmit power, allocated to the*** n^{th} ***subcarrier by the*** k^{th} ***user***", or "$P_{k,n}$" shown above, is a disclosure of a "**transmission power level**" for the particular "**Orthogonal Frequency Division Multiplexing (OFDM) tone**" corresponding to this "n^{th} ***subcarrier by the*** k^{th} ***user***".

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376. A POSITA would further understand from the equation shown above that this "**transmission power level**" for the particular "**Orthogonal Frequency Division Multiplexing (OFDM) tone**" corresponding to this "n^{th} ***subcarrier by the*** k^{th} ***user***", or "$P_{k,n}$", is based upon the value of "$\alpha_{k,n}$" as the "***magnitude of the channel gain***" for this "n^{th} ***subcarrier as seen by the*** k^{th} ***user***".

377. Moreover, by the equation shown above for "$P_{k,n}$", a POSITA would understand that as "$\alpha_{k,n}$" as the "***magnitude of the channel gain***" for this "n^{th} ***subcarrier as seen by the*** k^{th} ***user***" varies for the "***different subcarriers to different users***" at least because for the "***frequency selective fading channel, different subcarriers will experience different channel gains***" (as well as have different values of "$f_k(c_{k,n})$" based upon the "***number of bits/OFDM symbol to be transmitted on each subcarrier***") and because the "***greedy algorithm***" that "***assigns bits to the subcarriers one bit at a time***" (i.e. sets or updates "$c_{k,n}$") also determines how the "***additional power***" for each "***subcarrier***" is "***selected***" at "***each bit assignment iteration***", then Wong discloses "**selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal**" based upon "$\alpha_{k,n}$" as the "***magnitude of the channel gain***" for this "n^{th} ***subcarrier as seen by the*** k^{th} ***user***".

378. Accordingly, a POSITA would also understand that "$\alpha_{k,n}$" as the "***magnitude of the channel gain***" for this "n^{th} ***subcarrier as seen by the*** k^{th} ***user***" is an example of an "**at least one forward path pre-equalization parameter**" to which "**modifying a forward path data signal that is to be transmitted to the receiving device**" is "**based on**".

379. Since "$\alpha_{k,n}$" as the "***magnitude of the channel gain***" for this "n^{th} ***subcarrier as seen by the*** k^{th} ***user***" is also the parameter that I have shown previously to render obvious the

antecedent "**said at least one forward path pre-equalization parameter**" by my analysis of claim element 1(a) herein, then a POSITA would understand that Wong discloses all of the limitations of this claim element 1(b).

380. Thus, Wong and the knowledge of a POSITA renders obvious "**modifying a forward path data signal that is to be transmitted to the receiving device**" (for example, by applying the OFDM subcarrier, bit, and power allocation algorithm of Wong as also shown in annotated Fig. 1 of Wong) "**based on said at least one forward path pre-equalization parameter**" (for example, when the power allocation algorithm of Wong uses the magnitude of the channel gain $\alpha_{k,n}$ to determine the number of bits/OFDM symbol and the transmit power level for each subcarrier and user), "**where said modifying includes selectively setting different transmission power levels for at least two Orthogonal Frequency Division Multiplexing (OFDM) tones in said forward path data signal**" (for example, when the power allocation algorithm of Wong results in different values of the transmit power level or $P_{k,n}$ that is allocated to different ones of the n^{th} subcarrier for the k^{th} user within the overall transmit signal to the different users in a frequency selective fading channel with the different numbers of bits/OFDM symbol to be transmitted on such different subcarriers).

381. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

382. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 2

> 2. The method as recited in claim 1, further comprising: receiving said reverse path data signal over at least one reverse transmission path.

2. The method as recited in claim 1, further comprising: receiving said reverse path data signal over at least one reverse transmission path.

383. Wong discloses a “*time division duplex (TDD) wireless communication system*” wherein “*all the BS-to-mobile links*” include “*received uplink transmissions*” (see, for example, ¶ 122 above).

384. Accordingly, in view also of my analysis for claim element 1(a) above describing Wong and the knowledge of a POSITA with respect to “**a reverse path data signal received from a receiving device**”, a POSITA would also understand that Wong’s “***received uplink transmissions***” over “***multipath fading channels***” disclose at least “**receiving said reverse path data signal over at least one reverse transmission path**”.

385. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 1**” (for example, my analysis for Claim 1), further comprising: “**receiving said reverse path data signal**” (for example, the received uplink transmissions of Wong per my analysis of claim element 1(a)) “**over at least one reverse transmission path**” (for example, over the multipath fading channel of the BS-to-mobile link of Wong).

386. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

387. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 3

> 3. The method as recited in claim 2, further comprising: transmitting said modified forward path data signal over at least one forward transmission path.

3. The method as recited in claim 2, further comprising: transmitting said modified forward path data signal over at least one forward transmission path.

388. Wong discloses “*downlink transmission in a time division duplex (TDD) wireless communication system*” over “*multipath fading channels*” using “*orthogonal frequency division multiplex (OFDM)*” (see, for example, ¶¶ 117 and 121 above).

389. Accordingly, in view also of my analysis for claim element 1(b) above describing Wong and the knowledge of a POSITA with respect to “**a forward path data signal that is to be transmitted to the receiving device**”, a POSITA would also understand that Wong’s “***downlink transmission***” over “***multipath fading channels***” disclose at least “**transmitting said modified forward path data signal over at least one forward transmission path**”.

390. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 2**” (for example, my analysis for Claim 2), further comprising: “**transmitting said modified forward path data signal**” (for example, the downlink transmission of Wong per my analysis of claim element 1(b)) “**over at least one forward transmission path**” (for example, over the multipath fading channel of the BS-to-mobile link of Wong).

391. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

392. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 4

> 4. The method as recited in claim 1, wherein said reverse path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data.

4. The method as recited in claim 1, wherein said reverse path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data.

393. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that if “a *QPSK modulation* scheme is used at the *forward path*, the *reverse path has to use the same type of modulation* as well” or the patent examiner’s finding that the additional limitations of this claim are met by prior art that discloses only one of “**Orthogonal Frequency Division Multiplexing (OFDM) data**” or “**Quadrature Phase Shift Keying (QPSK) data**” as opposed to requiring a showing of a “**group of different types of data**” comprising both (see, for example, ¶¶ 78-82 and 106 above).

394. A POSITA would understand that Wong’s disclosure of OFDM for “*downlink transmission in a time division duplex (TDD) wireless communication system*” also indicates that OFDM would normally be used for the “*received uplink transmissions*” per my analysis of claim element 1(a) (see, for example, ¶ 301 above).

395. Additionally, Wong discloses an exemplary “system that employs *M-ary quadrature amplitude modulation (MQAM)*” using “*Square signal constellations (4-QAM, 16-QAM, and 64-QAM)*” (see, for example, ¶ 144 above).

396. A POSITA would understand that the terms “***4-QAM***” and “***QPSK***” were routinely used interchangeably at the time of the alleged invention of the ‘369 Patent (see, for example, ¶¶ 220 and 230-231 above) at least because the “***4-QAM***” and “***QPSK***” signal constellations are effectively interchangeable prior to acquiring a coherent phase reference in a

receiver since each signal constellation has 4 constellation points of equal amplitude and 90º phase separation (see, for example, ¶¶ 220 and 230 above). For example, the prior art explicitly teaches in reference to a depiction of a "***Square signal constellation***" for "***4-QAM***" that such "***4QAM constellation***" is "***more commonly known as a QPSK constellation***" (see, for example, ¶¶ 230-231 above).

397. Thus, Wong and the knowledge of a POSITA renders obvious "**The method as recited in claim 1**" (for example, my analysis for Claim 1), wherein "**said reverse path data signal**" (for example, the received uplink transmissions of Wong per my analysis of claim element 1(a)) includes "**at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data**" (for example, when such received uplink transmissions of Wong use either or both of OFDM or 4-QAM or QPSK modulation as would be obvious in view of the disclosures of Wong).

398. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

399. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 5

> 5. The method as recited in claim 1, wherein said modified forward path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data.

5. The method as recited in claim 1, wherein said modified forward path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data.

400. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim are met by prior art that discloses only one of “**Orthogonal Frequency Division Multiplexing (OFDM) data**” or “**Quadrature Phase Shift Keying (QPSK) data**” as opposed to requiring a showing of a “**group of different types of data**” comprising both (see, for example, ¶¶ 78 and 82 above).

401. See ¶¶ 388-389 above.

402. See ¶¶ 395-396 above.

403. Accordingly, in view also of my analysis for claim element 1(b) above describing Wong and the knowledge of a POSITA with respect to “**modifying a forward path data signal that is to be transmitted to the receiving device**”, a POSITA would also understand that Wong’s disclosure of OFDM “***downlink transmission***” using at least “***4-QAM***” (i.e. “***QPSK***”) discloses at least that “**said modified forward path data signal includes at least one type of data selected from a group of different types of data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data**”.

404. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 1**” (for example, my analysis for Claim 1), wherein “**said modified forward path data signal**” (for example, the downlink transmission of Wong per my analysis of claim element 1(b)) includes “**at least one type of data selected from a group of different types of**

data comprising Orthogonal Frequency Division Multiplexing (OFDM) data and Quadrature Phase Shift Keying (QPSK) data" (for example, when such downlink transmission of Wong uses either or both of OFDM or 4-QAM or QPSK modulation per the disclosures of Wong).

405. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

406. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 6

> 6. The method as recited in claim 5, wherein said modified forward path data signal includes sub-carrier pre-equalized OFDM data.

6. The method as recited in claim 5, wherein said modified forward path data signal includes sub-carrier pre-equalized OFDM data.

407. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference even though the base reference did not disclose either of a “**sub-carrier**” or “**OFDM data**” (see, for example, ¶¶ 79 and 82 above).

408. See ¶¶ 388-389 above.

409. Accordingly, in view also of my analysis for claim element 1(b) above describing Wong and the knowledge of a POSITA with respect to “**modifying a forward path data signal that is to be transmitted to the receiving device**”, a POSITA would understand that Wong’s teaching to apply a “***multiuser OFDM subcarrier, bit, and power allocation algorithm***” by “***assigning each user a set of subcarriers***” and by “***determining the number of bits and the transmit power level for each subcarrier***” and by using at least the “***Adaptive modulator***” blocks of annotated Fig. 1 of Wong is also an exemplary disclosure of “**wherein said modified forward path data signal includes sub-carrier pre-equalized OFDM data**”.

410. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 5**” (for example, my analysis for Claim 5), wherein “**said modified forward path data signal**” (for example, the downlink transmission of Wong per my analysis of claim element 1(b)) includes “**sub-carrier pre-equalized OFDM data**” (for example, Wong’s disclosure of the adaptive modulator blocks of annotated Fig. 1 that at least apply the determined the number of bits and the transmit power level for each subcarrier).

411. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

412. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 7

> 7. The method as recited in claim 6, further comprising: generating corresponding Quadrature Phase Shift Keying (QPSK) modulation values based on said sub-carrier pre-equalized OFDM data.

7. The method as recited in claim 6, further comprising: generating corresponding Quadrature Phase Shift Keying (QPSK) modulation values based on said sub-carrier pre-equalized OFDM data.

413. See ¶ 407 above.

414. See ¶¶ 395-396 above.

415. See ¶ 409 above.

416. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 6**” (for example, my analysis for Claim 6), further comprising: “**generating corresponding Quadrature Phase Shift Keying (QPSK) modulation values**” (for example, when the downlink transmission of Wong uses 4-QAM or QPSK modulation in one or more of the adaptive modulator blocks of annotated Fig. 1) “**based on said sub-carrier pre-equalized OFDM data**” (for example, Wong’s disclosure of the adaptive modulator blocks of annotated Fig. 1 that at least apply the determined the number of bits and the transmit power level for each subcarrier).

417. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

418. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 9

> 9. The method as recited in claim 1, wherein said reverse path data signal includes identifiable training data.

9. The method as recited in claim 1, wherein said reverse path data signal includes identifiable training data.

419. Wong discloses a “*time division duplex (TDD) wireless communication system*” wherein “the *base station (BS)* can *estimate the instantaneous channel characteristics* of all the BS-to-mobile links *based on the received uplink transmissions*” (see, for example, ¶ 122 above).

420. Additionally, as I have noted in my analysis of claim element 1(a) herein, a POSITA would understand that such “***received uplink transmissions***” disclose this antecedent “**said reverse path data signal**” and a POSITA would have found meeting the additional limitations of claim element 1(a) in view of the methods taught by Wong that include such need to “***estimate the instantaneous channel characteristics***” and the knowledge of a POSITA on how to perform such estimation to be obvious for at least the reasons I recited at ¶¶ 299-332 above.

421. More specifically, I note that for the 3 different known prior art methodologies that a POSITA would have been most motivated to combine with Wong with a high expectation of success that such prior art “***time domain***” approaches to channel estimation in OFDM at the base station (BS) of Wong assumed that such “***received uplink transmissions***” would include at least a “***training symbol*** (i.e., ***pilot tones on all subcarriers***)”, “***insert[ed] pilot tones into all of the carriers in an OFDM symbol***”, or “IEEE 802.11a ***standard training symbols***”, respectively (see, for example, ¶¶ 328-330 above).

422. Accordingly, a POSITA would have found obvious in view of Wong and the knowledge of a POSITA that the “***received uplink transmissions***” used to “***estimate the instantaneous channel characteristics***” would include at least “**identifiable training data**” such

as a "***training symbol*** (i.e., ***pilot tones on all subcarriers***)", "***insert[ed] pilot tones into all of the carriers in an OFDM symbol***", or "IEEE 802.11a ***standard training symbols***".

423. Thus, Wong and the knowledge of a POSITA renders obvious "**The method as recited in claim 1**" (for example, my analysis for Claim 1), wherein "**said reverse path data signal**" (for example, the received uplink transmissions of Wong per my analysis of claim element 1(a)) includes "**identifiable training data**" (for example, one or more training symbols with pilot tones across the subcarriers as described for time domain approaches to channel estimation in OFDM of such received uplink transmissions at the base station (BS) of Wong).

424. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

425. Minn discloses that "Pilot tones can be *inserted in all subcarriers of a particular OFDM symbol* forming an *OFDM training symbol*, in which case training symbols are *transmitted at an appropriate regular rate* determined by the *time varying nature of the wireless channel*" (see, for example, ¶ 152 above).

426. More specifically, Minn discloses the "***MST dual form DFT-based method***" as specifically applicable for a "*system with training symbol* (i.e., *pilot tones on all subcarriers*)" (see, for example, ¶ 175 above).

427. As have noted in my analysis of claim element 1(a) herein, a POSITA would have combined Wong and Minn including at least the "***MST dual form DFT-based method***" and such combination would meet all of the limitations of claim element 1(a) (see, for example, ¶¶ 346-356 above).

428. Accordingly, a POSITA would have found obvious in view of the combination of Wong and Minn and the knowledge of a POSITA that the "***received uplink transmissions***" used

to "***estimate the instantaneous channel characteristics***" would include at least "**identifiable training data**" such as a "***training symbol*** (i.e., ***pilot tones on all subcarriers***)".

429. Thus, Wong in view of Minn and the knowledge of a POSITA renders obvious "**The method as recited in claim 1**" (for example, my analysis for Claim 1), wherein "**said reverse path data signal**" (for example, the received uplink transmissions of Wong per my analysis of claim element 1(a)) includes "**identifiable training data**" (for example, one or more training symbols with pilot tones across the subcarriers as described for the MST dual form DFT-based method of Minn when applied to channel estimation in OFDM of such received uplink transmissions at the base station (BS) of Wong).

430. Therefore, in my opinion, Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element.

431. At least because each of Wong and the knowledge of a POSITA and Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element, then either of Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 10

> 10. The method as recited in claim 9, further comprising: comparing said identifiable training data to a local version of said training data to identify said at least one multipath transmission delay within said reverse path data signal.

10. The method as recited in claim 9, further comprising: comparing said identifiable training data to a local version of said training data to identify said at least one multipath transmission delay within said reverse path data signal.

432. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**comparing**” of “**training data**”, but instead the examiner stated that “it is ***known in the art to compare a received training sequence with a local training sequence*** so as to provide proper indication of transmission medium” (see, for example, ¶¶ 79 and 82 above).

433. See ¶¶ 419-421 above.

434. I further note that for the 3 different known prior art methodologies that a POSITA would have been most motivated to combine with Wong with a high expectation of success that such prior art “***time domain***” approaches to channel estimation in OFDM at the base station (BS) of Wong each included steps that a POSITA would understand to show comparing a frequency domain version of the as-received training symbol with the actual training symbol (see, for example, ¶ 174 above, particularly the sequence of multiplications of $R[k]$ with $1/P[k]$), comparing the as-received training symbol time domain samples with the actual time domain samples for the training symbol (see, for example, ¶ 189 above, particularly the TPTC estimation block operating upon $p[n]$ and $\hat{p}[n]$), or comparing the as-received training symbol time domain samples with the actual time domain samples for the training symbol (see, for example, ¶ 216 above, particularly the matrix multiplication of $X^{\dagger}$, which is comprised of actual

time domain samples for the training symbol, and the time-averaged, as-received training symbol time domain samples $r_{1,n}$ and $r_{2,n}$).

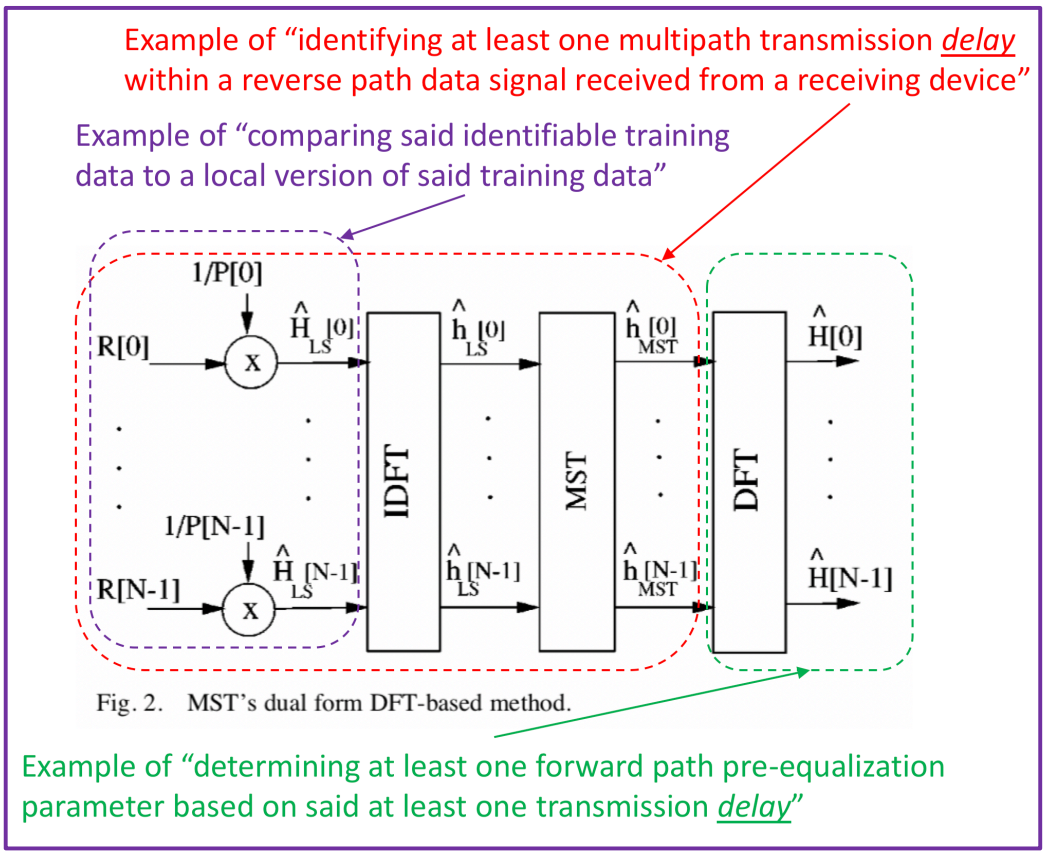
435. Accordingly, a POSITA would have found obvious in view of Wong and the knowledge of a POSITA that the methodologies applied to the "***received uplink transmissions***" used to "***estimate the instantaneous channel characteristics***" that would "**identify said at least one multipath transmission delay within said reverse path data signal**" per my analysis of claim element 1(a) herein would also render obvious the recited limitation of "**comparing said identifiable training data to a local version of said training data**".

436. Thus, Wong and the knowledge of a POSITA renders obvious "**The method as recited in claim 9**" (for example, my analysis for Claim 9), further comprising: "**comparing said identifiable training data to a local version of said training data**" (for example, the comparisons of as-received training symbols with actual training symbols at the base station (BS) of Wong per my analysis of claim element 1(a)) to "**identify said at least one multipath transmission delay within said reverse path data signal**" (for example, the known prior art time domain approaches to channel estimation in OFDM of such received uplink transmissions at the base station (BS) of Wong per my analysis of claim element 1(a)).

437. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

438. See ¶¶ 425-427 above.

439. A POSITA would understand that Minn discloses for the "***MST dual form DFT-based method***" at least a comparison of a frequency domain version of the as-received training symbol with the actual training symbol in the form of a sequence of multiplications of $R[k]$ with $1/P[k]$ (see, for example, ¶ 174 above, annotated Fig. 2 as reproduced below).



440. Thus, Wong in view of Minn and the knowledge of a POSITA renders obvious "**The method as recited in claim 9**" (for example, my analysis for Claim 9), further comprising: "**comparing said identifiable training data to a local version of said training data**" (for example, a comparison of a frequency domain version of the as-received training symbol with the actual training symbol in the form of a sequence of multiplications of $R[k]$ with $1/P[k]$ as shown in annotated Fig. 2 of Minn when applied at the base station (BS) of Wong per my analysis of claim element 1(a)) to "**identify said at least one multipath transmission delay within said reverse path data signal**" (for example, the known prior art time domain approaches to channel estimation in OFDM of such received uplink transmissions at the base station (BS) of Wong per my analysis of claim element 1(a)).

441. Therefore, in my opinion, Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element.

442. At least because each of Wong and the knowledge of a POSITA and Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element, then either of Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 12

> 12. The method as recited in claim 3, wherein said at least one reverse transmission path is substantially reciprocal to said at least one forward transmission path.

12. The method as recited in claim 3, wherein said at least one reverse transmission path is substantially reciprocal to said at least one forward transmission path.

443. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim are met by prior art based on citation to disclosure that assumes that a forward path is the “***inverse characteristic of the propagation path***” for a reverse path (see, for example, ¶¶ 78 and 82 above).

444. In my analysis of Claim 3 above, I noted that Wong discloses at least “**said at least one reverse transmission path**” by “***uplink transmission***” in Wong and at least “**said at least one forward transmission path**” by “***downlink transmission***” in Wong.

445. More specifically, Wong discloses a “*time division duplex (TDD) wireless communication system*” wherein “the *base station (BS)* can *estimate the instantaneous channel characteristics* of all the BS-to-mobile links *based on the received uplink transmissions*” such that “The multiuser *subcarrier*, bit, and *power allocation can then be used*” specifically for “*downlink transmission*” in order to “*improve the downlink capacity*” (see, for example, ¶¶ 121-122 above).

446. A POSITA would understand that Wong is teaching that the “***uplink***” and “***downlink***” are “**substantially reciprocal**” in Wong because the disclosed “***multiuser subcarrier, bit, and power allocation***” being applied to the “***downlink transmission***” relies upon having “***estimate[d] the instantaneous channel characteristics***” in the “***uplink transmissions***”, which the prior art also teaches as being based applicable to a “***time division duplex (TDD) system***” where the “***mobile station and base station use the same carrier frequency***” (see, for example, ¶ 253 above).

447. Thus, Wong and the knowledge of a POSITA renders obvious "**The method as recited in claim 3**" (for example, my analysis for Claim 3), wherein "**said at least one reverse transmission path is substantially reciprocal to said at least one forward transmission path**" (for example, when the multiuser subcarrier, bit, and power allocation applied to the downlink transmission of Wong uses channel estimation information from the received uplink transmissions within a TDD wireless communication system).

448. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

449. Lehne teaches that "For the *base station* to be able to *estimate the radio channel*, a *reference or training sequence* is normally necessary, i.e., a known bit sequence must be *transmitted periodically*" because to "*maximize the SIR*" will "*require knowledge of the instantaneous channel response*" (see, for example, ¶ 250 above).

450. Lehne discloses that "In a *time division duplex (TDD) system the mobile station and base station use the same carrier frequency* only separated in time" such that "In this case the *weights calculated on uplink will be optimal on downlink* if the *channel does not change during the period from uplink to downlink transmission*" (see, for example, ¶ 253 above).

451. As have noted in my analysis of Claim 19 herein, a POSITA would have combined Wong and Lehne as a "***base station***" operating within a "***time division duplex (TDD) system***" that comprises at least a "***smart antenna***" system of Lehne and that operates according to the "***multiuser subcarrier, bit, and power allocation***" approach applied to OFDM of Wong (see, for example, ¶¶ 478-486 below).

452. Accordingly, a POSITA would have found obvious in view of the combination of Wong and Lehne and the knowledge of a POSITA that using the "***received uplink***

transmissions" to "***estimate the instantaneous channel characteristics***" at a "***base station***" in a "***time division duplex (TDD) system***" for "***weights calculated on uplink***" that are also "***optimal on downlink***" discloses at least that "**said at least one reverse transmission path is substantially reciprocal to said at least one forward transmission path**".

453. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 3**" (for example, my analysis for Claim 3), wherein "**said at least one reverse transmission path is substantially reciprocal to said at least one forward transmission path**" (for example, when the base station in a TDD system using a smart antenna uses channel estimation information from the received uplink transmissions to determine optimal weights and subcarrier power allocation for the downlink transmission).

454. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

455. At least because each of Wong and the knowledge of a POSITA and Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then either of Wong in view of Minn and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 13

> 13. The method as recited in claim 1, wherein identifying said at least one multipath transmission delay, determining said at least one forward path pre-equalization parameter, and modifying said forward path data signal are performed by a transmitting device.

13. The method as recited in claim 1, wherein identifying said at least one multipath transmission delay, determining said at least one forward path pre-equalization parameter, and modifying said forward path data signal are performed by a transmitting device.

456. In my analysis of Claim 1 above, I noted that Wong discloses at least “**identifying at least one multipath transmission [*channel condition*]**” (or in view of the knowledge of a POSITA and/or Minn renders obvious the recited “**identifying said at least one multipath transmission delay**”), “**determining at least one forward path pre-equalization parameter**” and “**modifying a forward path data signal**” were performed at the “***base station (BS)***” of Wong, which a POSITA would understand to be disclosure at a “**transmitting device**”.

457. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 1**” (for example, my analysis for Claim 1), wherein “**identifying said at least one multipath transmission delay, determining said at least one forward path pre-equalization parameter, and modifying said forward path data signal are performed by a transmitting device**” (for example, when these method steps are disclosed or rendered obvious by the base station of Wong as shown at least in annotated Fig. 1).

458. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

459. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 14

> 14. The method as recited in claim 13, wherein said transmitting device includes a base station device that is operatively configured for use in a wireless communication system.

14. The method as recited in claim 13, wherein said transmitting device includes a base station device that is operatively configured for use in a wireless communication system.

460. In my analysis of Claim 13 above, I noted that Wong discloses and/or renders obvious (based on the knowledge of a POSITA and/or Minn) the recited steps at a “**transmitting device**” that is a “***base station (BS)***”, which Wong also discloses as being for use in a “***time division duplex (TDD) wireless communication system***” that uses “***orthogonal frequency division multiplex (OFDM)***”.

461. Thus, Wong and the knowledge of a POSITA renders obvious “**The method as recited in claim 13**” (for example, my analysis for Claim 13), wherein “**said transmitting device includes a base station device that is operatively configured for use in a wireless communication system**” (for example, by the OFDM base station in a TDD wireless communication system of Wong).

462. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

463. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 15

> 15. The method as recited in claim 13, further comprising: using at least one transmitting device receive antenna operatively coupled to said transmitting device to receive said reverse path data signal over at least one reverse transmission path from the receiving device.

15. The method as recited in claim 13, further comprising: using at least one transmitting device receive antenna operatively coupled to said transmitting device to receive said reverse path data signal over at least one reverse transmission path from the receiving device.

464. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim are met by prior art based on inherency for a “***transmitting device***” of including “***an antenna coupled thereto to receive data signal from the receiving device***” even though such prior art that “***relates to a radio communication system***” did not disclose any “**antenna**” either by text or within its figures (see, for example, ¶¶ 78, 82, 102-103 and 105 above).

465. In my analysis of Claim 2 above, I noted that Wong discloses at least “**said reverse path data signal over at least one reverse transmission path from the receiving device**” by at least the “***uplink transmission***” from the “***mobile***” or “***user***” to the “***base station (BS)***” in Wong.

466. A POSITA would understand that Wong’s disclosure of a “***base station (BS)***” for use in a “***time division duplex (TDD) wireless communication system***” that uses “***orthogonal frequency division multiplex (OFDM)***” indicates that such “***base station (BS)***” would be using “**at least one transmitting device receive antenna operatively coupled to said transmitting device to receive**” at least because such an “**antenna**” would be needed at such “***base station (BS)***” in order to perform as described in Wong.

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467. Additionally, a POSITA would know that prior art "***orthogonal frequency division multiplex (OFDM)***" and/or "***time division duplex (TDD)***" wireless communications devices comprise such an "**antenna**" (see, for example, ¶¶ 204, 253 and 256-257 above).

468. Thus, Wong and the knowledge of a POSITA renders obvious "**The method as recited in claim 13**" (for example, my analysis for Claim 13), further comprising: "**using at least one transmitting device receive antenna operatively coupled to said transmitting device to receive said reverse path data signal over at least one reverse transmission path from the receiving device**" (for example, by an antenna at the OFDM base station used to receive uplink transmissions in the TDD wireless communication system of Wong).

469. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

470. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 19

> 19. The method as recited in claim 15, wherein said transmitting device is operatively coupled to a plurality of first device receive antennas.

19. The method as recited in claim 15, wherein said transmitting device is operatively coupled to a plurality of first device receive antennas.

471. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**plurality of first device receive antennas**”, but instead the examiner stated that “it would have been ***obvious to couple the device with a plurality of antenna to enhance signal detection***” (see, for example, ¶¶ 79 and 82 above).

472. In my analysis of Claim 15 above, I noted that Wong discloses at least “**using at least one transmitting device receive antenna operatively coupled to said transmitting device**” at least because such an “**antenna**” would be needed at a “***base station (BS)***” (i.e. “**said transmitting device**”) in order to perform as described in Wong.

473. Lehne discloses a “*cellular system*” wherein “*the radio communication is between the user and a* ***base station***, which provides *radio coverage within a certain area*, which is *called a* ***cell***” (see, for example, ¶ 233 above).

474. Lehne notes that “Normally, the term “*antenna*” comprises only” the “*radiating element*” (see, for example, ¶ 236 above).

475. But Lehne teaches that advantageously a “*cellular system*” should use “*smart antennas*” at the “***base station***” in the form of “***array antennas***” that include “a *number of radiating elements*, a *combining/dividing network* and a *control unit*” to produce “*an adaptive … lobe-pattern*” in order to “*optimize the communications link*” (see, for example, ¶¶ 234-236 above).

476. For example, Lehne discloses that "Figure 12 shows schematically the elements of the *reception part of a smart antenna*" for an "*antenna array*" that "*contains N elements*" (see, for example, ¶ 246 above, annotated Figure 12 as reproduced below).

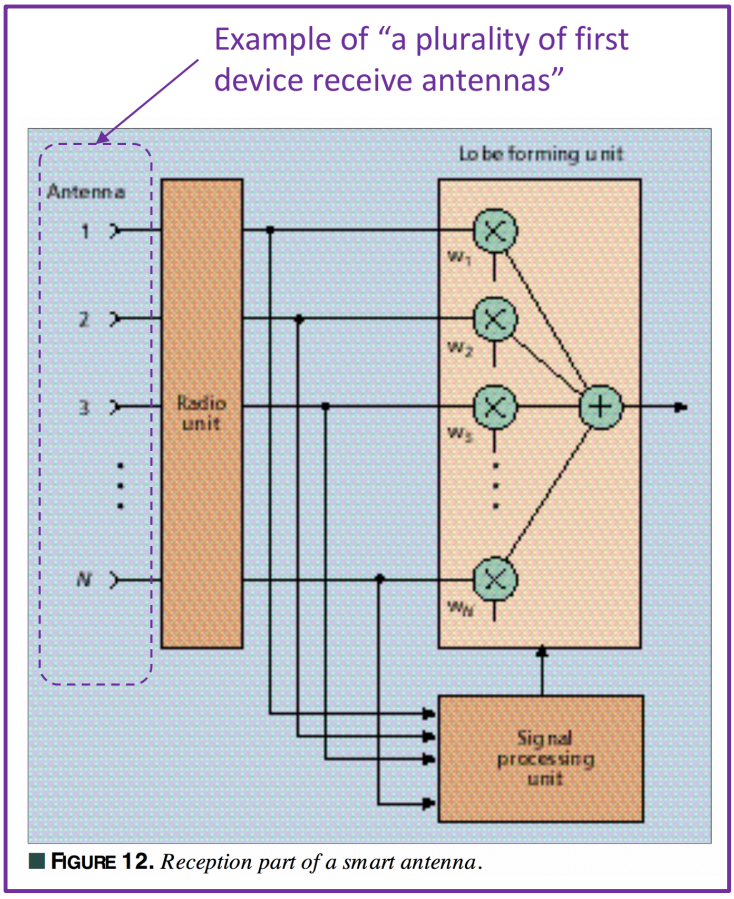


FIGURE 12. *Reception part of a smart antenna.*

477. Thus, a POSITA would understand that Lehne discloses a "***base station***" (i.e. "**said transmitting device**") that includes at least a "***number of radiating elements***" (i.e. "**a plurality of first device receive antennas**").

478. In my opinion, a POSITA would have been highly motivated to combine Wong in view of Lehne and the knowledge of a POSITA in a manner that would render obvious all of the limitations of this claim element for at least the following reasons.

479. First, a POSITA would understand that Wong discloses a "***multiuser OFDM subcarrier, bit, and power allocation algorithm***" at a "***base station (BS)***" for "***assigning each***

user a set of subcarriers" and "***determining the number of bits and the transmit power level for each subcarrier***" specifically in order to "***improve the downlink capacity***" for "***downlink transmission in a time division duplex (TDD) wireless communication system***" subject to "***multipath fading channels***" (see, for example, ¶¶ 114-115, 117 and 121-122 above).

480. A POSITA would also understand from the prior art at the time of the alleged invention of the '369 Patent that there is "***tremendous capacity potential for wireless communication systems using antenna diversity***", as well as "***OFDM***", particularly "***When the channel***" is "***fading***" such as, for example, when there is "***sufficient spacing between the antenna elements*** at the transmitters and receivers such that there is ***no or very little correlation amongst their respective signals***" such that "***antenna diversity*** can be used to either ***improve the link performance*** of a signal or ***increase data throughput***" and thereby "***increase capacity***" (see, for example, ¶¶ 221-222 above).

481. Additionally, a POSITA would understand that Lehne discloses that "***The principle reason for the growing interest in smart antennas is the capacity increase***" because while "***mobile systems are normally interference-limited***", "***Smart antennas***" operate by "***simultaneously increasing the useful received signal level and lowering the interference level***", thereby providing a "***capacity increase of 300 percent***" or alternatively a "***fivefold capacity gain***" (see, for example, ¶¶ 254-255 above).

482. Accordingly, at least because the disclosures of Wong are directed to "***improve the downlink capacity***", because the prior art teaches that combining "***OFDM***" such as used in Wong with "***antenna diversity***" such as used in Lehne would "***increase capacity***", and because Lehne also teaches "***smart antennas***" provide a significant "***capacity increase***", then a POSITA would have been highly motivated to combine the "***smart antennas***" disclosures of Lehne with

the "***multiuser OFDM subcarrier, bit, and power allocation algorithm***" at a "***base station (BS)***" in a "***time division duplex (TDD) wireless communication system***" of Wong in order to even further "***increase capacity***" for the combination as would be a common sense action in view of well-known market forces at the time of the alleged invention of the '369 Patent for a "***base station (BS)***" that highly value "***capacity***".

483. Second, a POSITA would have an expectation of success when combining the "***smart antenna***" disclosures of Lehne with the "***multiuser OFDM subcarrier, bit, and power allocation algorithm***" at a "***base station (BS)***" in a "***time division duplex (TDD) wireless communication system***" of Wong.

484. For example, a POSITA would have known that the output of the "***Lobe forming unit***" in the "***Reception part of a smart antenna***" (see, for example, ¶ 246 above) is analogous to the disclosure of "***received uplink transmissions***" in the "***base station (BS)***" of Wong (see, for example, ¶ 122 above) and that the input to the "***Lobe forming unit***" in the "***Transmission part of a smart antenna***" (see, for example, ¶ 252 above) is analogous to the disclosure of "***downlink transmission***" in the "***base station (BS)***" of Wong (see, for example, ¶ 121 above).

485. Accordingly, a POSITA would have known that the "***smart antenna***" system of Lehne can be substituted for the "***"dumb"/fixed antenna***" (see, for example, ¶ 235 above) that is effectively assumed by the disclosures of Wong (see, for example, ¶ 125 above).

486. Additionally, Lehne specifically reports that its "***smart antenna***" approaches have been successfully deployed with a "***time division duplex (TDD) wireless communication system***", which a POSITA would associate with Wong, by real-world examples such as the "***first trial to demonstrate commercial traffic through base stations equipped with smart antennas***" for "***GSM1800***" (a "***time division duplex (TDD) system***") as well as "***smart antenna solutions***

for the GSM standard and for the Japanese Personal Handyphone System (PHS)" (each a "***time division duplex (TDD) system***") as shown by "***Field trials***" performed in the USA (see, for example, ¶¶ 256-257 above).

487. Moreover, a POSITA would have known that prior art teaches that "***smart antenna***" approaches are specifically application to an "***OFDM***" form of "***time division duplex (TDD) wireless communication system***" because "***OFDM***" provides "***Spectral diversity***" that is "***effective when the fading is frequency-selective***", which a POSITA would associate with Wong, while "***spatial diversity can be used to provide substantial improvement in system performance***" through the use of "***multiple antennas sufficiently well-separated***" even for "***situations where the fading channel is nonselective***" (see, for example, ¶ 224 above), thereby teaching a POSITA that the combination of Wong and Lehne as described above would be even more reliable across all channel conditions (both "***frequency-selective***" and "***nonselective***") than either Wong or Lehne alone.

488. Third, a POSITA would understand from the disclosure of Lehne that all "***smart antenna***" approaches of Lehne are applicable to the combination of Wong in view of Lehne.

489. For example, Lehne discloses that while "***the benefits of using smart antennas are many, there are also drawbacks and cost factors***" associated with each of the "***Switched lobe (SL)***", "***phased array (PA)***" and "***Adaptive array (AA)***" approaches because the "***benefits***" of "***capacity increase***" for each respective approach are correlated with being "***more expensive***" for a "***base station***" using the respective approach (see, for example, ¶¶ 237-243 above).

490. More specifically, Lehne teaches that the simplest "***Switched lobe (SL)***" approach is "***easier to implement in existing cell structures***" but provides only a "***limited improvement***" while the "***phased array (PA)***" approach has "***greater gain potential than switched lobe***" but

needs "***separate transceiver chains for each of the array antenna elements***" and further the most complex "***Adaptive array (AA)***" approach provides an "***additional increase in capacity***" in the form of "***more users per carrier***" but requires a "***computationally intensive process***" associated with the "***beamforming***" (see, for example, ¶¶ 238-239 and 241-242 above).

491. However, a POSITA would also understand that since the combination of Wong in view of Lehne involves a substitution of a "***"dumb"/fixed antenna***" approach in Wong for any one of the 3 "***smart antenna***" approaches of Lehne, then accordingly, the common sense understanding of a POSITA for the market forces applicable to any particular "***base station***" would render obvious the choice of which among the 3 "***smart antenna***" approaches of Lehne would be chosen as a tradeoff between the "***benefits***" and the "***cost factors***".

492. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 15**" (for example, my analysis for Claim 15), wherein "**said transmitting device is operatively coupled to a plurality of first device receive antennas**" (for example, when the base station in a TDD system has multiple radiating elements within a smart antenna coupled to its receiver).

493. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

494. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 21

> 21. The method as recited in claim 15, wherein determining said at least one forward path pre-equalization parameter based on said at least one transmission delay further includes: determining at least one angle of arrival of said reverse path data signal with respect to said at least one transmitting device receive antenna.

21. The method as recited in claim 15, wherein determining said at least one forward path pre-equalization parameter based on said at least one transmission delay further includes: determining at least one angle of arrival of said reverse path data signal with respect to said at least one transmitting device receive antenna.

495. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**determining at least one angle of arrival of said reverse path data signal with respect to said at least one transmitting device receive antenna**”, but instead the examiner stated that “it would have been ***obvious to one skill in the art to determine at least one angle of arrival*** of said reverse path with respect to said receive antenna so as to so as ***to detect delays associated with the received signal***” (see, for example, ¶¶ 79 and 82 above).

496. See, for example, ¶¶ 472-491 above, which are also applicable to my analysis of this claim.

497. See also my analysis for claim element 1(a) above, which shows that a POSITA would understand that the “***magnitude of the channel gain***” in Wong as determined by known prior art “***time domain***” approaches to channel estimation in OFDM at a base station (BS), including specifically the “***MST dual form DFT-based method***” of Minn, discloses “**determining said at least one forward path pre-equalization parameter based on said at least one transmission delay**” based upon at least the “***received uplink transmissions***” of Wong.

498. Lehne teaches to use a "*direction of arrival (DoA) algorithm*" on the "*signal received from the user*" such that the "received *power is maximized*" in order to "maximize the *signal to interference ratio* (SIR)" and Lehne also discloses that this general approach is applicable to exemplary forms of "***smart antennas***" disclosed in Lehne (see, for example, ¶¶ 237-239 and 251 above).

499. More specifically, Lehne teaches that "The signal processing unit will, *based on the received signal*, *calculate the complex weights* $w_1 - w_N$ with which the *received signal from each of the array elements is multiplied*" such that these "*weights can be optimized*" for the "*maximization of received signal from the desired user*" (see, for example, ¶ 249 above).

500. Lehne also notes that to "*maximize the SIR*" will "*require knowledge of the instantaneous channel response*" and thus that the "*base station*" must "be able to *estimate the radio channel*" by, for example, using a "*reference or training sequence*" that is "*transmitted periodically*" (see, for example, ¶ 250 above), which a POSITA would understand to be in accordance with the methodologies I described in reference to Wong and/or Minn and/or the knowledge of a POSITA in my analysis of claim element 1(a) herein.

501. Additionally, Lehne teaches that the "*direction-of-arrival* (DoA) is first *estimated* and then the *weights are calculated*" with the "*amplitude and phase in accordance with the desired steering angle*" wherein "*well documented methods exist for estimating the DoA*" (see, for example, ¶ 251 above).

502. Accordingly, a POSITA would understand that Wong in view of Lehne (or Wong in view of Minn further in view of Lehne) not only discloses "**determining said at least one forward path pre-equalization parameter based on said at least one transmission delay**" as I have described previously in my analysis of claim element 1(a) herein, but that in view of

Lehne such determination based upon at least the "***received uplink transmissions***" of Wong would also be applicable for "***estimating the DoA***" using at least a "***direction of arrival (DoA) algorithm***" on the "***signal received from the user***" such that the "***received power is maximized***" with respect to the "***array elements***" of the "***smart antennas***" disclosed in Lehne.

503. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 15**" (for example, my analysis for Claim 15), wherein "**determining said at least one forward path pre-equalization parameter based on said at least one transmission delay**" (for example, determining the magnitude of the channel gain at the base station based upon received uplink transmissions for OFDM using a time domain approach) further includes: "**determining at least one angle of arrival of said reverse path data signal with respect to said at least one transmitting device receive antenna**" (for example, when such determining also uses a direction of arrival (DoA) algorithm on the signal received from the user across the array elements of the smart antenna such that the received power is maximized).

504. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

505. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 28

> 28. The method as recited in claim 13, further comprising: using at least one transmitting device transmit antenna operatively coupled to said transmitting device to transmit said modified forward path data signal over at least one forward transmission path to the receiving device.

28. The method as recited in claim 13, further comprising: using at least one transmitting device transmit antenna operatively coupled to said transmitting device to transmit said modified forward path data signal over at least one forward transmission path to the receiving device.

506. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim are met by prior art based on inherency for a “***transmitting device***” of including “***an antenna coupled thereto to receive data signal from the receiving device***” even though such prior art that “***relates to a radio communication system***” did not disclose any “**antenna**” either by text or within its figures (see, for example, ¶¶ 78, 82, 102-103 and 105 above).

507. In my analysis of Claim 3 above, I noted that Wong discloses at least “**said modified forward path data signal over at least one forward transmission path to the receiving device**” by at least the “***downlink transmission***” to the “***mobile***” or “***user***” from the “***base station (BS)***” in Wong.

508. A POSITA would understand that Wong’s disclosure of a “***base station (BS)***” for use in a “***time division duplex (TDD) wireless communication system***” that uses “***orthogonal frequency division multiplex (OFDM)***” indicates that such “***base station (BS)***” would be using “**at least one transmitting device transmit antenna operatively coupled to said transmitting device to transmit**” at least because such an “**antenna**” would be needed at such “***base station (BS)***” in order to perform as described in Wong.

509. Additionally, a POSITA would know that prior art "***orthogonal frequency division multiplex (OFDM)***" and/or "***time division duplex (TDD)***" wireless communications devices comprise such an "**antenna**" (see, for example, ¶¶ 204, 253 and 256-257 above).

510. Thus, Wong and the knowledge of a POSITA renders obvious "**The method as recited in claim 13**" (for example, my analysis for Claim 13), further comprising: "**using at least one transmitting device transmit antenna operatively coupled to said transmitting device to transmit said modified forward path data signal over at least one forward transmission path to the receiving device**" (for example, by an antenna at the OFDM base station used to transmit downlink transmissions in the TDD wireless communication system of Wong).

511. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

512. At least because Wong and the knowledge of a POSITA renders obvious the limitations of this claim element, then any of Wong in view of Minn and the knowledge of a POSITA, Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 32

> 32. The method as recited in claim 28, further comprising: setting at least one antenna pointing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter.

32. The method as recited in claim 28, further comprising: setting at least one antenna pointing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter.

513. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**setting at least one antenna pointing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter**”, but instead the examiner stated that “it would have been ***obvious to one skill in the art to set at least one antenna pointing parameter or phase array associated with said transmit antenna based on the pre-equalization parameter so as to improve signal detection***” (see, for example, ¶¶ 79 and 82 above).

514. See, for example, ¶¶ 496-502 above, which are also applicable to my analysis of this claim.

515. Lehne discloses that “*Electronically steerable antenna patterns* are most often generated using *array antennas*” that are “consisting of a *number of antenna elements* on which the *signal is divided or combined* in *both phase and amplitude*” (see, for example, ¶ 245 above).

516. Lehne discloses that “The *transmission part of the smart antenna* will be schematically very *similar to the reception part*” wherein “The signal is split into N branches, which are *weighted by the complex weights* $z_1 – z_N$ in the *lobe forming unit*” and these “*weights*, which decide the *radiation pattern in the downlink direction*, are calculated by the *signal processing unit*” (see, for example, ¶ 252 above).

517. Lehne teaches that "In a *time division duplex (TDD) system the mobile station and base station use the same carrier frequency* only separated in time" such that "In this case the *weights calculated on uplink will be optimal on downlink* if the *channel does not change during the period from uplink to downlink transmission*" (see, for example, ¶ 253 above).

518. Accordingly, a POSITA would understand that Wong in view of Lehne (or Wong in view of Minn further in view of Lehne) not only discloses "**said at least one forward path pre-equalization parameter**" as I have described previously in my analysis of claim element 1(a) herein, but that in view of Lehne such determination based upon at least the "***received uplink transmissions***" of Wong would also be applicable for "***estimating the DoA***" using at least a "***direction of arrival (DoA) algorithm***" on the "***signal received from the user***" such that the "***received power is maximized***" using "***weights calculated on uplink***" with respect to the "***array elements***" of the "***smart antennas***" disclosed in Lehne, and then because the "***channel does not change during the period from uplink to downlink transmission***" as I have described previously in my analysis of Claim 12 herein, such "***weights calculated on uplink***" will be "***optimal on downlink***", thereby setting the "***radiation pattern in the downlink direction***" that is "***Electronically steerable***" to be the same as the optimum "***direction of arrival (DoA)***" on the uplink (i.e. "**setting at least one antenna pointing parameter associated with said at least one transmitting device transmit antenna**") as determined by the calculation of the "***magnitude of the channel gain at the base station***" (i.e. "**based on said at least one forward path pre-equalization parameter**").

519. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 28**" (for example, my analysis for Claim 28), further comprising: "**setting at least one antenna pointing parameter associated with said at least**

one transmitting device transmit antenna" (for example, using a direction of arrival (DoA) algorithm on the signal received from the user across the array elements of the smart antenna to calculate both the magnitude of the channel gain and the optimal complex weights and then applying these results as optimal downlink weights to set the direction of the radiation pattern for downlink transmission from the base station) based on "**said at least one forward path pre-equalization parameter**" (for example, the magnitude of the channel gain at the base station).

520. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

521. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 33

> 33. The method as recited in claim 28, further comprising: setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter.

33. The method as recited in claim 28, further comprising: setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter.

522. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna based on said at least one forward path pre-equalization parameter**”, but instead the examiner stated that “it would have been ***obvious to one skill in the art to set at least one antenna pointing parameter or phase array associated with said transmit antenna based on the pre-equalization parameter so as to improve signal detection***” (see, for example, ¶¶ 79 and 82 above).

523. See, for example, ¶¶ 514-518 above, which are also applicable to my analysis of this claim.

524. Additionally, Lehne specifically discloses a “*Dynamically phased array* (PA)” wherein “*continuous tracking can be achieved*” for the “*Electronically steerable antenna patterns*” by using “a *direction of arrival (DoA) algorithm* for the *signal received from the user*” (see, for example, ¶¶ 238 and 245 above).

525. Accordingly, a POSITA would understand that Wong in view of Lehne (or Wong in view of Minn further in view of Lehne) not only discloses “**said at least one forward path pre-equalization parameter**” as I have described previously in my analysis of claim element

1(a) herein, but that in view of Lehne such determination based upon at least the "***received uplink transmissions***" of Wong would also be applicable for "***estimating the DoA***" using at least a "***direction of arrival (DoA) algorithm***" on the "***signal received from the user***" such that the "***received power is maximized***" using "***weights calculated on uplink***" with respect to the "***array elements***" of the "***smart antennas***" disclosed in Lehne including specifically the "***Dynamically phased array (PA)***", and then because the "***channel does not change during the period from uplink to downlink transmission***" as I have described previously in my analysis of Claim 12 herein, such "***weights calculated on uplink***" will be "***optimal on downlink***", thereby setting the "***radiation pattern in the downlink direction***" that is "***Electronically steerable***" to be the same as the optimum "***direction of arrival (DoA)***" on the uplink (i.e. "**setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna**") as determined by the calculation of the "***magnitude of the channel gain at the base station***" (i.e. "**based on said at least one forward path pre-equalization parameter**").

526. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 28**" (for example, my analysis for Claim 28), further comprising: "**setting at least one phased array antenna transmission directing parameter associated with said at least one transmitting device transmit antenna**" (for example, using a direction of arrival (DoA) algorithm on the signal received from the user across the array elements of a dynamically phased array antenna to calculate both the magnitude of the channel gain and the optimal complex weights and then applying these results as optimal downlink weights to set the direction of the radiation pattern for downlink transmission from the base

station) based on "**said at least one forward path pre-equalization parameter**" (for example, the magnitude of the channel gain at the base station).

527. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

528. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 35

> 35. The method as recited in claim 28, further comprising: selecting said at least one transmitting device transmit antenna from a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device.

35. The method as recited in claim 28, further comprising: selecting said at least one transmitting device transmit antenna from a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device.

529. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**selecting said at least one transmitting device transmit antenna from a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device**”, but instead the examiner stated that “it would have been ***obvious to one skill in the art to select one antenna from a plurality of antenna to improve system flexibility***” (see, for example, ¶¶ 79 and 82 above).

530. In my analysis of Claim 28 above, I noted that Wong discloses at least “**at least one transmitting device transmit antenna operatively coupled to said transmitting device**” at least because such an “**antenna**” would be needed at a “***base station (BS)***” (i.e. “**said transmitting device**”) in order to perform as described in Wong.

531. See, for example, ¶¶ 473-475 above, which are also applicable to my analysis of this claim.

532. For example, Lehne discloses that “The *transmission part of the smart antenna* will be schematically very *similar to the reception part*” as “shown in Fig. 16” (see, for example, ¶ 252 above, annotated Figure 16 as reproduced below).

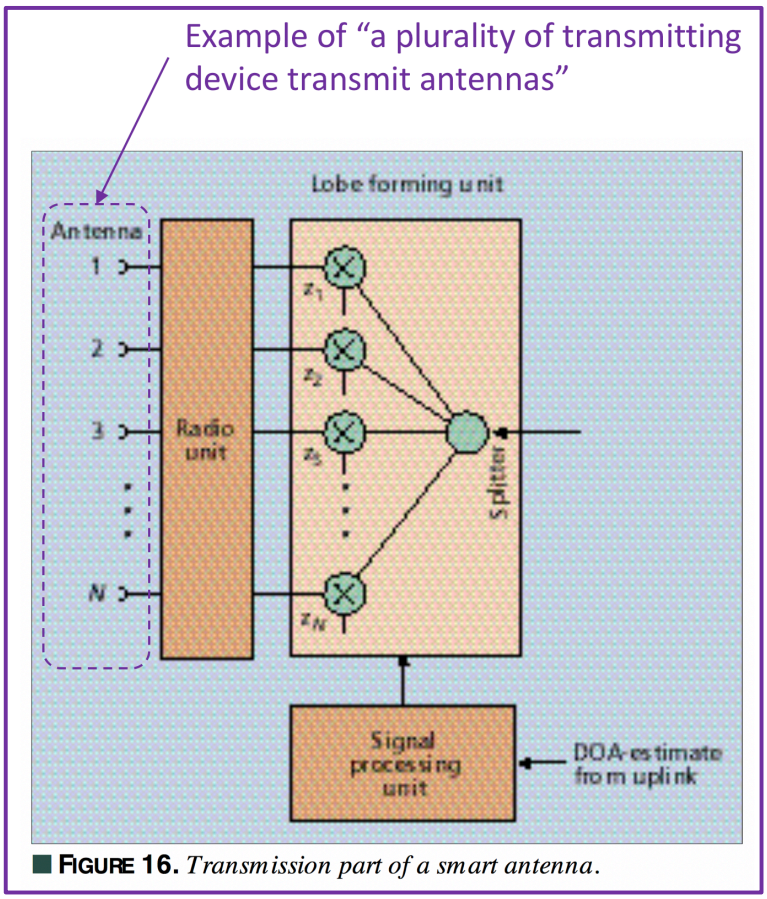


FIGURE 16. *Transmission part of a smart antenna.*

533. Thus, a POSITA would understand that Lehne discloses a "***base station***" (i.e. "**said transmitting device**") that includes at least a "***number of radiating elements***" (i.e. "**a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device**").

534. Additionally, Lehne explains that the "*Switched lobe* (SL)" or "*switched beam*" approach, which is "*easier to implement in existing cell structures*", uses a "*switching function between separate directive antennas or predefined beams of an array*" wherein a "*setting that gives the best performance*, usually in terms of *received power*, is *chosen*" (see, for example, ¶¶ 237 and 241 above).

535. See, for example, ¶¶ 478-491 above, which are also applicable to my analysis of this claim.

536. Accordingly, a POSITA would understand that Wong in view of Lehne (or Wong in view of Minn further in view of Lehne) not only discloses "**at least one transmitting device transmit antenna operatively coupled to said transmitting device**" as I have described previously in my analysis of claim element 28 herein, but that in view of Lehne some "***number of radiating elements***" (i.e. "**at least one transmitting device transmit antenna from a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device**") is "***chosen***" for "***best performance***" as a "***separate directive antenna***" or as a "***predefined beam of an array***" (i.e. "**selecting said at least one transmitting device transmit antenna**") .

537. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 28**" (for example, my analysis for Claim 28), further comprising: "**selecting said at least one transmitting device transmit antenna from a plurality of transmitting device transmit antennas that are each operatively coupled to said transmitting device**" (for example, when the base station in a TDD system has multiple radiating elements within a smart antenna coupled to its transmitter wherein at least one such radiating element within a separate directive antenna or predefined beam of an array is chosen based on a setting that gives best performance for received power).

538. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

539. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

‘369 Patent: Claim 36

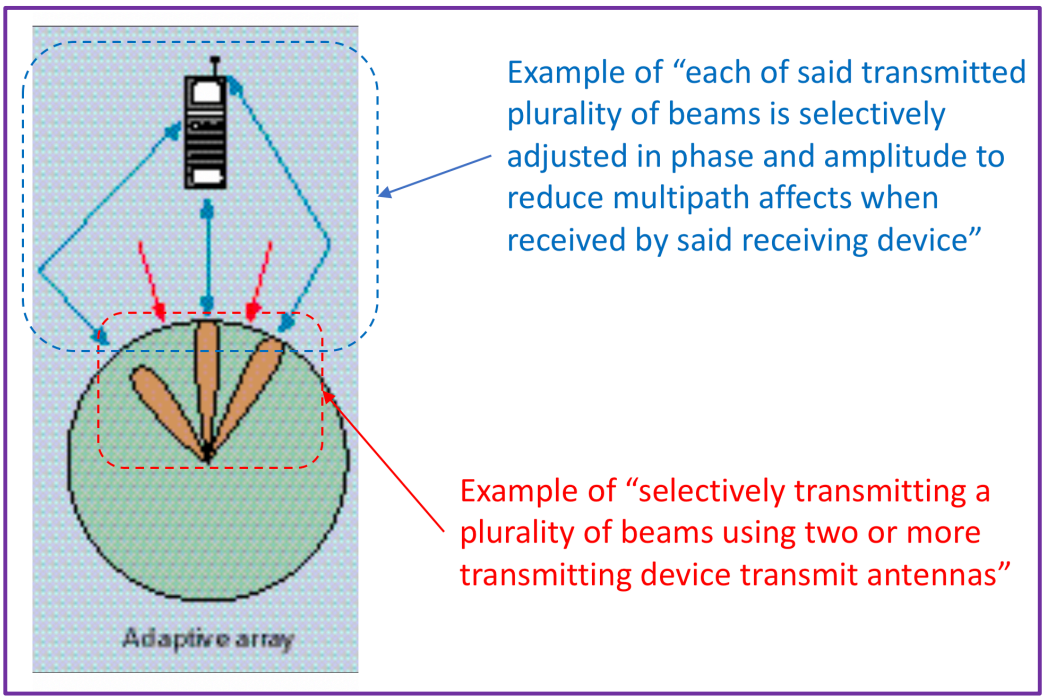
> 36. The method as recited in claim 35, further comprising: selectively transmitting a plurality of beams using two or more transmitting device transmit antennas.

36. The method as recited in claim 35, further comprising: selectively transmitting a plurality of beams using two or more transmitting device transmit antennas.

540. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**selectively transmitting a plurality of beams using two or more transmitting device transmit antennas**”, but instead the examiner stated that “it would have been ***obvious to one skill in the art to selectively transmit a plurality of beam using at least two transmit antenna in order to improve signal detection***” (see, for example, ¶¶ 79 and 82 above).

541. See, for example, ¶¶ 515-518 and 530-536 above, which are also applicable to my analysis of this claim.

542. Additionally, Lehne describes for the “*Adaptive array* (AA)” that with “*space diversity techniques*, the radiation *pattern can be adapted to receive multipath signals which can be combined*” as “illustrated in Fig. 3” (see, for example, ¶¶ 237 and 239 above, excerpted and annotated Figure 3 as reproduced below).



543. Accordingly, a POSITA would understand that Lehne describes the "***Adaptive array (AA)***" approach as shown by excerpted and annotated Figure 3 as having a "***radiation pattern in the downlink direction***" that is "***adapted***" to have multiple "***beams***" (i.e. 3 such "***beams***" being depicted in Figure 3, or hence "**a plurality of beams**") that are transmitted across the multiple "***antenna elements***" in the "***array***" (i.e. "**two or more transmitting device transmit antennas**") on which the "***signal is divided***" in "***both phase and amplitude***" (i.e. "**selectively transmitting**").

544. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 35**" (for example, my analysis for Claim 35), further comprising: "**selectively transmitting a plurality of beams using two or more transmitting device transmit antennas**" (for example, when the base station in a TDD system uses an adaptive antenna array that is adapted by both phase and amplitude for each antenna element to produce multiple beams within its radiation pattern in the downlink direction).

545. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

546. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 37

> 37. The method as recited in claim 36, wherein each of said transmitted plurality of beams is selectively adjusted in phase and amplitude to reduce multipath affects when received by said receiving device.

37. The method as recited in claim 36, wherein each of said transmitted plurality of beams is selectively adjusted in phase and amplitude to reduce multipath affects when received by said receiving device.

547. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**of said transmitted plurality of beams is selectively adjusted in phase and amplitude to reduce multipath affects when received by said receiving device**”, but instead the examiner stated that “it would have been ***obvious to one skill in the art to adjust the plurality of beams in amplitude and in phase so as to improve signal detection***” (see, for example, ¶¶ 79 and 82 above).

548. See, for example, ¶¶ 541-543 above, which are also applicable to my analysis of this claim.

549. Lehne discloses for the “*transmission part of the smart antenna*” that “The signal is split into N branches, which are *weighted by the complex weights* $z_1 – z_N$ in the *lobe forming unit*” and these “*weights*, which decide the *radiation pattern in the downlink direction*, are calculated by the *signal processing unit*” (see, for example, ¶ 252 above).

550. I note that a POSITA would understand this disclosure of “***complex weights***” to mean that each “***weight***” comprises a real and an imaginary component as a Cartesian coordinate representation of the polar coordinate combination of amplitude and phase.

551. Lehne also discloses that “*Electronically steerable antenna patterns* are most often generated using *array antennas*” that are “consisting of a *number of antenna elements* on

which the *signal is divided or combined* in *both phase and amplitude*" such that "By using a *narrow antenna beam at the base station* the *multipath propagation* can be somewhat *reduced*" (see, for example, ¶ 245 above).

552. See also, excerpted and annotated Figure 3 at ¶ 542 above which shows, as a POSITA would understand, that Lehne discloses multiple such "***narrow antenna beam[s] at the base station***" for the "***radiation pattern in the downlink direction***" that as "***combined***" when "**received by said receiving device**" (i.e. the "***user***") cause such "***multipath propagation***" to be "***reduced***".

553. Accordingly, a POSITA would understand that Lehne describes the "***Adaptive array (AA)***" approach as shown by excerpted and annotated Figure 3 as having a "***radiation pattern in the downlink direction***" that is "***adapted***" to have multiple "***narrow antenna beams***" (i.e. 3 such "***beams***" being depicted in Figure 3, or hence the "**each of said transmitted plurality of beams**") that are transmitted across the multiple "***antenna elements***" in the "***array***" on which the "***signal is divided***" in "***both phase and amplitude***" when "***weighted by the complex weights***" (i.e. "**selectively adjusted in phase and amplitude**") such that the effects of "***multipath propagation***" is "***reduced***" for the "***user***" (i.e. "**to reduce multipath affects when received by said receiving device**").

554. Thus, Wong in view of Lehne and the knowledge of a POSITA renders obvious "**The method as recited in claim 36**" (for example, my analysis for Claim 36), wherein "**each of said transmitted plurality of beams is selectively adjusted in phase and amplitude to reduce multipath affects when received by said receiving device**" (for example, when the base station in a TDD system uses an adaptive antenna array that is adapted by both phase and amplitude for each antenna element to produce multiple beams within its radiation pattern in the

downlink direction that when combined at the receiver in the user cause the effects of multipath propagation to be reduced).

555. Therefore, in my opinion, Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element.

556. At least because Wong in view of Lehne and the knowledge of a POSITA renders obvious the limitations of this claim element, then Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

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‘369 Patent: Claim 41

> 41. The method as recited in claim 1, wherein determining said at least one forward path pre-equalization parameter based on said at least one transmission delay further includes: sub-band equalizing said forward path data signal using corresponding frequency domain reverse path data.

41. The method as recited in claim 1, wherein determining said at least one forward path pre-equalization parameter based on said at least one transmission delay further includes: sub-band equalizing said forward path data signal using corresponding frequency domain reverse path data.

557. I note that during the prosecution of the ‘369 Patent that applicant did not dispute the patent examiner’s finding that the additional limitations of this claim were obvious to a POSITA without citation to a combining reference or showing that the base reference discloses any “**sub-band equalizing**”, whether using any “**corresponding frequency domain reverse path data**” or otherwise, but instead the examiner stated that “it would have been ***obvious*** to one skill in the art to ***subband equalize said forward path using corresponding reverse path data*** so as to ***remove interference***” (see, for example, ¶¶ 79 and 82 above).

558. A POSITA would understand that the plain, ordinary meaning of the term “**sub-band equalizing said forward path data signal**” in the context of an OFDM system would at least include performing equalization in the forward path across a group or band of related subcarriers instead of across each subcarrier individually.

559. For example, the ‘369 Patent describes a “*frequency domain equalization technique*” that “essentially acts a *sub-band equalizer in the transmitting node* (here, the base station device)” wherein “*power may be set to be equal in each of the sub-bands*, allowing regulatory rules, such as FCC rules, to be satisfied” while “the power may be *substantially flattened over the spectrum*” (see, for example, ¶ 68 above), which is consistent with the plain, ordinary meaning of “**sub-band equalizing said forward path data signal**” as equalization in the forward path across a group or band of related subcarriers.

560. In my analysis of claim element 1(a) above, I noted that Wong and/or Minn and the knowledge of a POSITA renders obvious at least "**determining said at least one forward path pre-equalization parameter based on said at least one transmission delay**" based at least upon the determination of the "***magnitude of the channel gain***" based upon "***channel conditions***" from the "***users***" as derived from the "***received uplink transmissions***" over "***multipath fading channels***" at the "***base station (BS)***" as described in Wong.

561. A POSITA would understand as I explained previously for claim element 1(a) herein that such "***magnitude of the channel gain***" (i.e. "$H[k]$" or "$\widehat{H}[k]$" where "k" is a "***subcarrier index***") based upon "***channel conditions***" from the "***users***" as derived from the "***received uplink transmissions***" over "***multipath fading channels***" at the "***base station (BS)***" in Wong is a disclosure of "**corresponding frequency domain reverse path data**" as this term is used in this claim element (see, for example, ¶¶ 306-312 above).

562. Additionally, Wong teaches that "the bit and *power allocation* algorithm can be *applied to each user on its allocated subcarriers*" for "*downlink transmission in a time division duplex (TDD) wireless communication system to improve the downlink capacity*" but also notes that "there is a *certain amount of transmission overhead* as the BS has to inform the mobiles about their *allocated subcarriers* and the *number of bits assigned to each subcarrier*" even in a "*TDD system*" and thus Wong further teaches that "To *further reduce the overhead*, we can *assign a contiguous band of subcarriers with similar fading characteristics as a group*, instead of *assigning each individual subcarrier*" (see, for example, ¶¶ 121 and 123-124 above).

563. Accordingly, a POSITA would have known that in order to "***reduce the overhead***" associated with application of the "***power allocation algorithm***" to "***each user on its allocated subcarriers***" using such "***magnitude of the channel gain***" as derived from the

"***received uplink transmissions***" (i.e. "**equalizing said forward path data signal using corresponding frequency domain reverse path data**") that Wong also discloses to instead perform such application of the "***power allocation algorithm***" to a "***contiguous band of subcarriers with similar fading characteristics as a group***" (i.e. to a "**sub-band**" in the terminology of this claim element).

564. Thus, Wong and/or Minn and the knowledge of a POSITA renders obvious "**The method as recited in claim 1**" (for example, my analysis for Claim 1), wherein "**determining said at least one forward path pre-equalization parameter based on said at least one transmission delay**" (for example, my analysis of claim element 1(a)) further includes: "**sub-band equalizing said forward path data signal**" (for example, applying the power allocation algorithm to downlink transmission at the base station in Wong to multiple ones of a contiguous band of subcarriers with similar fading characteristics as a group) using "**corresponding frequency domain reverse path data**" (for example, using the magnitude of the channel gain as derived from received uplink transmissions as shown for claim element 1(a)).

565. Therefore, in my opinion, Wong and the knowledge of a POSITA renders obvious the limitations of this claim element.

566. Therefore, in my opinion, Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element.

567. At least because each of Wong and the knowledge of a POSITA and Wong in view of Minn and the knowledge of a POSITA renders obvious the limitations of this claim element, then either of Wong in view of Lehne and the knowledge of a POSITA or Wong in view of Minn further in view of Lehne and the knowledge of a POSITA also renders obvious the limitations of this claim element.

IX. CONCLUSION

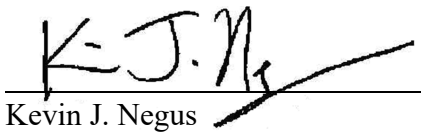
568. In my opinion, the claims of the '369 Patent are invalid for at least the reasons stated above.

569. I reserve the right to supplement my opinions in the future to respond to any arguments raised by Patent Owner or its experts and to take into account new information that becomes available to me.

570. I declare under penalty of perjury that all statements made herein are of my own knowledge and are true and correct and were made with the knowledge that willful false statements are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Respectfully submitted,

Date: Jan. 2, 2024



Kevin J. Negus