UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Cisco Systems, Inc.,
Petitioner

Case IPR2016-_____

U.S. Patent No. 7,835,430

DECLARATION OF DR. SAYFE KIAEI, UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,835,430

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I, Sayfe Kiaei, do hereby declare as follows:

I. INTRODUCTION

1. I have been retained as an independent expert witness on behalf of Cisco Systems, Inc. ("Cisco") for the above-captioned Petition for *Inter Partes* Review ("IPR") of U.S. Patent No. 7,835,430 ("the '430 patent"). I am being compensated at my usual and customary rate of $400 per hour for the time I spend in connection with this IPR. My compensation is not affected by the outcome of this IPR.

2. I have been asked to provide my opinions regarding whether claims 1-6 ("the Challenged Claims") of the '430 patent are invalid as they would have been obvious to a person having ordinary skill in the art ("POSITA") at the time of the alleged invention. It is my opinion that all of the limitations of claims 1-6 would have been obvious to a POSITA after reviewing the Milbrandt, Chang, Hwang and ANSI T1.413 references, as discussed further below.

3. The '430 patent issued on November 16, 2010, from U.S. Patent Appl. No. 12/477,742 ("the '742 Application"), filed on June 3, 2009. The '742 Application is a continuation of U.S. Patent Appl. No. 10/619,691 ("the '691 Application"), filed July 16, 2003, which is a continuation of U.S. Patent Appl. No. 09/755,173, filed on January 8, 2001. The '430 patent also claims the benefit of

U.S. Provisional Application No. 60/224,308, filed on August 10, 2000, and U.S. Provisional Application No. 60/174,865, filed on January 7, 2000.[1]

4. The face of the '430 patent names David M. Krinsky and Robert Edmund Pizzano, Jr., as the inventors. Further, the face of the '430 patent identifies Aware, Inc. as the assignee of the '430 patent.

5. In preparing this Declaration, I have reviewed:

a) the '430 patent, Ex. 1001;

b) the file history of the '430 patent, Ex. 1004;

c) the file histories of the patent applications to which the '430 patent is related, Ex. 1002-1003 and 1005-1008;

d) the prior art references discussed below: Ex. 1011 (Milbrandt), Ex. 1012 (Chang), Ex. 1013 (Hwang), and Ex. 1014 (ANSI T1.413); and

e) selected portions of these references, as discussed below:

- Charles K. Summers, ADSL Standards, Implementation, and Architecture (CRC Press 1999) ("Summers"),

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[1] Although it does not appear that the '430 patent claims are entitled to the provisional date of January 7, 2000, this declaration presents prior art and analysis which demonstrates that the Challenged Claims would have been obvious even as of the provisional date.

- Walter Goralski, ADSL and DSL Technologies (McGraw-Hill 1998) ("Goralski"),
- Harry Newton, Newton's Telecom Dictionary, 16th Ed. (2000) ("Newton's"),
- Valerie Illingworth and John Daintith, The Facts on File Dictionary of Computer Science (Market House Books 2001) ("Illingworth"),
- Thomas Starr, John M. Cioffi, Peter J. Silverman, Understanding Digital Subscriber Line Technology, (Prentice Hall 1999) ("Starr"),
- Andrew S. Tanenbaum, Computer Networks (Prentice Hall 1996) ("Tanenbaum"),
- B. P. Lathi, Modern Digital and Analog Communication Systems (Oxford University Press 1998) ("Lathi"), and
- Behzad Razavi, RF Microelectronics (Prentice Hall 1997) ("Razavi").

6. In forming the opinions expressed in this Declaration, I relied upon my education and experience in the relevant field of art, and have considered the viewpoint of a POSITA, as of January 7, 2000. I have also considered:

a) the documents listed above,

b) the additional documents and references cited in the analysis below,

c) the relevant legal standards, including the standard for obviousness provided in and any additional authoritative documents as cited in the body of this declaration, and

d) my knowledge and experience based upon my work in this area as described below.

7. I understand that claims in an IPR are given their broadest reasonable interpretation in view of the patent specification and the understandings of a POSITA. I further understand that this is not the same claim construction standard as one would use in a District Court proceeding.

II. BACKGROUND AND QUALIFICATIONS

8. My qualifications are set forth in my curriculum vitae, a copy of which is attached as Ex. 1010 to this declaration. As set forth in my curriculum vitae:

9. I earned my B.S. in Computer and Electrical Engineering from Washington State University-Northeastern in 1982, a M.S. in Electrical and Computer Engineering from Washington State University in 1984, and a PhD. in Electrical and Computer Engineering from Washington State University in 1987.

10. I have been a Professor at Arizona State University (ASU) since 2001. In this capacity, I have served as a Motorola Endowed Professor and Chair in analog and RF integrated circuits. I am also Director of ASU's Center on Global Energy Research and Director of NSF Connection One Research Center with a focus on integrated communication systems.

11. From 2009 to 2012, and concurrent with my position at ASU, I was the Associate Dean of Research at the Ira A. Fulton Schools of Engineering.

12. From 1993 to 2001, I was a senior member of technical staff with the Wireless Technology Center and Broadband Operations at Motorola. In that capacity, I was responsible for the development of RF and transceiver integrated circuits, GPS RF IC and digital subscriber lines (DSL) transceivers.

13. From 1987 to 1993, I served as an Associate Professor at Oregon State University.

14. In addition to the above noted positions, I was the Co-Director of the Industry-University Center for the Design of Analog/Digital ICs (CDADIC). Also, I am an IEEE Fellow, and have been the Chair and on the Technical Program Committee of several IEEE conferences including RFIC, MTT, ISCAS and other international conferences.

15. In total, I have more than thirty years of experience in research, development, design, commercialization, evaluation, and testing, of wireless

technologies, products, and systems. My research interests include wireless transceiver design, RF, and mixed-signal IC's in CMOS and SiGe.

16. I have published more than 100 journal and conference papers and have been awarded several U.S. patents.

17. I have organized and chaired international conferences on electrochemical capacitor technology and taught short courses at Electrochemical Society and IEEE meetings.

III. UNDERSTANDING OF PATENT LAW

18. I am not an attorney. For the purposes of this declaration, I have been informed about certain aspects of the law that are relevant to my opinions. My understanding of the law was provided to me by Cisco's attorneys.

19. I understand that prior art to the '430 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the '430 patent. I have applied the date of January 7, 2000, the filing date of the earliest provisional application in the chain of continuing applications resulting in the '430 patent, as the priority date. I understand, however, that the '430 patent claims may not be entitled to this earlier date, and that the actual entitled priority date may be later.

20. I understand that a claim is invalid if it would have been obvious. Obviousness of a claim requires that the claim would have been obvious from the

perspective of a POSITA at the time the alleged invention was made. I understand that a claim could have been obvious from a single prior art reference or from a combination of two or more prior art references.

21. I understand that an obviousness analysis requires an understanding of the scope and content of the prior art, any differences between the alleged invention and the prior art, and the level of ordinary skill in evaluating the pertinent art.

22. I further understand that certain factors may support or rebut the obviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the patented invention, skepticism of those having ordinary skill in the art at the time of invention, unexpected results of the invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field. I understand that there must be a nexus—a connection—between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

23. I further understand that a claim would have been obvious if it unites old elements with no change to their respective functions, or alters prior art by

mere substitution of one element for another known in the field and that combination yields predictable results. Also, I understand that obviousness does not require physical combination/bodily incorporation, but rather consideration of what the combined teachings would have suggested to persons of ordinary skill in the art at the time of the alleged invention.

24. While it may be helpful to identify a reason for this combination, common sense should guide and no rigid requirement of finding a teaching, suggestion, or motivation to combine is required. When a product is available, design incentives and other market forces can prompt variations of it, either in the same field or different one. If a POSITA can implement a predictable variation, obviousness likely bars its patentability. For the same reason, if a technique has been used to improve one device and a POSITA would recognize that it would improve similar devices in the same way, using the technique would have been obvious. I understand that a claim would have been obvious if common sense directs one to combine multiple prior art references or add missing features to reproduce the alleged invention recited in the claims.

25. I am not aware of any allegations by the named inventor of the '430 patent or any assignee of the '430 patent that any secondary considerations tend to rebut the obviousness of any Challenged Claim of the '430 patent.

26. I understand that in considering obviousness, it is important not to determine obviousness using the benefit of hindsight derived from the patent being considered.

27. The analysis in this declaration is in accordance with the above-stated legal principles.

IV. THE '430 PATENT

28. The '430 patent relates to a "diagnostic information transmission mode allow[ing] for two modems to exchange diagnostic and/or test information that may not otherwise be exchangeable during normal communication." '430 patent, Abstract. The '430 patent states that "[i]n the diagnostic link mode, the RT [remote terminal] modem sends diagnostic and test information in the form of a collection of information bits to the CO [central office] modem that are, for example, modulated by using one bit per DTM [discrete multi-tone] symbol modulation." *Id.*, 3:32-35. "Other exemplary modulation techniques include Differential Phase Shift Keying (DPSK) on a subset or all the carriers, as specified in, for example, ITU standard G.994.1, higher order QAM [quadrature amplitude modulated] modulation (>1 bit per carrier), or the like." *Id.*, 3:38-41.

29. The '430 patent shows in Table 1, below, "an example of a data message that can be sent by the RT to the CO during the diagnostic link mode." *Id.*, 4:19-20.

TABLE 1

Exemplary Message Variables
Data Sent in the Diag Link
Train Type
ADSL Standard
Chip Type
Vendor ID
Code Version
Average Reverb Received Signal
Programmable gain amplifier (PGA) Gain - Training

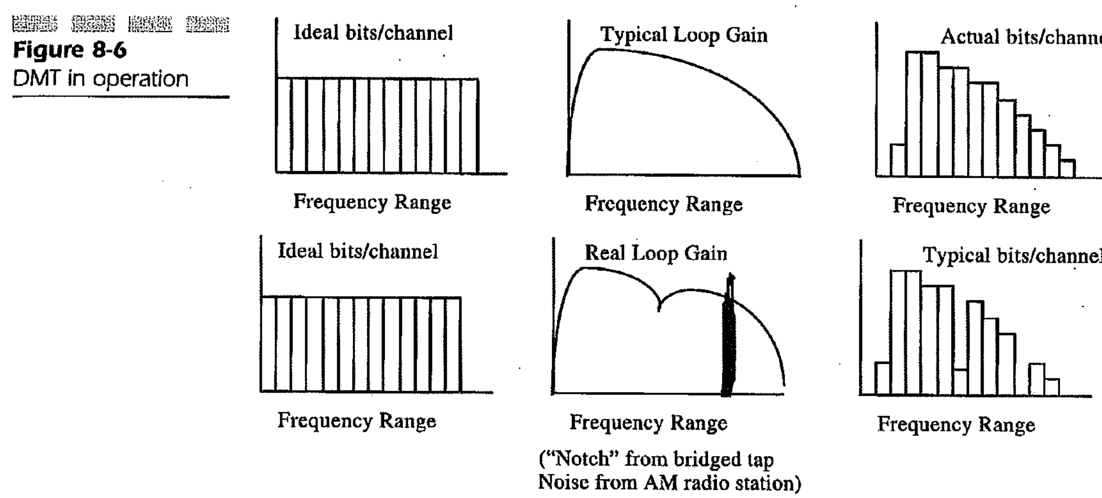
TABLE 1-continued

Exemplary Message Variables
Programmable gain amplifier PGA Gain - Showtime
Filter Present during Idle Channel Calculation
Average Idle Channel Noise
Signal to Noise during Training
Signal to Noise during Showtime
Bits and Gains
Data Rate
Framing Mode
Margin
Reed-Solomon Coding Gain
QAM Usage
Frequency Domain Equalizer (FDQ) Coefficients
Gain Scale
Time domain equalizer (TDQ) Coefficients
Digital Echo Canceller (DEC) Coefficients

'430 patent, 3:56-4:17.

30. The '430 patent describes communicating digital data using discrete multitone (DMT) signals. Those of skill in the art would have been familiar with DMT, as it had been employed for over five years in various communication systems, including asymmetric digital subscriber line (ADSL) standards such as

ANSI T1.413-1995 and ITU G.992.1. Summers, 26-27; ANSI T1.413, 1-2. DMT divides the available communication bandwidth (range of frequencies) into multiple distinct subchannels (or subcarriers). Goralski, 187. Each subcarrier is tested for its characteristic signal attenuation (or the reciprocal, its signal gain) and for noise. *Id.,* 188. The amount of data encoded into each subchannel is then tailored to the subchannel's characteristics. A subchannel with a strong signal and low noise will have more bits of data encoded into it than another subchannel with a weaker signal or greater noise. These ideas are illustrated in the figure below.



Goralski, Fig. 8-6, 189.

31. As discussed above, the '430 patent purports to provide for transmitting test or diagnostic information from one modem to another modem.

32. Independent claim 1 is representative of the Challenged Claims:

> 1. A transceiver capable of transmitting test information over a communication channel using multicarrier modulation comprising:

a transmitter portion capable of transmitting a message, wherein the message comprises one or more data variables that represent the test information, wherein bits in the message are modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and wherein at least one data variable of the one or more data variables comprises an array representing frequency domain received idle channel noise information.

V. LEVEL OF ORDINARY SKILL IN THE PERTINENT ART

33. I understand that the level of ordinary skill may be reflected by the prior art of record, and that a POSITA to which the claimed subject matter pertains would have the capability of understanding the scientific and engineering principles applicable to the pertinent art. I understand that one of ordinary skill in the art has ordinary creativity, and is not a robot.

34. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems. There are likely a wide range of educational backgrounds in the technology field pertinent to the '430 patent.

35. I am very familiar with the knowledge and capabilities that a POSITA of multicarrier communication systems (such as digital subscriber line (DSL) communications) would have possessed during the late 90s and early 2000s, especially as it pertains to testing lines for their support of multicarrier communications. Specifically, my experience in the industry, with colleagues from academia, and with engineers practicing in the industry during the relevant timeframe allowed me to become personally familiar with the knowledge and capabilities of a person of ordinary skill in the area of multicarrier communications. Unless otherwise stated, my testimony below refers to the knowledge of one of ordinary skill in the art in the field of multicarrier communications during the time period around the priority date of the '430 patent.

36. In my opinion, the level of a POSITA needed to have the capability of understanding multicarrier communications and engineering principles applicable to the '430 patent is (i) a Master's degree in Electrical and/or Computer Engineering, or equivalent training, and (ii) approximately five years of experience working in digital telecommunications. Lack of work experience can be remedied by additional education, and vice versa. Such academic and industry experience would be necessary to appreciate what was obvious and/or anticipated in the industry and what a POSITA would have thought and understood at the time. For example, an understanding of the '430 patent requires an appreciation of digital

communications using discrete multitone (DMT) signals. Such knowledge would be within the level of skill in the art. I believe I possess such experience and knowledge, and am qualified to opine on the '430 patent.

37. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of January 2000.

VI. BROADEST REASONABLE INTERPRETATION

38. It is my understanding that in order to properly evaluate the '430 patent, the terms of the claims must first be interpreted. It is my understanding that the claims are to be given their broadest reasonable interpretation in light of the specification. It is my further understanding that claim terms are given their ordinary and accustomed meaning as would be understood by a POSITA, unless the inventor, as a lexicographer, has set forth a special meaning for a term.

39. In order to construe the claims, I have reviewed the entirety of the '430 patent along with its prosecution history.

A. "frequency domain received idle channel noise information"

40. The term "frequency domain received idle channel noise information" appears in each of claims 1-6.

41. The ’430 patent does not provide an express definition for the term “frequency domain received idle channel noise information,” nor does the specification use this term. Aside from the claims, the term only appears in the ’430 patent’s title.

42. The specification refers to portions of the overall term in several places. For example, the specification mentions “average idle channel noise” in a bulk enumeration of various types of message variables:

TABLE 1-continued

Exemplary Message Variables
Programmable gain amplifier PGA Gain - Showtime
Filter Present during Idle Channel Calculation
Average Idle Channel Noise
Signal to Noise during Training
Signal to Noise during Showtime
Bits and Gains
Data Rate
Framing Mode
Margin
Reed-Solomon Coding Gain
QAM Usage
Frequency Domain Equalizer (FDQ) Coefficients
Gain Scale
Time domain equalizer (TDQ) Coefficients
Digital Echo Canceller (DEC) Coefficients

’430 patent, 4:1-17.

43. The specification also mentions a “frequency domain received idle channel” as part of a bulk enumeration of kinds of test information:

> The diagnostic and/or test information can include, but is not limited to, the version number of the diagnostic link mode, the length of the diagnostic and/or test information, the

> communications standard, such as the ADSL standard, the chipset type, the vendor identifications, the ATU version number, the time domain received reverb signal, the frequency domain reverb signal, the amplifier settings, the CO transmitter power spectral density, ***the frequency domain received idle channel***, the signal to noise ratio, the bits and gains and the upstream and downstream transmission rates, or the like.

'430 patent, 5:59-6:2.

44. The '430 specification does not, however, describe how "average idle channel noise" is measured, nor does it explain what tests are performed to gather information about "the frequency domain received idle channel."

45. A POSITA would have known that a waveform or signal represented in "time domain" can be converted to "frequency domain" representation. Time domain graphs show how the signal changes over time. Frequency-domain graphs show the signal in each given frequency band over a range of frequencies. Fourier Transformation—which is a mathematical operation—converts the time domain signal into a sum of sine waves at different frequencies, each of which represents a frequency component. Newton's., 377. Thus, "frequency domain" refers generally to analysis of a signal on a frequency basis.

46. Those of skill in the art also would have been familiar with the concept of an "idle channel noise," which is a term commonly used within the telecommunications industry to refer to noise that exists in a communication path

"when no signals are present." *See* Newton's, 438. This same concept is sometimes also referred to as "background noise." *See Id.,* 97.

47. As discussed above, those of skill in the art would have been familiar with the discrete multitone (DMT) techniques described in the '430 patent, which allow for the number of bits encoded into each subchannel to be tailored to the noise present in that subchannel. Using DMT, fewer (or no) bits can be encoded into subchannels with lower signal to noise ratio. Also, a POSITA would have been familiar not to assign any bits to a subchannel, or not to send any signal in an idle subchannel. If there signal is not present in that subchannel, only the idle channel noise is present.

48. Bringing these concepts together, a POSITA would have understood the entire phrase "frequency domain received idle channel noise information" to refer to *information about the background noise present in each of a plurality of frequency subchannels when the subchannels are not in use.*

B. "array"

49. The term "array" appears in each of claims 1-6.

50. Aside from the claims, the term "array" appears in the '430 patent specification only once:

> Many variables that represent the type of diagnostic and test information that are used to analyze the condition of the link are sent from the RT modem to the CO modem. These variables can be, for

> example, ***arrays*** with different lengths depending on, for example, information in the initiate diagnostic mode message.

'430 patent, 4:30-35.

51. Thus, the '430 patent does not provide an express definition for the term "array," but instead uses it according to its ordinary meaning.

52. In my opinion, a POSITA would have been familiar with the term "array," which is commonly used in both the computer and mathematical arts. Contemporary technical dictionaries define array as an "ordered collection of identical structures" (Newton's, 71) or a "collection of data items … [that are] arranged in a particular order or pattern and are all of the same type." (Illingworth, 9).

53. Consistent with these dictionary definitions and the usage of the term "array" in the '430 patent specification, I believe that a POSITA would have understood the broadest reasonable interpretation of "array" to mean *an ordered collection of multiple data items of the same type.*

C. "transceiver"

54. The term "transceiver" appears in the preamble of each of claims 1-6.

55. Claims 1, 3, and 5 each refer to the claimed transceiver *transmitting* information, and claim 1 recites that the transceiver includes a "transmitter portion." Claims 2, 4, and 6 each refer to the claimed transceiver *receiving* information, and claim 2 recites that the transceiver includes a "receiver portion."

56. A POSITA would have been familiar with the term "transceiver" as being a combination of the words "transmitter" and "receiver." Consistent with this ordinary understanding, the'430 patent specification states that a "transceiver" is also referred to as a modem and includes a transmitter and a receiver:

> For simplicity of reference, the systems and methods of the invention will hereafter ***refer to the transceivers generically as modems***. One such modem is typically located at a customer premises such as a home or business and is "downstream" from a central office with which it communicates. The other modem is typically located at the central office and is "upstream" from the customer premises. Consistent with industry practice, the modems are often referred to as "ATU-R" ("ADSL transceiver unit, remote," i.e., located at the customer premises) and "ATU-C" ("ADSL transceiver unit, central office" i.e., located at the central office). ***Each modem includes a transmitter section*** for transmitting data and ***a receiver section*** for receiving data, and is of the discrete multitone type, i.e., the modem transmits data over a multiplicity of subchannels of limited bandwidth.

'430 patent, 1:48-62. A POSITA would have understood that a modem, which stands for modulator/demodulator, is a transceiver since it modulates and demodulates for the purpose of transmitting and receiving.

57. A contemporary dictionary defines a transceiver as "Any device that transmits and receives." Newton's, 913.

58. Accordingly, I believe that a POSITA would have understood that the broadest reasonable interpretation of "transceiver" is a *device, such as a modem, with a transmitter and a receiver.*

59. I apply these constructions as the broadest reasonable constructions in view of the specification for purposes of this Declaration.

D. Other relevant terms

60. The '430 patent and the prior art – Milbrandt, Chang, Hwang, and ANSI T1.413 – describe communication systems that use Discrete Multitone Modulation (DMT). As DMT communication systems evolved, so did the terms that persons of ordinary skill in the art use to describe the system's components and functions. Some of these terms are different, but are used interchangeably by those of ordinary skill in the art, and refer to the same component or function in the communication system. I describe several of these terms below, with reference to the '430 patent and the prior art and Newton's.

61. **Channel**: A channel is a medium over which data is transmitted. Newton describes a channel as a "path of communication, either electrical or electromagnetic, between two or more points." Newton's, 180. Examples of a channel may be a twisted pair of a telephone wire, a fiber optic cable, or a quad cable. '430 patent, 5:26-29; Hwang, 5:3-5. The '430 patent refers to a broadband communications channel. '430 patent, 1:30-33.

62. A channel may have a defined frequency response, gain, and bandwidth. Newton's, 180. A bandwidth of an analog channel is typically measured in Hertz, which are cycles per second. Newton's, 101.

63. **Subchannel**: A channel may be divided into multiple sub-channels, where each sub-channel has its own frequency. For example, the broadband communications channel of the '430 patent is formed by multiple carriers, where the carriers "form discrete, non-overlapping communication subchannels of limited bandwidth." '430 patent, 1:29-30.

64. Also, a person of ordinary skill would have recognized that the term "frequency sub-carrier" in the ANSI T1.413 standard (ANSI T1.413, 107) corresponds to Milbrandt's "sub-frequency" (Milbrandt, 12:14-31) and that both of these terms correspond to the "subchannel" in the '430 patent. '430 patent, 1:29-30.

65. **Carrier**: A carrier is an electrical signal at a continuous frequency that is capable of being modified (also referred to as modulated) to carry information. The modifications can be changes to amplitude, frequency or phase. The modifications or the changes from the carrier's frequency become the carried information. Newton's, 159. A carrier may be another term for a sub-channel when the sub-channel's frequency is modified to carry information.

66. The '430 patent uses terms carrier and sub-channel in the same context. For example, "the carriers form discrete, non-overlapping communication subchannels of limited bandwidth" that collectively form a broadband communication channel. '430 patent, 1:29-30. Similarly, Hwang refers to the signals being "carried over a distinct carrier frequency channel" where "frequency separation between consecutive carriers is 4.3125 KHz." Hwang, 2:67-3:5.

67. **Tone**: A tone is a type of a carrier or a carrier signal. A tone refers to an "audio signal consisting of one or more superimposed amplitude modulated frequencies with a distinct cadence and duration." Newton's, 908. Hwang uses the terms "carrier" and "tone" interchangeably. For example, in Hwang, "[t]he frequency separation between consecutive carriers is 4.3125 KHz with a total number of 256 carriers or tones (ANSI)." Hwang, 3:3-5. And, in the "256 tone-carrier DMT coding scheme … tones 8-31 are used as carriers to provide an upstream channel of approximately 100 kHz analog bandwidth." Hwang, 3:5-3:14. The '430 patent also describes a discrete multitone transmission scheme to transmit data, where "the Average Reverb Signal contains the power levels per tone, up to, for example, 256 entries, detected during the ADSL Reverb signal." '430 patent, 4:25-27.

68. **Frequency**: Frequency is a rate at which electronic signal alternates. As I mentioned above, frequency is measured in Hertz (Hz) and represents a

number of cycles per second. A channel can have a particular frequency bandwidth that is divided among multiple sub-channels. The '430 patent describes an "upstream or ATU-C modem transmits data to the downstream or ATU-R modem over a first set of subchannels, which are usually the higher-frequency subchannels" and "receives data from the downstream or ATU-R modem over a second, usually smaller, set of subchannels, commonly the lower-frequency subchannels." '430 patent, 1:63-2:1. Hwang describes "[t]he frequency separation between consecutive carriers" or subchanels "is 4.3125 KHz with a total number of 256 carriers or tones (ANSI)." Hwang, 2:66-3:5.

69. **Symbol**: A symbol is a recognizable electrical state associated with an electrical signal, such as a carrier or a carrier signal. A symbol includes one or more data bits that are carried by a carrier during each cycle. In a binary transmission, a symbol can represent two possible states, e.g., 0 or 1. The '430 patent describes diagnostic and test data that is sent "in the form of a collection of information bits" and is "modulated by using one bit per DTM symbol modulation." '430 patent, 3:33-35. In this "one bit per DMT symbol modulation message encoding scheme, a bit with value 0 is mapped to the REVERB1 signal and a bit with a value of 1 mapped to a SEGUE1 signal." *Id.* 3:42-46. Hwang also describes a symbol that is transmitted using a sub-channel or a carrier, but using multiple bits rather than a single bit. For example, in Hwang "[e]ach tone is QAM

to carry up to 15 bits of data on each cycle of the tone waveform (symbol)." Hwang, 3:11-12.

VII. DETAILED INVALIDITY ANALYSIS

70. I have been asked to provide my opinion as to whether the Challenged Claims of the '430 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references identified below teach the limitations of the Challenged Claims of the '430 patent. It is my opinion that the Milbrandt, Chang, Hwang, and ANSI T1.413 references would have rendered obvious to a POSITA the subject matter of claims 1-6 of the '430 patent.

71. As part of my analysis, I have considered the scope and content of the prior art, and any differences between the alleged invention and the prior art. I took the time of the alleged invention to be the priority date of the earliest provisional application to which the application that issued as the '430 patent claimed priority— January 7, 2000—although it may be that the '430 patent claims are not entitled to this early date. I have also considered the level of ordinary skill in the pertinent art as of that date.

72. I describe in detail below the scope and content of the prior art, as well as any differences between the alleged invention and the prior art, on an element-by-element basis for each Challenged Claim of the '430 patent. At most,

there are only minor differences between the identified prior art references and the alleged invention recited in the Challenged Claims of the '430 patent.

73. As described in detail below, the alleged invention of the Challenged Claims would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA.

A. Background on Prior Art References

74. Before providing a detailed analysis of how the prior art teaches the limitations of the Challenged Claims, I provide a brief summary of the prior art references.

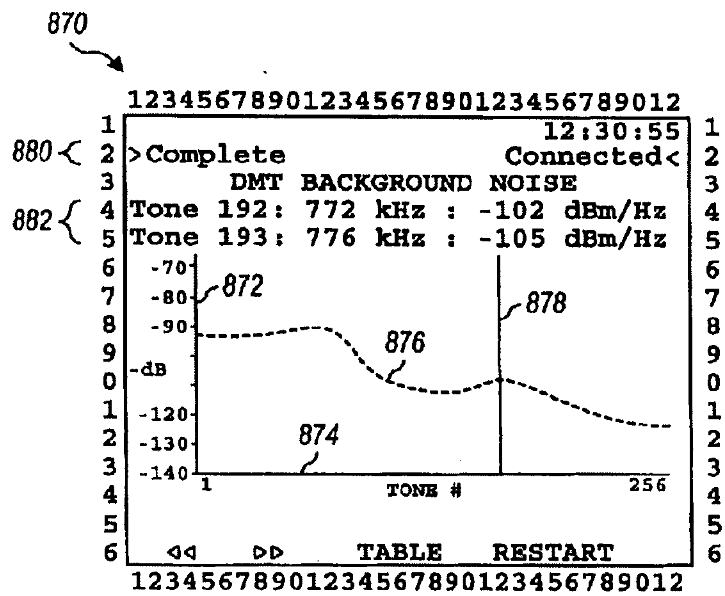
1. Background on Milbrandt

75. Milbrandt describes technology that allows a digital subscriber line (DSL) service provider to test the telephone lines used to deliver service to its customers. Milbrandt's system collects measurements of "line noise" and other characteristics using devices located at the customers' premises. Ex. 1011, Abstract. The noise measurements and other information are transmitted from the customers' premises to the service provider's central office over the same telephone lines used to provide DSL service. *Id.*, 11:38-53. Milbrandt describes using the collected measurements for various purposes, including determining a transmit power level for the modems providing DSL services and estimating the data rate capacity of the subscriber lines. *Id.*, Abstract, 3:17-24, 10:18-24.

76. Milbrandt further describes how DSL services can provide for high speed data transmission and Internet access. *Id.*, 1:30-39. The communication components in Milbrandt's network use "ADSL [asymmetric DSL] techniques that comply with ANSI Standard T1.413, such as discrete multi tone (DMT) modulation" to transmit and receive messages. *Id.*, 9:33-34.

2. Background on Chang

77. Just like Milbrandt, Chang is directed to evaluating a telephone line for its ability to support DSL services. Chang, 1:6-8 & 1:18-19. Chang describes a device for testing digital telecommunications networks. *Id.*, 2:54-55. Among the tests the device can perform is a measurement of "background noise." *Id.*, 2:59-60. During this test, a device on the far end of the telephone line simply terminates the line with a characteristic impedance, thereby ensuring that no signals are being transmitted. *Id.*, 12:61-63. A device on the near end of the telephone line then measures the background noise present on the line. *Id.*, 12:63-65. As Chang illustrates in Fig. 8F, the measurements are used to determine the level (volume) of the background noise present at each of the 256 frequencies (tones or subchannels) used in a DSL communication system. Fig. 8F shows a graph of these per-frequency measurements as the line 876.



Chang, Fig. 8F.

78. Further, in this context, Chang describes storing executable programs on "ROM" "PROM" "EPROM" and "FLASH" to cause a ADSL modem to perform various steps during operation. Chang, 7:31-56 and 7:55-56.

79. Thus, Chang discloses a circuit and method to measure background noise and also provides additional details about memory and executable software that can be utilized in ADSL modems, such as the ADSL modems described in Milbrandt. *See* Milbrandt, 6:47-56.

3. Background on Hwang

80. Like Milbrandt and Chang, Hwang describes "higher-rate digital subscriber line communication schemes capable of utilizing twisted pair wiring from an office or other terminal node of a telephone network to the subscriber premises." Hwang, 2:23-27. Hwang further describes techniques used with

Asymmetric Digital Subscriber Line, or ADSL, communications. Hwang explains that ADSL uses discrete multi-tone (DMT) technology to divide the available frequency range into 256 distinct carriers, or tones. *Id.,* 3:3-5. Within each carrier, data are encoded using quadrature amplitude modulation (QAM) signals. *Id.,* 3:1-3. Hwang explains that these techniques provide "effective high-speed data communications over twisted pair wiring between customer premises and corresponding network-side units, for example located at a central office of the telephone network." *Id.,* 3:15-19.

81. Thus, Hwang describes additional details about the DSL communication techniques referenced in Milbrandt and Chang. *See* Milbrandt, 9:31-34; Chang, 11:60-62.

4. Background on ANSI T1.413-1995

82. I am personally familiar with the ANSI T1.413 reference (1995 version), i.e., Ex. 1014, relied upon in this declaration. Through my experience in the industry, I represented Motorola in DSL Telecommunications standard Working Group T1E1.4. In that capacity, I had the opportunity to review and became familiar with the ANSI T1.413 reference. Based on my personal knowledge and understanding, the ANSI T1.413 reference was made widely available to persons of ordinary skill in the art and to the public during and after

1995. Indeed, I personally received a copy of the ANSI T1.413 reference around 1996.

83. ANSI T1.413 is a standards specification defining the electrical characteristics and signals used in Asymmetric Digital Subscriber Line (ADSL) communications. ANSI T1.413, Abstract. The standard specifies the minimum requirements for equipment implementing ADSL. ANSI T1.413, Abstract.

84. Among the features of ADSL is the encoding to data into discrete multitone (DMT) symbols. *Id.,* 24. Within each DMT subchannel, an ADSL transmitter encodes a variable number of bits of data using a constellation encoder. *Id.,* 43-44. Those of skill in the art would have recognized the constellation encoder of ANSI T1.413 as performing quadrature amplitude modulation. Goralski, 188.

B. Claims 1-6 are Obvious over Milbrandt, Chang, Hwang, and ANSI T1.413

85. It is my opinion that Milbrandt, Chang, Hwang, and ANSI T1.413 render claims 1-6 of the '430 patent obvious.

86. Unless otherwise noted, all ***bold italics*** emphasis in any quoted material has been added.

1. Reasons to Combine Milbrandt and Chang

87. It is my opinion that a POSITA would have found it obvious to combine the teachings of Milbrandt and Chang.

88. Milbrandt and Chang are directed to the same general issue of evaluating a telephone line for its ability to support DSL communication services. Milbrandt, 1:20-39; Chang, 1:6-8 & 1:18-22.

89. Milbrandt explains that telephone lines within a common binder group share common characteristics: "Subscriber lines 16 sharing the same binder group segment 46 may share the same noise information for that length of segment 46." Milbrandt, 19:58-60. Accordingly, to estimate the data rate capacity of a subscriber line for which Milbrandt's server does not have actual measurements, Milbrandt teaches that the server may use attenuation and noise information gathered from another subscriber line which is in the same binder groups. Milbrandt, 15:58-16:25.

90. Milbrandt describes collecting noise information during operation. *Id.*, 12:58-62. Specifically, Milbrandt teaches sampling a time domain signal communicated by the central office to a modem at the subscriber premises. Milbrandt, 12:58-13:3.

91. Those of skill in the art would have recognized, however, that it is also important to measure and evaluate the noise present on the subscriber when the subchannel is *not* in operation, since these measurements represent system noise not associated with signals transmitted on the channel. Skilled artisans understood that "noise" in a communication system generally refers to any

unwanted signals introduced into the telephone line. Newton's, 613. System noise can come from a variety of sources. Examples include thermal noise, which is caused by the random motion of electrons in the wires that make up the subscriber line. Tanenbaum, 109. Cross talk is the inductive coupling of signals between adjacent wires. *Id.* Impulse noise is a power spike and can be caused by events such as making or breaking electrical connections to the line. *Id.* Those of skill in the art would recognize that all of these common noise sources are independent of the data signals transmitted on a subscriber line, and therefore, they are most readily and directly measured when there are no data signals on the line.

92. Chang reinforces these ideas by teaching that one of the tests used to qualify a subscriber line for DSL services is a measurement of background noise. Chang, 2:59-61. As already noted above, background noise may also be referred to as idle noise. Newton's, 97. Chang measures background noise when no data signals are transmitted on the subscriber line. Chang, 12:59-66 & 13:7-21. Thus, Chang's approach provides a simple and direct measurement of the background noise level across the frequency range used for DSL services.

93. A POSITA working with Milbrandt's system would have recognized the advantages of measuring background noise using Chang's technique. For example, when the system of Milbrandt updates the transmit power level for a device on one telephone line, the impact on adjacent idle telephone lines within a

binder group can be monitored using Chang's approach. Those of skill in the art would have understood that raising the transmit power level on a telephone line can improve service quality by delivering a stronger signal to the far end. With a stronger signal, a denser modulation scheme can be employed, allowing more bits to be encoded onto the DMT subcarriers, and thus faster data communication speeds to be provided.

94. However, a POSITA would also have recognized that increasing the transmit power level on one telephone line has the potential to create additional "cross-talk" noise on adjacent telephone lines. This additional cross-talk noise could negatively impact service on those adjacent telephone lines. By directly measuring the background noise on each telephone line before and after changing the transmit power level, an assessment can be made as to whether, and to what extent, changing the transmit power level impacted the potential service quality on adjacent lines.

95. Accordingly, it would have been obvious to a POSITA at the time to combine the teachings of Chang with those of Milbrandt, for the purpose of assessing system interactions due to, for example thermal effect, inductive coupling, and power spikes. This understanding is evidenced by ANSI T1.413, which notes: "In order to maximize the throughput and reliability of this link, ADSL transceivers shall determine certain relevant attributes of the connecting

channel and establish transmission and processing characteristics suitable to that channel." ANSI T1.413, 87.

96. A person of ordinary skill would have understood that assessing the background noise would allow for taking appropriate remedial measures to minimize system interactions. For example, taking remedial measures could include adjusting the gains for a particular communications channel to minimize inductive coupling and including devices to dampen power spikes. A person of ordinary skill would have understood that taking appropriate remedial measures to address system noise would maximize throughput and reliability, improve service to customers, and also make the system as whole commercially desirable in the marketplace.

97. In short, the combination of Milbrandt and Chang is nothing more than applying the Chang's known technique (i.e., measuring background noise in a DSL system) to the DSL system of Milbrandt, to yield predictable results (e.g., assessing system interactions, taking remedial measures, maximizing throughput and reliability, improving service to customers, and also making the system as whole commercially desirable in the marketplace.)

98. Further, the combination of Milbrandt and Chang is nothing more than combining prior art elements (i.e., Chang's background noise test circuitry and measurement approach to Milbrandt's system) according to known methods to

yield predictable results (e.g., assessing system interactions, taking remedial measures, maximizing throughput and reliability, improving service to customers, and also making the system as whole commercially desirable in the marketplace). It is worth noting that I do not suggest that physical incorporation of Chang's test circuitry into Milbrandt's modems is required; however, it is permitted in the proposed combination.

99. Moreover, Chang teaches that it was well known to use various types of non-transitory memory (ROM and FLASH) for storing executable instructions to cause an ADSL modem to perform various steps during operation. Chang, 7:31-56. A POSITA working with the technology of Milbrandt would have found it obvious to look Chang, which describes additional modem hardware/software implementation details for the purpose of obtaining a more complete understanding. In doing so, it would have been obvious to a POSITA at the time to combine the teachings of Chang with those of Milbrandt, for the purpose of allowing Milbrandt's modems to include executable instructions on non-transitory memory to perform various communication protocol steps during operation. Milbrandt, 4:53-5:19 and 6:47-58.

100. Utilizing non-transitory memory such, ROM, PROM, EPROM, and FLASH for storing executable instructions (as Chang teaches), is well suited and desirable for use in Milbrandt's modems because the information in the non-

transitory memory is retained when the modem is powered down thus obviating the need to reload the memory with the executable instructions on power up, thereby expediting the time to power up. Indeed, it was commonplace and well known to use any one of ROM, PROM, EPROM, and FLASH for storing executable instructions in production modems.

101. In short, the combination of Milbrandt and Chang is nothing more than combining prior art elements (i.e., Chang's teachings of using read only memory for storing executable instructions to cause an ADSL modem to perform various steps during operation and Milbrandt's modems) according to known methods to yield predictable results (e.g., allow Milbrandt's modems to perform the steps required by various communications protocols and also allow for the executable instructions for performing such steps to be retained when powering down and minimize the powering up time). It is worth noting that I do not suggest that physical incorporation of Chang's various read only memory into Milbrandt's modems is required; however, it is permitted in the proposed combination.

2. Reasons to Combine Milbrandt/Chang with Hwang

102. Both Milbrandt and Chang describe communicating via digital subscriber line (DSL) techniques, including Asymmetrical Digital Subscriber Line (ADSL). Milbrandt, 9:31-34, Chang, 11:60-62. Hwang is similarly directed toward DSL communications to provide data services using a subscriber's existing

twisted-pair copper telephone wiring. Hwang, 2:30-36. Hwang further describes the data modulation techniques employed by ADSL modems. As Hwang explains, "ADSL services utilize[] discrete multi-tone (DMT) technology." *Id.,* 2:66-67. Hwang provides additional details, beyond those expressly disclosed in Milbrandt and Chang, by explaining that multitone (DMT) symbols are modulated using quadrature amplitude modulation (QAM). Hwang, 2:67-3:3. This modulation technique allows up to 15 bits of data to be transmitted with each symbol. *Id.,* 3:11-12.

103. A POSITA would have found it obvious to combine the teachings of Milbrandt and Chang with Hwang because Hwang provides additional details of ADSL communication technology. Because Milbrandt, Chang, and Hwang all describe different aspects of the same ADSL communication technology, a POSITA would have found it obvious to refer to all of their teachings in implementing an ADSL communication system for the purpose of obtaining a more complete understanding.

104. Accordingly, it would have been obvious to a POSITA at the time to utilize up to 15 bits for each subchannel, as Hwang teaches, in the communication system of Milbrandt, for the purpose of transmitting more data on each subchannel. Also, it would have been obvious to transmit Milbrandt's message (including the subscriber line information) by modulating bits onto DMT symbols using QAM

with up to 15 bits of data for each subchannel, because it would allow for utilization of the communications channel already established, which uses up to 15 bits of data for each subchannel, and allow for transmitting more data on each subchannel. Doing so would have resulted in a system that is overall more efficient and has higher throughput. A person of ordinary skill would have understood that transmitting data at a higher throughput would have practical implications such as improving service for customers and making the system as whole commercially desirable in the marketplace.

105. In short, the combination of Hwang with Milbrandt/Chang is nothing more than applying Hwang's known technique (i.e., using up to 15 bits per subchannel) to the DSL system of Milbrandt that uses DMT/QAM, for the purpose of yielding predictable results (e.g., transmitting data more efficiently, increasing throughput, improving service for customers, and making the system as whole commercially desirable in the marketplace.)

3. Reasons to Combine Milbrandt/Chang/Hwang with ANSI T1.413

106. A POSITA would have found it obvious to combine the teachings of Milbrandt, Chang and Hwang with the teachings of ANSI T1.413 because Milbrandt, Chang and Hwang all describe ADSL communication systems, and ANSI T1.413 defines the ADSL communication standard. Because Milbrandt, Chang and Hwang implement the technology standardized by ANSI T1.413, a

POSITA would have referred to the ANSI T1.413 document for additional details about how the ADSL communication equipment should function in accordance with the standard.

107. Additionally, Milbrandt specifically describes an embodiment "using ADSL techniques that comply with ANSI Standard T1.413." Milbrandt, 9:33-34. Chang and Hwang similarly refer to details of the ADSL standard set by ANSI. Chang 11:41-43; Hwang, 3:5. These explicit references in Milbrandt, Chang, and Hwang would have directed the skilled artisan to combine the teachings of Milbrandt, Chang, and Hwang with the teachings of ANSI T1.413.

108. Accordingly, a POSITA would have utilized the teachings of ANSI T1.413, in the communication system represented by the combination of Milbrandt, Chang, and Hwang for the purpose making its devices and system compliant with the ANSI T1.413—which Milbrandt explicitly references as a desirable feature. Being compliant with the ANSI T1.413 standard would be desirable because it would allow for interoperability with other devices that are ANSI T1.413 standard compliant, make the overall system more robust since it has been developed through an accredited consensus process represented by the ANSI T1.413 standard, and also make the system as whole commercially desirable in the marketplace.

109. Along with looking to the ANSI T1.413 standard for its specific requirements to be standard compliant, a POSITA would have looked to ANSI T1.413 to gain a better understanding of how communications are performed in general. In one instance, with respect to communications, ANSI T1.413 teaches that the modems transmit in an orderly manner an array indexed by the sub-carrier number *i* to the upstream central office modem (ATU-C). ANSI T1.413, 107 and 110.

110. A POSITA would have recognized and it would have been obvious to transmit information pertaining to sub-carrier frequencies as an array (as ANSI T1.413 teaches), because it would allow for the information to be transmitted in an ordered manner and allow the receiving modem to receive and access the information on a per sub-carrier basis, without the need for additional processing or reordering of the received information. A skilled artisan would have recognized that such an approach would minimize CPU utilization and provide an overall more efficient and organized communication approach.

111. In short, the combination of ANSI T1.413 with the system represented by the combination of Milbrandt, Chang, and Hwang is nothing more than applying the ANSI T1.413's known techniques (i.e., using a standardized approach and transmitting data in array format on a per sub-carrier basis) to the DSL system of Milbrandt that seeks to comply to the ANSI T1.413 standard, for the purpose of

yielding predictable results (e.g., allowing for interoperability with other devices that are standard compliant, minimizing CPU utilization, providing an overall more efficient and organized communication approach, making the system more robust, and making the system as whole commercially desirable in the marketplace.)

VIII. CHALLENGES

112. I believe that the elements of claims 1-6 of the '430 patent are taught by the prior art discussed here. I have included claim charts that map the prior art to claims 1-6 in the pages that follow. These charts support my finding that the differences between the claims of the '430 patent and the prior art discussed herein are such that the subject matter as a whole would have been obvious at the time of the filing of the '430 patent to a person having ordinary skill in the art to which the subject matter pertains. Reasons to combine are provided above and are also discussed in the charts below. The prior art elements combined as detailed in the below charts yield predictable results. I will now describe on an element-by-element basis how the prior art teaches all elements of claims 1-6.

**Claims 1-6 are unpatentable over
Milbrandt, Chang, Hwang, and ANSI T1.413**

U.S. Patent No. 7,835,430	Claims 1-6 are unpatentable over Milbrandt, Chang, Hwang, and ANSI T1.413
Claim 1	
[1.0] A transceiver	Milbrandt alone and in combination with Hwang discloses

capable of transmitting test information over a communication channel using multicarrier modulation comprising:	the features recited in the preamble, element [1.0]. As previously construed, a "transceiver" is a device such as a modem. First, Milbrandt teaches that modem 42 (of a subscriber 12) communicates data with via a communication channel (data line 40): "A computer 32 of a subscriber 12 already equipped to receive data service from communication system 10 includes an XDSL ***modem 42 that communicates data using data line 40***." Milbrandt, 4:46-49. Milbrandt also explains that the data line 40 is part of subscriber line 16, and thus subscriber line 16 is a "communication channel" that couples the modem 42 to a central office: "Throughout this description, phone line 38 and data line 40 may be referred to specifically, or collectively as part of ***subscriber line 16***. * * * Subscriber line 16 couples subscriber 12 to central office 14." Milbrandt, 5:25-27 & 5:39-40. Milbrandt provides further details about how the modem 42 is capable of gathering and transmitting test information: "***Modem 42 measures the received signal power spectrum density***, S_f, of the received data signal for each downlink channel ***and communicates this and other subscriber***

	line information 28 to modem 60.*" Milbrandt, 11:19-24 "If modem 42 is subscribed to receive data services from central office 14, then ***modem 42 may communicate the measured noise information to modems 60 of central office 14 using any suitable communication protocol and frequencies supported by subscriber lines 16." Milbrandt, 13:11-16. "***Modem 42*** at subscriber premises 12 . . . determines ***subscriber line information 28, such as attenuation information, noise information, received signal power spectrum density, S_f, or any other information describing the physical or operating characteristics of subscriber line 16 at the one or more sub-frequencies*** . . . and ***communicates the determined subscriber line information 28 to central office 14*** over any achievable range of sub-frequencies using any suitable communication protocols, such as, for example, over a sub-frequency in the voice frequency spectrum using the V.90 communication protocol." Milbrandt, 11:38-53. Consistent with the interpretation of "transceiver" discussed above, Milbrandt's modem 42 is a "transceiver" as claimed. Indeed, it was known and well understood that a modem, such as Milbrandt's modem 42, performs both "modulation" and "demodulation" of data for the purpose of transmitting and receiving messages.

	Based on the quotes from Milbrandt above, a POSITA would have understood that the subscriber line information (including power spectrum density per sub-frequency S_f, attenuation information per sub-frequency H_f, and noise information per sub-frequency) is test information transmitted to the central office. This is consistent with the '430 patent which discloses that the test information can include "signal to noise information" and "power spectral density," which the '956 patent also calls "Average Reverb Received Signal." '430 patent, 2:26-28 & 6:12-13. To a POSITA, the phrase "power spectral density" in the '430 patent has the same meaning as the phrase "power spectrum density" in Milbrandt. Milbrandt's communications system is illustrated in FIG. 1, reproduced below.

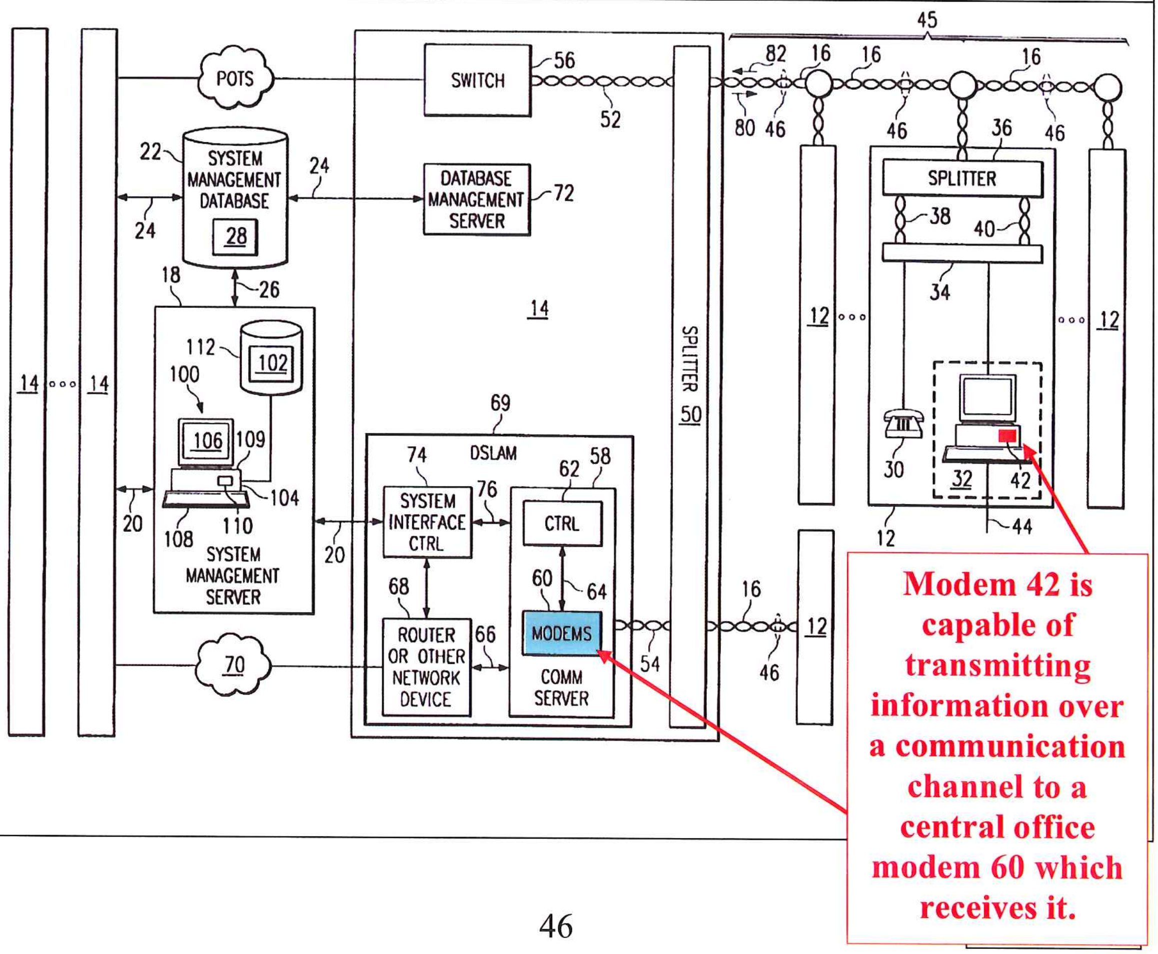


FIG. 1 of Milbrandt (annotated)	
	<u>Second</u>, Milbrandt further discloses that its transceiver (i.e., modem 42 at the subscriber 12), complies with DMT modulation to transmit data: "In one embodiment, subscriber line 16 and components of subscriber 12 and central office 14 support communication using ***ADSL techniques that comply with ANSI Standard T1.413, such as discrete multi tone (DMT) modulation***." Milbrandt, 9:31-34. "ADSL modems 60 increase the amount of data that the conventional twisted-pair subscriber lines 16 can carry by using ***DMT technology to divide the bandwidth of a subscriber line 16, generally referred to as the frequency spectrum supported by a subscriber line 16, into many individual sub-bands or channels***." Milbrandt, 10:58-62. Discrete multitone (DMT) modulation is an example of multicarrier modulation. See '430 patent, 1:24-30 & 1:58-62. A POSITA would have understood that ADSL modem 42, which uses discrete multi tone (DMT) modulation to transmit data in each subchannel simultaneously, as taught by Milbrandt, as disclosed by Milbrandt, is performing multi-carrier modulation to transmit the subscriber line information. Thus, a POSITA would understand and it would have been obvious, therefore, that DMT modulation taught by Milbrandt is an example of

	"multicarrier communication" used by the transceiver (modem 42) to transmit test information, as claimed. Third, Hwang supplements the teachings of Milbrandt and describes, in its background, a communications system similar to Milbrandt's ADSL communications system for transmitting and receiving data. *See* Hwang, 2:66-67. In this context, Hwang teaches performing multi-carrier modulation by way of utilizing DMT technology to transmit information upstream over a communication channel: "The FDM data transport for ***ADSL services utilizes discrete multi-tone (DMT) technology***. A DMT signal is basically the sum of N independently quadrature amplitude modulated (QAM) signals, each carried over a distinct carrier frequency channel. The frequency separation between consecutive carriers is 4.3125 KHz with a total number of 256 carriers or tones (ANSI). ***An asymmetrical implementation of this 256 tone-carrier DMT coding scheme might use tones 32-255 to provide a downstream channel of approximately 1 MHz analog bandwidth. In such an implementation, tones 8-31 are used as carriers to provide an upstream channel*** of approximately 100 KHz analog bandwidth. Each tone is QAM to carry up to 15 bits of data on each cycle of the tone waveform (symbol). An example of a conventional DMT-based system is illustrated in FIG. 1." Hwang, 2:66-3:14. A POSITA would have understood that "upstream channel" refers to the communication path from a remote device, such as a DSL modem located at a subscriber premises, to a central office modem. Thus, Hwang's tones 8-31, which are used as carriers to provide an upstream channel, discloses a communication channel

	using multicarrier modulation. Moreover, it is noted that the '430 patent, in the Background section, readily admits that DSL technology communicates by performing multi-carrier modulation: "***In DSL technology***, communications over a local subscriber loop between a central office and a subscriber premises is accomplished by modulating the data to be transmitted ***onto a multiplicity of discrete frequency carriers***." '430 patent, 1:24-27. Therefore, because Milbrandt alone and in combination with Hwang discloses an ADSL modem that transmits subscriber line information (including power spectrum density per sub-frequency S_f, attenuation information per sub-frequency H_f, and noise information per sub-frequency) over a communication channel to the central office using DMT modulation, the references teach "[a] transceiver capable of transmitting test information over a communication channel using multicarrier modulation," as recited in the preamble, element [1.0], of claim 1.
[1.1] a transmitter portion capable of transmitting a message,	Milbrandt teaches the features recited in [1.1]. Milbrandt teaches that modem 42 is capable of transmitting a message: "***Modem 42 comprises any suitable communication device 65 that transmits*** and receives data in communication system 10 using any suitable digital subscriber line technology (xDSL), referred to generally as an XDSL communication." Milbrandt, 4:64-68.

	Milbrandt's communication device that transmits data is a "transmitter portion capable of transmitting a message." Milbrandt further describes the data transmission capabilities of, and the messages transmitted by, the modem 42: > "***Modem 42*** measures the received signal power spectrum density, S_f, of the received data signal for each downlink channel and ***communicates this and other subscriber line information 28 to modem 60***." Milbrandt, 11:19-24. > Modem 42 then extrapolates subscriber line information 28 for all frequencies in the frequency spectrum supported by subscriber line 16 and communicates the determined subscriber line information 28 to central office 14 over any achievable range of sub-frequencies ***using any suitable communication protocols***. Milbrandt, 11:45-53. > "In one embodiment, subscriber line 16 and ***components of subscriber 12*** and central office 14 support communication using ***ADSL techniques that comply with ANSI Standard T1.413, such as discrete multi tone (DMT) modulation***." Milbrandt, 9:31-34. > "To access data services, in particular, a subscriber 12 operates a ***modem 42 . . . exchanges data with a modem 60 of a central office*** 14 using any suitable communication protocol."

	Milbrandt, 9:54-57. "Similarly, the attenuation information of subscriber line 16 at sub-frequencies supporting the uplink transmission of data may be obtained by measuring the power spectrum density, Q_f, of a ***signal transmitted by modem 42***, and the power spectrum density, S_f, of the signal received by modem 60, and performing the appropriate attenuation information modeling techniques as described above." Milbrandt, 12:50-57. A POSITA would have understood and it would have been obvious that Milbrandt's subscriber line information is transmitted in a message using DMT. Also, a POSITA would have understood and it would have been obvious that Milbrandt's modem 42, which transmits messages (including subscriber line information) to the central office, has a transmitter portion (communication device 65) for transmitting the message using DMT. Thus, Milbrandt's disclosure of modem 42, including the modem's communication device that transmits messages using DMT, teaches "a transmitter portion capable of transmitting a message," as recited in element [1.1] of claim 1.
[1.2] wherein the message comprises one or more data variables that represent the test information,	Milbrandt teaches the features recited in [1.2]. <u>First</u>, Milbrandt teaches that modem 42 (at the subscriber 12) determines subscriber line information by measuring a received signal for each channel: "***Modem 42*** at subscriber premises 12 receives the data signal that is communicated by modem 60 and

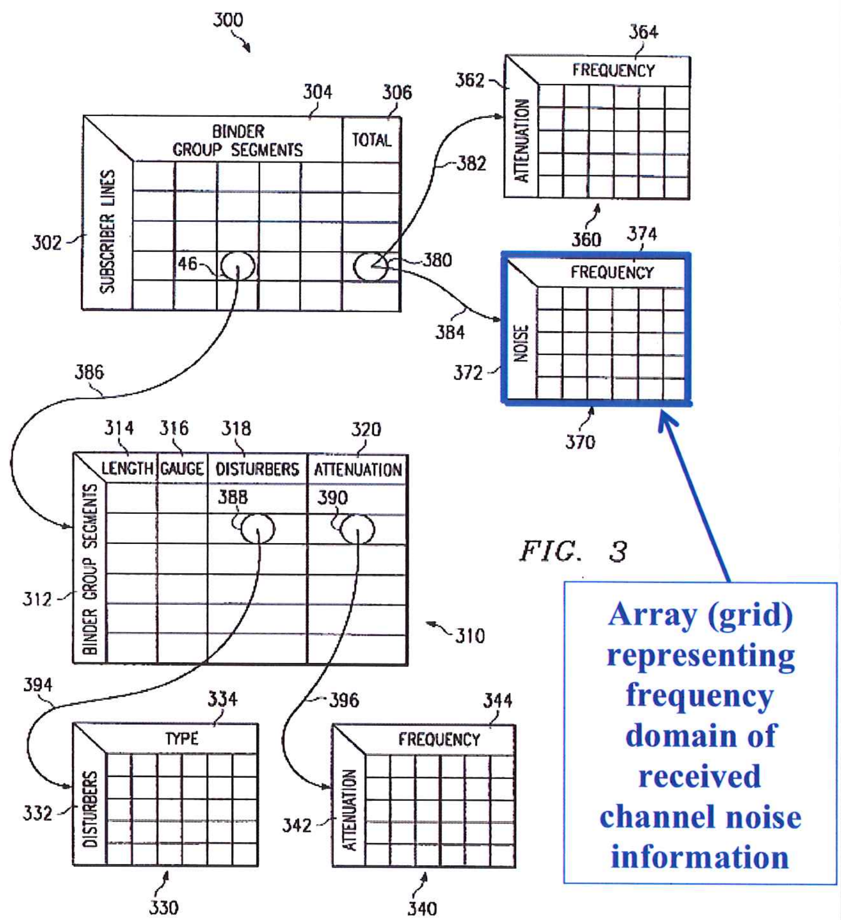
	determines subscriber line information 28, such as attenuation information, noise information, received signal power spectrum density, S_f, or any other information describing the physical or operating characteristics of subscriber line 16 at the one or more sub-frequencies over which the connection between modem 60 and 42 is established." Milbrandt, 11:38-45. It would have been obvious to a POSITA that the values representing Milbrandt's measurements of attenuation information per sub-frequency H_f, signal power spectrum density per sub-frequency S_f, and noise information per sub-frequency are "one or more data variables," as claimed. Thus, a POSITA would have understood that the determined subscriber line information (including attenuation information per sub-frequency, signal power spectrum density per sub-frequency, and noise information per sub-frequency) is one or more data variables that represent test information. <u>Second</u>, Milbrandt teaches that modem 42 communicates to modem 60 (at the central office) a message including the determined subscriber line information: "***Modem 42*** then extrapolates ***subscriber line information 28 for all frequencies*** in the frequency spectrum supported by subscriber line 16 and ***communicates the determined subscriber line information 28 to central office 14*** over any achievable range of sub-frequencies using any suitable communication protocols." Milbrandt, 11:45-51.

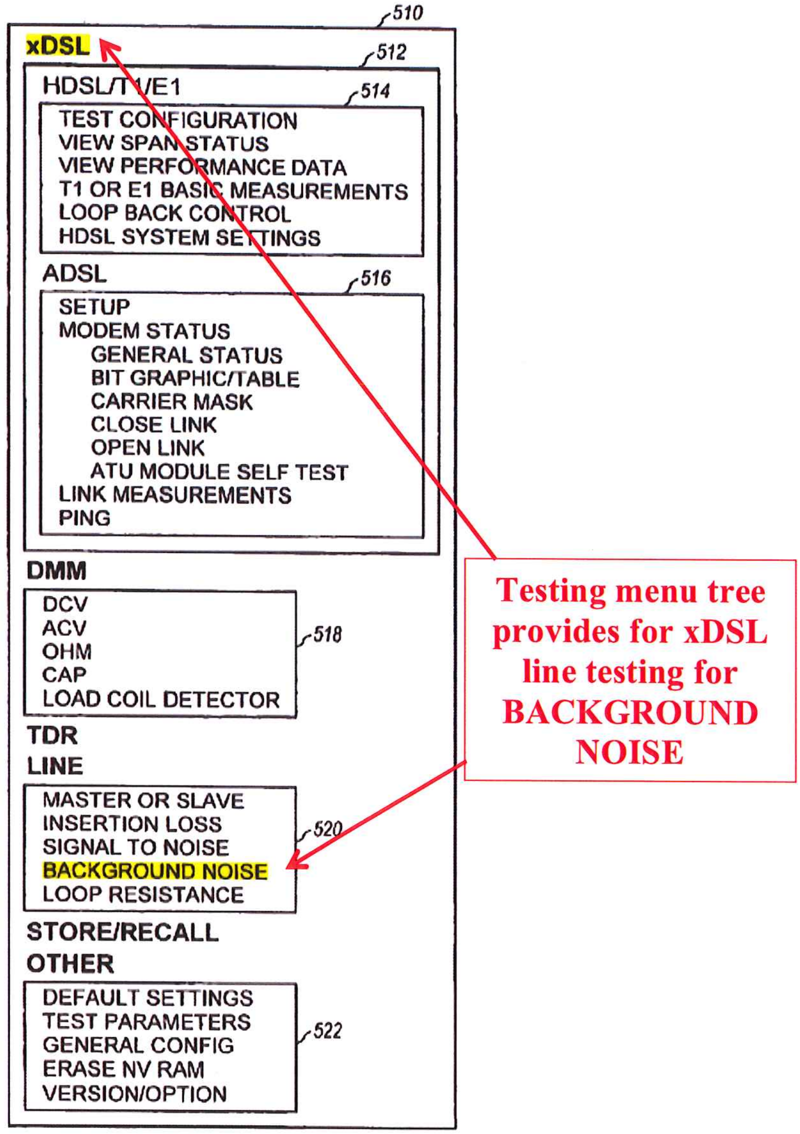
	It would have been obvious to a POSITA that modem 42 communicates the determined subscriber line information by transmitting a message including one or more data variables representing the subscriber line information. Thus, communicating subscriber line information (including power spectrum density per sub-frequency S_f, attenuation information per sub-frequency H_f, and noise information per sub-frequency) to the central office in a message, discloses that the message comprises one or more data variables that represent the test information. Thus, Milbrandt disclosing that modem 42 determines test information (including power spectrum density per sub-frequency S_f, attenuation information per sub-frequency H_f, and noise information per sub-frequency) and communicates the information to the central office in a message, teaches that "the message comprises one or more data variables that represent the test information," as recited in element [1.2] of claim 1.
[1.3] wherein bits in the message are modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and	The combination of Milbrandt and Hwang teaches the features recited in [1.3]. <u>First</u>, Milbrandt discloses that modem 42 (at the subscriber) supports communication using ADSL techniques that comply with DMT modulation: "In one embodiment, subscriber line 16 and ***components of subscriber 12*** and central office 14 support communication using ***ADSL techniques that comply with . . . discrete multi tone (DMT) modulation***." Milbrandt, 9:31-34. "***DMT technology is very useful for ADSL*** technology where the sub-channels are divided into groups and one group of ***channels is allocated for the uplink***

	> ***transmission of data*** and the other for the downlink transmission of data." Milbrandt, 11:6-10. Second, Milbrandt teaches that modem 60 (at the central office) and modem 42 (at the subscriber) transmit and receive data by modulating the data onto DMT symbols using QAM: > "ADSL modems 60 increase the amount of data that the conventional twisted-pair ***subscriber lines 16 can carry by using DMT technology to divide the bandwidth*** of a subscriber line 16, generally referred to as the frequency spectrum supported by a subscriber line 16, into many individual sub-bands or channels. ***Each channel of a subscriber line 16 uses a form of quadrature amplitude modulation (QAM) to transmit data in each channel simultaneously***." Milbrandt, 10:58-65. Thus, it would have been understood and obvious that Milbrandt's modem 42 (at the subscriber) transmits a message (including subscriber line information) whose bits are modulated onto DMT symbols using QAM to modem 60. However, Milbrandt does not describe in detail how many bits are used for the QAM. Third, on the other hand, Hwang teaches that the bits in the message are modulated onto DMT symbols using QAM with more than 1 bit per subchannel: > "The FDM data transport for ***ADSL services utilizes discrete multi-tone (DMT) technology. A DMT signal is basically the sum of N independently quadrature***

	amplitude modulated (QAM) signals, each carried over a distinct carrier frequency channel. The frequency separation between consecutive carriers is 4.3125 KHz with a total number of 256 carriers or tones (ANSI). An asymmetrical implementation of this 256 tone-carrier ***DMT coding scheme*** might use tones 32-255 to provide a downstream channel of approximately 1 MHz analog bandwidth. In such an implementation, ***tones 8-31 are used as carriers to provide an upstream channel of approximately 100 KHz analog bandwidth. Each tone is QAM to carry up to 15 bits of data on each cycle of the tone waveform (symbol).*** An example of a conventional DMT-based system is illustrated in FIG. 1." Hwang, 2:66-3:14. In the above passage, Hwang describes that tones 8-31 (which are subchannels used for upstream communication) carry coded DMT symbols using QAM with up to 15 bits of data per subchannel. Since Milbrandt and Hwang employ the same ADSL communication techniques, it would have been obvious to a person of ordinary skill in the art to transmit Milbrandt's message (including subscriber line information) by modulating bits in the message onto DMT symbols using QAM with more than 1 bit per subchannel, as taught by Hwang. Thus, the combination of Milbrandt and Hwang teaches that the "bits in the message are modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel," as recited in element [1.3] of claim 1.
[1.4] wherein at least one data variable of the one or more data variables comprises an array representing frequency domain	The combination of Milbrandt, Chang, and ANSI T1.413, teaches the features recited in [1.4], because Milbrandt teaches measuring noise on a per-frequency basis, Chang teaches measuring the noise of an idle channel, and ANSI T1.413 teaches transmitting per-frequency data variables in an array format.

received idle channel noise information.	First, Milbrandt teaches that modem 42 determines noise information for sub-frequencies (i.e., frequency sub-channels): "***Modem 42 at subscriber premises 12 receives the data signal*** that is communicated by modem 60 and ***determines subscriber line information 28, such as . . . noise information***, received signal power spectrum density, S_f, or any other information describing the physical or operating characteristics of subscriber line 16 ***at the one or more sub-frequencies*** over which the connection between modem 60 and 42 is established." Milbrandt, 11:38-45. "***Modem 42, operating as a spectrum analyzer, measures the noise variance*** of the time domain signal over a statistically significant period of time and ***converts the measured noise variance from the time domain to the frequency domain*** by performing, for example, a Fast Fourier Transform." Milbrandt, 12:65-13:3. Second, Milbrandt teaches that frequency domain channel noise information is stored as an array (grid with rows and columns) as a function of frequency: "***Line noise grid 370 includes a row 372 for each entry of column 306 of subscriber line grid 300, and a column 374 for each sub-frequency*** at which the noise is determined for a particular subscriber line 16. Generally, the combination of ***grids 360 and 370***

	establish the attenuation information and ***noise information of subscriber lines 16 as a function of frequency*.**" Milbrandt, 23:51-57 and FIG. 3; see also *Id.,* 13:5-8.  **FIG. 3 of Milbrandt (annotated)** <u>Third</u>, Chang supplements the teachings of Milbrandt and teaches that the channel noise information is of an idle channel. Chang pertains to transmission testing that is capable of performing measurements of various line characteristics including, background noise. The menu tree for the disclosed testing device is provided by Chang, FIG. 5, reproduced below. Chang is similar to Milbrandt since it measures channel noise on DSL lines.

	 **Chang, FIG. 5** Also, and similar to Milbrandt, Chang performs its testing in a digital communications network that utilizes DSL modems at a central office and DSL modems at a customer premises, as illustrated below in FIG. 1.

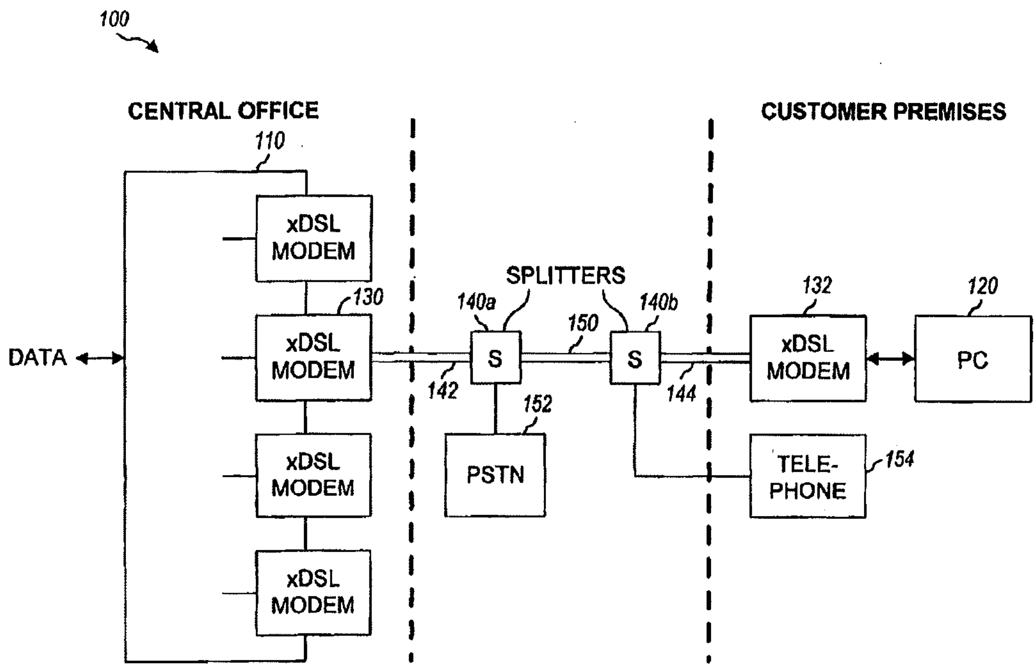


FIG. 1

Chang, FIG. 1

	In this context, Chang teaches measuring the background noise on a communication line when no signals are being transmitted: "Background noise measures the noise characteristics on the wire pair over a frequency band of interest. Referring back to FIG. 7, ***for background noise measurement, slave test set 200b terminates the far end of wire pair 720 with the characteristic impedance of wire pair*** 720. Master test set 200a then performs measurement of the extraneous signals at the near end. A filter within test set 200a can be used for improved measurements." Chang, 12:59-66. As already noted, the concept of idle noise is sometimes also referred to as "background noise." *See* Newton's 97. ("**Background Noise** The noise you

	hear when nothing is being transmitted.") A POSITA would have understood that by terminating the far end of the wire pair with characteristic impedance and measuring the background noise at the near end, Chang is measuring the noise of the idle channel. Chang, in connection with FIG. 8F, further discloses that the background noise is measured on a per sub-frequency basis: "FIG. 8F shows a graphical display of background noise test results. A result screen 870 includes a vertical axis 872, a horizontal axis 874, an output graph 876, and a cursor 878. Screen 870 can also include a status message 880 indicating the status of the test. A result can be plotted as ***each data point (i.e., for a frequency)*** is collected. Cursor 878 can be placed anywhere on output graph 876. An alphanumeric display section 882 lists pertinent data associated with the test result at the location of cursor 878. Vertical axis 872, horizontal axis 874, and cursor 878 and be adjusted in similar manner to that described above. The results shown in screen 870 can also be displayed on an alphanumeric table, as described above. Furthermore, the background noise of the filters used in the testing can also be measured and displayed." Chang, 13:7-21. This is shown by Chang at Fig. 8F.

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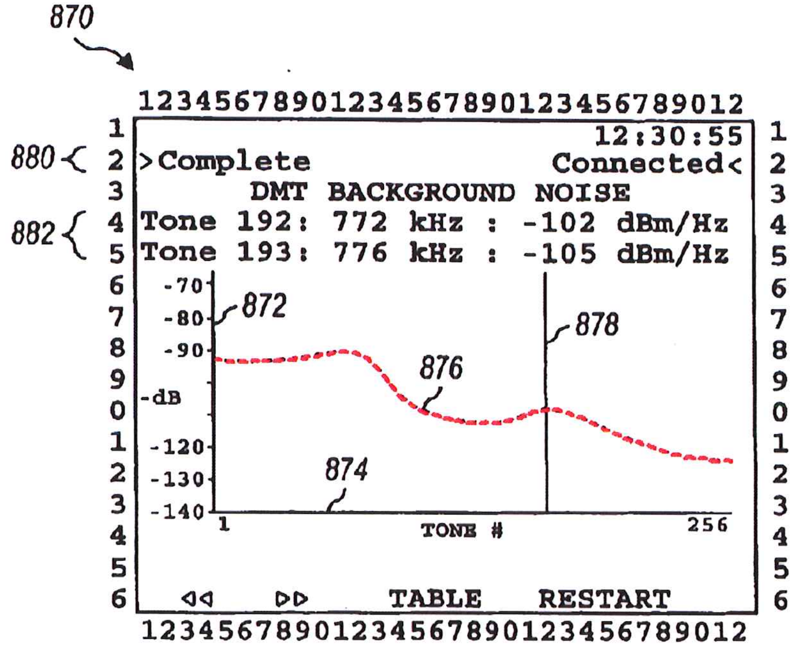

Chang, FIG. 8F (annotated)

In the above figure of Chang, the dashed line 876 (annotated red) represents information about the background noise present is frequency subchannels (tones 1-256) when the subchannels are not in use. Thus, Chang's measurement of background noise is "frequency domain received idle channel noise information."

Since both Milbrandt and Chang seek to measure channel noise on DSL lines, it would have been obvious for Milbrandt to measure idle/background channel noise in the frequency domain for each channel, as taught by Chang.

It is noted that the claimed feature of "at least one data variable of ***the one or more data variables***" has antecedent basis in element [1.2], which recites "the message comprises ***one or more data variables*** that represent the test information." As such, the at least one data variable of the one or more data variables is part of

</td>
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</table>

	the transmitted message. Although, as discussed above, Milbrandt teaches that the at least one data variable of the one or more data variables that represents the received frequency domain channel noise information is stored as an array, as illustrated in Milbrandt's FIG. 3, and that this information is transmitted upstream to the central office, as discussed above at elements [1.1] and [1.2], Milbrandt is silent as to whether the information is transmitted as an array. Fourth, Milbrandt notes that it "support[s] ***communication using ADSL techniques that comply with ANSI Standard T1.413*** such as discrete multi tone (DMT) modulation." Milbrandt, 9:31-34. A POSITA, therefore, would have looked to the ANSI T1.413 standard document to gain a better understanding of how communications are performed. With respect to communications, ANSI T1.413 teaches techniques for transmitting data variables that have a value for a plurality of frequency sub-carriers. Specifically, ANSI T1.413 teaches transmitting each data variable as an ordered sequence of values: ". . . ***transmit to the ATU-R the bits and gains information, {b1, g1, b2, g2, ... b 255, g31}***, that are to be used on the upstream sub-carriers. b_i indicates the number of bits to be coded by the ATU-R transmitter onto the *i* th upstream carrier." ANSI T1.413, 107. ". . . ***transmit to the ATU-C the bits and gains information, {b1, g1, b2, g2, ... b 255, g255}***, to be used on the downstream sub-carriers. b_i indicates the number of bits to be coded by the ATU-C transmitter onto the *i* th downstream sub-carrier g_i indicates

	the scale factor that shall be applied to the *i* th downstream sub-carrier." ANSI T1.413, 110. The numeric subscripts (i.e., the values of "*i*") represent indices corresponding to each of the 256 distinct carrier frequencies, or subchannels, that are employed in ADSL communications under the ANSI T1.413 standard. Thus, the ANSI T1.413 standard teaches transmit bit-and-gain value pairs as an ordered sequence of values, i.e., an "array" as that term was construed above. A POSITA would have recognized that the term "frequency sub-carrier" in the ANSI T1.413 standard corresponds to Milbrandt's "sub-frequency," and that both of these terms correspond to the claimed "subchannel." It would have been obvious to a POSITA to transmit to the central office modem Milbrandt's noise per sub-frequency information in an array format (as ANSI T1.413 teaches), because it would provide efficient and ordered communication and because it would allow the central office modem to receive and access the information on a per channel basis, without the need for additional processing or reordering of the received information. Thus, the combination of Milbrandt, ANSI T1.413, and Chang teaches that "at least one data variable of the one or more data variables comprises an array representing frequency domain received idle channel noise information," as recited in element [1.4] of claim 1.
Claim 2	
[2.0] A transceiver capable of receiving test information over a communication channel using multicarrier	Milbrandt alone and in combination with Hwang discloses the features recited in the preamble, element [2.0]. <u>First</u>, as analyzed above in portion [1.0], Milbrandt describes a subscriber modem 42 that transmits data to a central office modem 60. It would have been obvious to a

modulation comprising:	POSITA that Milbrandt's central office modem 60 receives those data. More specifically, Milbrandt teaches that modem 60 (of the central office 14) receives test information over a communication channel: "A ***modem 60 comprises any suitable communication device that . . . receives data in communication system 10*** using any suitable communication protocol supported by subscriber lines 16." Milbrandt, 6:47-50. "If modem 42 is subscribed to receive data services from central office 14, then modem 42 may ***communicate the measured noise information to modems 60 of central office 14*** using any suitable communication protocol and frequencies supported by subscriber lines 16." Milbrandt, 13:11-16. "Modem 42 measures the received ***signal power spectrum density***, S_f, of the received data signal for each downlink channel and ***communicates this and other subscriber line information 28 to modem 60***." Milbrandt, 11:19-24. "During ***modem training, an ADSL modem 60 employing DMT modulation technology may collect subscriber line information 28*** used to determine attenuation information and noise information for each channel of the data frequency spectrum for a particular subscriber line 16."

	Milbrandt, 11:11-15. "[T]hen server 18 determines the attenuation and ***noise information of subscriber line 16e based upon information collected by modems 60 during training***, as described above." Milbrandt, 20:58-62. Based on the above discussion, a POSITA would have understood that the subscriber line information (including power spectrum density per sub-frequency S_f, attenuation information per sub-frequency H_f, and noise information per sub-frequency) is test information transmitted by modem 42 in a message using DMT and QAM with more than 1 bit per subchannel and that is received by modem 60 of the central office. This is consistent with the '430 patent which discloses that the test information can include "signal to noise information" and "power spectral density." '430 patent, 2:26-28 & 5:66-67. To a POSITA, the phrase "power spectral density" in the '430 patent has the same meaning as the phrase "power spectrum density" in Milbrandt. Milbrandt's communications system is illustrated in FIG. 1, reproduced below.

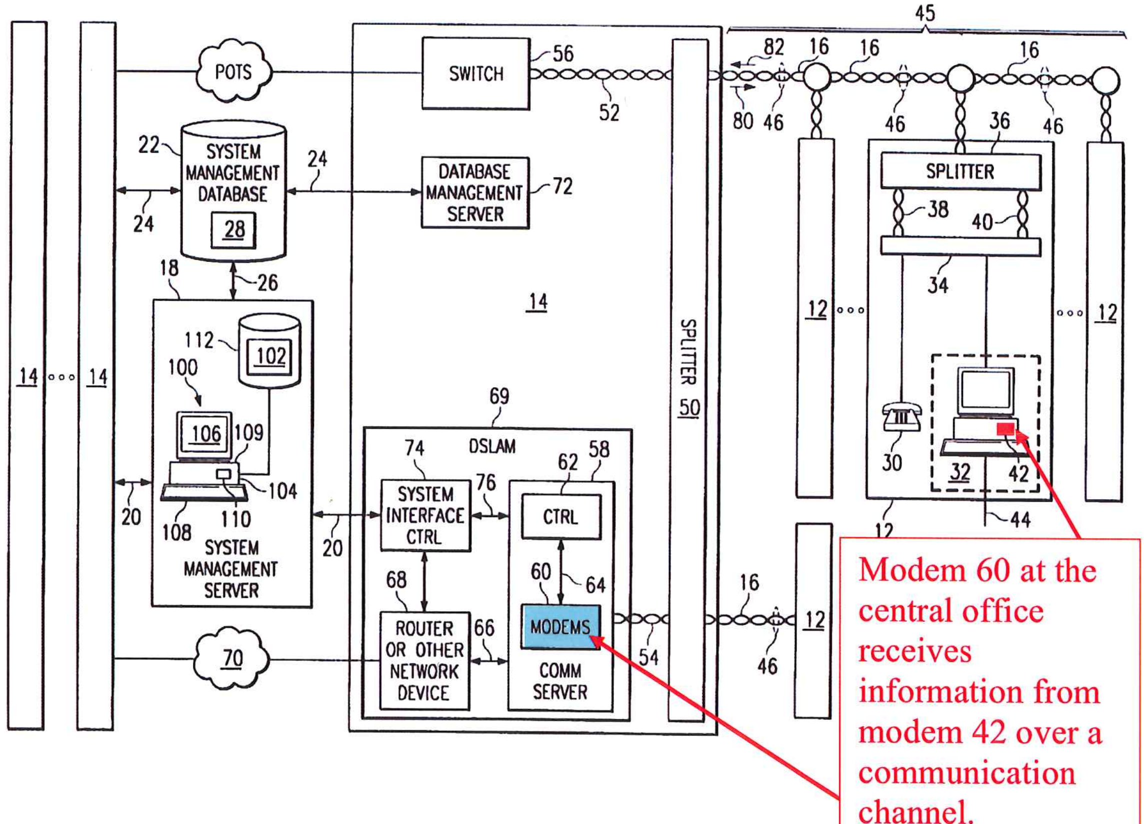

FIG. 1 of Milbrandt (annotated)

Second, Milbrandt further discloses that its transceiver (i.e., modem 60 at the central office 14) communicates over a channel using DMT:

> "In one embodiment, subscriber line 16 and ***components of . . . central office 14*** support communication using ***ADSL techniques that comply with ANSI Standard T1.413, such as discrete multi tone (DMT) modulation***."

Milbrandt, 9:31-34.

> "***ADSL modems 60 increase the amount of data that the conventional twisted-pair subscriber lines 16 can carry by using DMT technology*** to divide the bandwidth of

	a subscriber line 16, generally referred to as the frequency spectrum supported by a subscriber line 16, into many individual sub-bands or channels..." Milbrandt, 10:58-62. Discrete multitone (DMT) modulation is an example of multicarrier modulation. See '430 patent, 1:24-30 & 1:58-62. A POSITA would have understood that the data received by modem 60 is modulated using multi-carrier modulation, such as DMT. Thus, a POSITA would understand that Milbrandt's modem 60 engages in "multicarrier communication" as claimed. <u>Third</u>, Hwang supplements the teachings of Milbrandt and describes, in its background, a communications system similar to Milbrandt's ADSL communications system for transmitting and receiving data. *See* Hwang, 2:66-67. In this context, Hwang teaches performing multi-carrier modulation by way of utilizing DMT technology for communications: "The FDM data transport for ***ADSL services utilizes discrete multi-tone (DMT) technology***. A DMT signal is basically the sum of N independently quadrature amplitude modulated (QAM) signals, each carried over a distinct carrier frequency channel. The frequency separation between consecutive carriers is 4.3125 KHz with a total number of 256 carriers or tones (ANSI). ***An asymmetrical implementation of this 256 tone-carrier DMT coding scheme might use tones 32-255 to provide a downstream channel of approximately 1 MHz analog bandwidth. In such an implementation, tones 8-31 are used as***

> ***carriers to provide an upstream channel*** of approximately 100 KHz analog bandwidth. Each tone is QAM to carry up to 15 bits of data on each cycle of the tone waveform (symbol). An example of a conventional DMT-based system is illustrated in FIG. 1."

Hwang, 2:66-3:14. A POSITA would have understood that upstream channel is used by the subscriber modem to communicate with the central office modem. Hence, tones 8-31 represent data received by Milbrandt's modem 60 at the central office. Accordingly, a POSITA would have understood that tones 8-31 which are used as carriers to provide an upstream channel, discloses a communication channel using multicarrier modulation.

Moreover, it is noted that the '430 patent, in the Background section, readily admits that DSL technology communicates by performing multi-carrier modulation:

> "***In DSL technology***, communications over a local subscriber loop between a central office and a subscriber premises is accomplished by ***modulating the data*** to be transmitted ***onto a multiplicity of discrete frequency carriers***."

'430 patent, 1:24-27.

Accordingly, it would have been obvious to a person of ordinary skill in the art that modem 60 receives the message including the test information (subscriber line information) transmitted by modem 42 over the communications channel using DMT and QAM with more than 1 bit per subchannel.

Therefore, because Milbrandt alone and in combination with Hwang discloses an ADSL modem that receives subscriber line information (including power spectrum density per sub-frequency S_f, attenuation information per

	sub-frequency H_f, and noise information per sub-frequency) over a communication channel to the central office using DMT modulation, the references teach "[a] transceiver capable of receiving test information over a communication channel using multicarrier modulation," as recited in the preamble, element [2.0], of claim 2.
[2.1] a receiver portion capable of receiving a message,	Milbrandt teaches the features recited in [2.1]. Milbrandt teaches that modem 60 is capable of receiving a message: "A ***modem 60 comprises any suitable communication device that transmits and receives data in communication system 10*** using any suitable communication protocol supported by subscriber lines 16. Modems 60 may be integrated into any suitable chipset that includes the appropriate hardware and memory to support the data scrambling and descrambling, encoding and decoding, interleaving and deinterleaving, data insertion and extraction, filtering, amplifying, and other signal processing techniques employed by the appropriate communication protocols. Modem 60 refers to one or more modems at central office 14 as well as any of the components of the modem chipset." Milbrandt, 6:47-58. Milbrandt's communication device that receives data is a "receiver portion capable of receiving a message." Milbrandt further describes the data reception capabilities of, and the messages received by, the modem 60: "***Modems 60 may collect information defining the operational characteristics of***

	> ***subscriber lines 16*** while providing data services to subscribers 12. This process of gathering ***subscriber line information*** 28 is referred to as "modem training," and generally occurs during the normal course of operation of system 10." Milbrandt, 10:40-46. > "To access data services, in particular, a subscriber 12 operates a modem 42 . . . ***exchanges data with a modem 60 of a central office*** 14 using any suitable communication protocol." Milbrandt, 9:54-57. > "Similarly, the attenuation information of subscriber line 16 at sub-frequencies supporting the uplink transmission of data may be obtained by measuring the power spectrum density, Q_f, of a signal transmitted by modem 42, and the power spectrum density, S_f, of ***the signal received by modem 60***, and performing the appropriate attenuation information modeling techniques as described above." Milbrandt, 12:50-57. A POSITA would have understood and it would have been obvious that Milbrandt's subscriber line information collected by modem 60 was received in a message transmitted by modem 42 which was modulated using DMT and QAM with more than one bit per subchannel. Also, a POSITA would have understood and it would have been obvious that Milbrandt's modem 60, which receives messages (including subscriber line information) from the subscriber modem 42, has a receiver portion (communication device) for receiving the message.

	Thus, Milbrandt's disclosure of modem 60, including the modem's communication device that receives data, teaches "a receiver portion capable of receiving a message," as recited in element [2.1] of claim 2.
[2.2] wherein the message comprises one or more data variables that represent the test information,	This limitation is the same as [1.2]. The analysis of portion [1.2] focused on a "message" transmitted by Milbrandt's subscriber modem 42. It would have been obvious to a POSITA, however, that the same "message" is then received by Milbrandt's central office modem 60. Thus, the analysis of the "message" limitation in portion [1.2] is equally applicable to the "message" limitation recited in this portion [2.2].
[2.3] wherein bits in the message were modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and	As discussed above at [1.3], Milbrandt teaches that the bits in the message transmitted by the subscriber modem 42 were modulated onto DMT symbols using QAM with more than 1 bit per subchannel. Further, as discussed above at [2.1] (above) and [4.1] (below), the central office modem 60 receives the message that was sent by modem 42. *See also* Milbrandt, 9:54-57 and 12:50-57. It would have been understood and it would have been obvious that the bits in the message, received by modem 60 from modem 42, were modulated onto DMT symbols using QAM with more than 1 bit per subchannel. Thus, Milbrandt teaches that "bits in the message were modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel," as recited in element [2.3] of claim 2.
[2.4] wherein at least one data variable of the one or more data variables comprises an array representing frequency domain received idle channel noise information.	This limitation is the same as [1.4]. The analysis at [1.4] focused on data transmitted by Milbrandt's subscriber modem 42. It would have been obvious to a POSITA, however, that the same data are then received by Milbrandt's central office modem 60. Thus, the analysis of the limitation in portion [1.4] is equally applicable to the limitation recited in this portion [2.4].

Claim 3	
[3.0] In a transceiver capable of transmitting test information over a communication channel using multicarrier modulation, a method comprising:	As discussed above in [1.0], the prior art discloses a transceiver (Milbrandt's modem 42) capable of transmitting test information over a communication channel using multicarrier modulation. Further, it is noted that the claim is directed to a one-step method of transmitting and Milbrandt throughout the specification discloses that in the transceiver (modem 42) a method for transmitting is performed. For example, Milbrandt discloses: "Another embodiment of the present invention is a ***method*** for determining the transmit power of a communication device operating on a twisted pair subscriber line. The method includes storing noise information for a first subscriber line and a second subscriber line." Milbrandt, 2:36-40. "According to the first ***method***, if subscriber line 16e receives data services from central office 14, then server 18 determines the attenuation and noise ***information of subscriber line 16e based upon information collected by modems 60 during training***, as described above." Milbrandt, 20:58-62. "***Modem 42 measures*** the received signal power spectrum density, S_f, of the received data signal for each downlink channel ***and communicates this and other subscriber line information 28 to modem 60***." Milbrandt, 11:19-24. In view of the above disclosure, it

	would have been obvious to a POSITA that the modem 42 is performing a one-step method of transmitting. More specifically, a POSITA would have understood Milbrandt's modem 42 to be performing a method in a transceiver capable of transmitting test information over a communication channel using multicarrier modulation. Further still, Hwang teaches a method performed in a transceiver capable of transmitting information: "Another aspect of the present invention provides a ***method of transmitting data from a network node***. The ***method includes transmitting a first packet*** comprising bits of data." Hwang, 4:15-17. Hwang further teaches that the information was transmitted over a communication channel using multicarrier modulation, such as DMT. Hwang, 2:66-3:14. Therefore, the prior art discloses "in a transceiver capable of transmitting test information over a communication channel using multicarrier modulation, a method," as recited in the preamble, element [3.0], of claim 3.
[3.1] transmitting a message,	Milbrandt teaches the features recited in [3.1]. Milbrandt teaches that modem 42 is transmitting a message: "***Modem 42 comprises any suitable communication device 65 that transmits*** and receives data in communication system 10 using any suitable digital subscriber line technology (xDSL), referred to generally as an XDSL communication." Milbrandt, 4:64-68.

	"***Modem 42*** measures the received signal power spectrum density, S_f, of the received data signal for each downlink channel and ***communicates this and other subscriber line information 28 to modem 60***." Milbrandt, 11:15-19. "To access data services, in particular, a subscriber 12 operates a ***modem 42*** . . . ***exchanges data with a modem 60 of a central office*** 14 using any suitable communication protocol." Milbrandt, 9:54-57. "Similarly, the attenuation information of subscriber line 16 at sub-frequencies supporting the uplink transmission of data may be obtained by measuring the power spectrum density, Q_f, of a ***signal transmitted by modem 42***, and the power spectrum density, S_f, of the signal received by modem 60, and performing the appropriate attenuation information modeling techniques as described above." Milbrandt, 12:50-57. "***Modem 42*** at subscriber premises 12 . . . determines ***subscriber line information 28, such as attenuation information, noise information, received signal power spectrum density, S_f, or any other information describing the physical or operating characteristics of subscriber line 16*** at the one or more sub-frequencies . . . and ***communicates the determined subscriber line information 28 to central office 14*** over any achievable range of sub-

	frequencies using any suitable communication protocols, such as, for example, over a sub-frequency in the voice frequency spectrum using the V.90 communication protocol." Milbrandt, 11:38-53. A POSITA would have understood and it would have been obvious that Milbrandt's subscriber modem 42 communicates the subscriber line information by transmitting a message. Thus, Milbrandt's disclosure of modem 42 transmitting a message teaches "transmitting a message," as recited in element [3.1] of claim 3.
[3.2] wherein the message comprises one or more data variables that represent the test information,	This limitation is the same as [1.2] and is disclosed in the prior art as discussed in that same section above.
[3.3] wherein bits in the message are modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and	This limitation is the same as [1.3] and is disclosed in the prior art as discussed in that same section above.
[3.4] wherein at least one data variable of the one or more data variables comprises an array representing frequency domain received idle channel noise information.	This limitation is the same as [1.4] and is disclosed in the prior art as discussed in that same section above.

Claim 4	
[4.0] In a transceiver capable of receiving test information over a communication channel using multi carrier modulation comprising, a method comprising:	As discussed above in [2.0], the prior art discloses a transceiver (Milbrandt's modem 60) capable of receiving test information over a communication channel using multi carrier modulation comprising. Further, it is noted that the claim is directed to a one-step method of receiving and Milbrandt throughout the specification discloses that in the transceiver (modem 60) a method for receiving is performed. For example, Milbrandt discloses: "Another embodiment of the present invention is a ***method*** for determining the transmit power of a communication device operating on a twisted pair subscriber line. The method includes storing noise information for a first subscriber line and a second subscriber line." Milbrandt, 2:36-40. "According to the first ***method***, if subscriber line 16e receives data services from central office 14, then server 18 determines the attenuation and noise information of subscriber line 16e based upon ***information collected by modems 60 during training***, as described above." Milbrandt, 20:58-62. In view of the above disclosure, a POSITA would have understood that Milbrandt's modem 60 collects the information by performing a one-step method of receiving. Further still, Hwang teaches a method performed in a transceiver capable of receiving information:

	"The ***method also includes*** receiving an acknowledgement signal from a destination node when the ***first packet was received without errors***." Hwang, 4:18-20. Hwang further teaches that the information was received over a multicarrier communications channel, i.e., DMT. Hwang, 2:66-3:14. A POSITA would have understood that the transceiver that received the packet was capable of receiving the information. Accordingly, Hwang also teaches a method performed in a transceiver capable of receiving information over a communication channel using multi carrier modulation. Therefore, the prior art discloses "a transceiver capable of receiving test information over a communication channel using multi carrier modulation comprising, a method," as recited in the preamble, element [4.0], of claim 4.
[4.1] receiving a message,	Milbrandt teaches the features recited in [4.1]. Milbrandt teaches that modem 60 receives a message: "A ***modem 60 comprises any suitable communication device that transmits and receives data in communication system 10*** using any suitable communication protocol supported by subscriber lines 16. Modems 60 may be integrated into any suitable chipset that includes the appropriate hardware and memory to support the data scrambling and descrambling, encoding and decoding, interleaving and deinterleaving, data insertion and extraction, filtering, amplifying, and other signal processing techniques employed by the appropriate communication protocols. Modem 60 refers to one or more modems at central office 14

	as well as any of the components of the modem chipset." Milbrandt, 6:47-58. "***Modems 60 may collect information defining the operational characteristics of subscriber lines 16*** while providing data services to subscribers 12. This process of gathering ***subscriber line information*** 28 is referred to as "modem training," and generally occurs during the normal course of operation of system 10." Milbrandt, 10:40-46. "To access data services, in particular, a subscriber 12 operates a modem 42 . . . ***exchanges data with a modem 60 of a central office*** 14 using any suitable communication protocol." Milbrandt, 9:54-57. "Similarly, the attenuation information of subscriber line 16 at sub-frequencies supporting the uplink transmission of data may be obtained by measuring the power spectrum density, Q_f, of a signal transmitted by modem 42, and the power spectrum density, S_f, of ***the signal received by modem 60***, and performing the appropriate attenuation information modeling techniques as described above." Milbrandt, 12:50-57. "Modem 42 measures the received signal power spectrum density, S_f, of the received data signal for each downlink channel and

	communicates this and other subscriber line information 28 to modem 60." Milbrandt, 11: 19-24. "According to the first method, if subscriber line 16e receives data services from central office 14, then server 18 determines the attenuation and noise information of subscriber line 16e based upon ***information collected by modems 60 during training***, as described above." Milbrandt, 20:58-62. A POSITA would have understood and it would have been obvious that Milbrandt's subscriber line information collected by modem 60 was received in a message. Thus, Milbrandt's disclosure of modem 60 which receives a message teaches "receiving a message," as recited in element [4.1] of claim 4.
[4.2] wherein the message comprises one or more data variables that represent the test information,	This limitation is the same as [2.2] and is disclosed in the prior art as discussed in that same section above.
[4.3] wherein bits in the message were modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and	This limitation is the same as [2.3] and is disclosed in the prior art as discussed in that same section above.
[4.4] wherein at least one data variable of	This limitation is the same as [2.4] and is disclosed in the prior art as discussed in that same section above.

the one or more data variables comprises an array representing frequency domain received idle channel noise information.	
Claim 5	
[5.0] A non-transitory computer-readable information storage media having stored thereon instructions that if executed cause a transceiver to perform a method comprising:	Milbrandt in combination with Hwang and Chang discloses the features recited in the preamble, element [5.0]. <u>First</u>, Milbrandt teaches that its ADSL modems have computer-readable information storage media (memory) which has stored on it instructions that if executed cause the modem to perform a method for communication protocols: "***Modem 42 comprises any suitable communication device 65 that transmits*** and receives data in communication system 10 using any suitable digital subscriber line technology (xDSL), referred to generally as an XDSL communication." Milbrandt, 4:64-68. "Another embodiment of the present invention is a ***method*** for determining the transmit power of a communication device operating on a twisted pair subscriber line. The method includes storing noise information for a first sub scriber line and a second subscriber line." Milbrandt, 2:36-40. "According to the first ***method***, ***<u>if subscriber line 16e receives data services from central</u>***

	office 14, then server 18 determines the attenuation and noise information of subscriber line 16e based upon information collected by modems 60 during training, as described above." Milbrandt, 20:58-62. "If ***modem 42*** is subscribed to receive data services from central office 14, then modem 42 may communicate the measured noise information to modems 60 of central office 14 using any suitable ***communication protocol and frequencies supported by subscriber lines 16***." Milbrandt, 13:11-16. *See also* above [3.0], where Hwang supplements the teachings of Milbrandt and also discloses a method for a transceiver. A POSITA would have understood and it would have been obvious that Milbrandt's description of a DSL modem that has hardware and memory for performing various methods employed by communication protocols in order to transmit/receive messages, is disclosing a non-transitory computer-readable information storage media having stored thereon instructions that if executed cause a transceiver to perform a method, as recited in the claim. <u>Second</u>, Chang supplements Milbrandt and further elaborates as to the memory and operation of the modem: "As shown in FIG. 4A, ***modem*** module 330 ***includes a processor*** 410 that controls the operation of modem module 330 according to ***program instructions stored in a memory*** 430. Processor 410 couples to modem module interface 32B of test set 200 via a

	data/address bus 420 and a serial bus 422. Through buses 420 and 422, processor 410 can send data to and receive instructions from test set 200. Processor 410 further couples to a modem circuit 430 and an optional test circuit 432. Processor 410 also optionally couples to a fingerprint circuit 434. Processor 410 can be implemented with a ***microcomputer, a microprocessor, a signal processor, an ASIC***, or the like. ***Memory 430 can be implemented as a RAM, a ROM, a PROM, an EPROM, a FLASH memory, registers, or other similar devices***. ***Memory 430 can be used to store the program codes or data, or both***." Chang, 7:31-46. "Modem circuit 430 can emulate a DSL, HDSL, ***ADSL***, or other xDSL modems." Chang, 7:55-56. A POSITA would have understood that ROM, a PROM, an EPROM, memory are non-transitory computer-readable since "ROM" is an acronym for "Read Only Memory." Also, a person of ordinary skill would have recognized that and FLASH memory is also a form of non-transitory memory. Further, a person or ordinary skill in the art would have understood that Chang's disclosure of "program instructions stored in a memory" and "program codes" is describing executable instructions for causing the modem to perform various steps (methods). Since both Milbrandt and Chang seek to facilitate operation of ADSL modems, it would have been obvious for Milbrandt to utilize a processor, non-transitory memory, and program instructions stored on the memory, as taught by Chang, such that when the program

	instructions are executed Milbrandt's ADSL modems perform various methods employed by communication protocols for transmitting/receiving messages. It would have been obvious to a POSITA at the time to combine the teachings of Chang with those of Milbrandt, for the purpose of allowing Milbrandt's modem 42 to perform the step of transmitting messages in accordance with various communications protocols and also allow for the executable instructions to be retained when powering down the modem and also minimize the powering up time. Thus, Milbrandt alone and in combination with Chang discloses "[a] non-transitory computer-readable information storage media having stored thereon instructions that if executed cause a transceiver to perform a method," as recited in the preamble, element [5.0], of claim 5.
[5.1] transmitting a message,	This limitation is the same as [3.1] and is disclosed in the prior art as discussed in that same section above.
[5.2] wherein the message comprises one or more data variables that represent the test information,	This limitation is the same as [1.2] and is disclosed in the prior art as discussed in that same section above.
[5.3] wherein bits in the message are modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and	This limitation is the same as [1.3] and is disclosed in the prior art as discussed in that same section above.
[5.4] wherein at least one data variable of	This limitation is the same as [1.4] and is disclosed in the prior art as discussed in that same section above.

the one or more data variables comprises an array representing frequency domain received idle channel noise information.	
Claim 6	
[6.0] A non-transitory computer-readable information storage media having stored thereon instructions that if executed cause a transceiver to perform a method comprising:	Milbrandt in combination with Hwang and Chang discloses the features recited in the preamble, element [6.0]. First, Milbrandt teaches that its ADSL modems have computer-readable information storage media (memory) which has stored on it instructions that if executed cause the modem to perform a method for communication protocols: "A ***modem 60 comprises any suitable communication device that transmits and receives data*** in communication system 10 using any suitable communication protocol supported by subscriber lines 16. Modems 60 may be integrated into any suitable ***chipset that includes the appropriate hard ware and memory to support . . . techniques employed by the appropriate communication protocols***." Milbrandt, 6:47-56. "Another embodiment of the present invention is a ***method*** for determining the transmit power of a communication device operating on a twisted pair subscriber line. The method includes storing noise information for a first sub scriber line and a second subscriber line."

	Milbrandt, 2:36-40. > "According to the first ***method***, if subscriber line 16e receives data services from central office 14, then server 18 determines the attenuation and noise information of subscriber line 16e based upon ***information collected by modems 60 during training***, as described above." Milbrandt, 20:58-62. *See also* above [4.0], where Hwang supplements the teachings of Milbrandt and also discloses a method for a transceiver. A POSITA would have understood and it would have been obvious that Milbrandt's description of a DSL modem that has hardware and memory for performing various methods employed by communication protocols in order to transmit/receive messages, is disclosing a non-transitory computer-readable information storage media having stored thereon instructions that if executed cause a transceiver to perform a method, as recited in the claim. <u>Second</u>, Chang supplements Milbrandt and further elaborates as to the memory and operation of the modem: > "As shown in FIG. 4A, ***modem*** module 330 ***includes a processor*** 410 that controls the operation of modem module 330 according to ***program instructions stored in a memory*** 430. Processor 410 couples to modem module interface 32B of test set 200 via a data/address bus 420 and a serial bus 422. Through buses 420 and 422, processor 410 can send data to and receive instructions from test set 200. Processor 410 further couples to a modem circuit 430 and an optional test circuit 432. Processor 410 also

	optionally couples to a fingerprint circuit 434. Processor 410 can be implemented with a ***microcomputer, a microprocessor, a signal processor, an ASIC***, or the like. ***Memory 430 can be implemented as a RAM, a ROM, a PROM, an EPROM, a FLASH memory, registers, or other similar devices. Memory 430 can be used to store the program codes or data, or both***." Chang, 7:31-46. "Modem circuit 430 can emulate a DSL, HDSL, ***ADSL***, or other xDSL modems." Chang, 7:55-56. A POSITA would have understood that ROM, a PROM, an EPROM, memory are non-transitory computer-readable since "ROM" is an acronym for "Read Only Memory." Also, a person of ordinary skill would have recognized that and FLASH memory is also a form of non-transitory memory. Further, a person or ordinary skill in the art would have understood that Chang's disclosure of "program instructions stored in a memory" and "program codes" is describing executable instructions for causing the modem to perform various steps (methods). Since both Milbrandt and Chang seek to facilitate operation of ADSL modems, it would have been obvious for Milbrandt to utilize a processor, non-transitory memory, and program instructions stored on the memory, as taught by Chang, such that when the program instructions are executed Milbrandt's ADSL modems perform various methods employed by communication protocols for transmitting/receiving messages. It would have been obvious to a POSITA at the time to combine the teachings of Chang with those of Milbrandt,

	for the purpose of allowing Milbrandt's modem 60 to perform the step of receiving messages in accordance with various communications protocols and also allow for the executable instructions to be retained when powering down the modem and also minimize the powering up time. Thus, Milbrandt alone and in combination with Chang discloses "[a] non-transitory computer-readable information storage media having stored thereon instructions that if executed cause a transceiver to perform a method," as recited in the preamble, element [6.0], of claim 6.
[6.1] receiving a message,	This limitation is the same as [4.1] and is disclosed in the prior art as discussed in that same section above.
[6.2] wherein the message comprises one or more data variables that represent the test information,	This limitation is the same as [2.2] and is disclosed in the prior art as discussed in that same section above.
[6.3] wherein bits in the message were modulated onto DMT symbols using Quadrature Amplitude Modulation (QAM) with more than 1 bit per subchannel and	This limitation is the same as [2.3] and is disclosed in the prior art as discussed in that same section above.
[6.4] wherein at least one data variable of the one or more data variables comprises an array representing frequency domain received idle channel noise information.	This limitation is the same as [2.4] and is disclosed in the prior art as discussed in that same section above.

IX. CONCLUSION

113. I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both. See 18 U.S.C. § 1001.

Date: April 29, 2016

Respectfully submitted,

Sayfe Kiaei

Dr. Sayfe Kiaei