UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Cisco Systems, Inc.,
Petitioner

Case IPR2016-_____

U.S. Patent No. 8,718,158

DECLARATION OF DR. JOSE TELLADO, UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,718,158

TABLE OF CONTENTS

I, Dr. Jose Tellado, do hereby declare as follows:

I. INTRODUCTION

1. I have been retained as an independent expert declarant on behalf of Cisco Systems, Inc. ("Cisco") for the above-captioned Petition for *Inter Partes* Review ("IPR") of U.S. Patent No. 8,718,158 ("the '158 patent"). I am being compensated at my usual and customary rate for the time I spend in connection with this IPR. My compensation is not affected by the outcome of this matter.

2. I have been asked to provide my opinions regarding whether claims 1-30 ("the Challenged Claims") of the '158 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 1-30 would have been obvious to a POSITA after reviewing the Shively, Stopler, Gerszberg, and Bremer references, as discussed further below.

3. The '158 patent issued on May 6, 2014, from U.S. Patent Appl. No. 13/303,417 ("the '417 Application"), filed on November 23, 2011. The '417 Application is a continuation of application No. 12/783,725, filed on May 20, 2010, now U.S. Pat. No. 8,090,008, which is a continuation of U.S. Patent Appl. No. 12/255,713, filed Oct. 22, 2008, now U.S. Pat. No. 7,769,104, which is a continuation of U.S. Patent Appl. No. 11/863,581, filed Sep. 28, 2007, now U.S. Pat. No. 7,471,721, which is a continuation of U.S. Appl. No. 11/211,535, filed

Aug. 26, 2005, now U.S. Pat. No. 7,292,627, which is a continuation of U.S. Patent Appl. No. 09/710,310, filed Nov. 9, 2000, now U.S. Pat. No. 6,961,369.

4. The '158 patent also claims the benefit of U.S. Provisional Application No. 60/164,134, filed on November 9, 1999.

5. The face of the '158 patent names Marcos C. Tzannes as the purported inventor. Further, the face of the '158 patent identifies TQ Delta, LLC as the initial assignee of the '158 patent.

6. In preparing this Declaration, I have reviewed:

a) the '158 patent, Ex. 1001;

b) the file history of the '158 patent, Ex. 1002;

c) the file histories of the patent applications to which the '158 patent claims priority, Ex. 1003-1008; and

d) the prior art references discussed below, Ex. 1011-1013, 1017, and 1019.

7. 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 November 9, 1999 (the earliest claimed priority date). 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, and

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

8. 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.

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

II. BACKGROUND AND QUALIFICATIONS

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

11. I received a Ph.D. in Electrical Engineering from Stanford in 1999. The topic of my Ph.D. dissertation was peak-to-average ratio (PAR) power reduction for multicarrier modulation. I also received a Master of Science degree in Electrical Engineering from Stanford in 1994 and a Bachelor of Science degree in

Telecommunication Engineering from the University of Santiago de Compostela (Spain) in 1992.

12. I have over twenty years of experience in a wide range of technologies and industries relating to signal processing and data communication. My industry experience includes development of multicarrier modulation advancements using technologies such as Discrete Multitone Modulation (DMT) and Quadrature Amplitude Modulation (QAM).

13. I am listed as an inventor on over sixty patent applications, of which over thirty of the patent applications have been issued as patents.

14. I authored the book "Multicarrier Modulation with Low PAR: Applications to DSL and Wireless" that was published in 2000. I am an author of fifteen IEEE publications, which include subject matter in the areas of xDSL, WiMAX, and Ethernet communication technologies. I submitted several PAR reduction contributions to xDSL standards at ANSI T1E1.4, ETSI TM6 and ITU. I was a key contributor to IEEE standardization efforts relating to 802.16 (WiMAX) and 802.3an (10GBase-T).

III. LEVEL OF ORDINARY SKILL IN THE PERTINENT ART

15. 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 '158 patent.

16. I am very familiar with the knowledge and capabilities that a person of ordinary skill in the art (POSITA) of multicarrier communications would have possessed during the late 1990's, especially as it relates to managing the peak-to-average ratio (PAR) of multicarrier signals. Specifically, through my PhD research work I interacted with numerous individuals working on reducing PAR for multicarrier communication systems, such as digital subscriber line (DSL). I attended meetings of the group that drafted the ANSI T1.413 standard for asymmetric DSL (ADSL). At those meetings, I met and worked with engineers practicing in the industry who were actively working in the area of multicarrier communications.

17. These experiences during the relevant timeframe allowed me to become personally familiar with the knowledge and capabilities of a POSITA in the area of multicarrier communications. Unless otherwise stated, my testimony below refers to the knowledge of a POSITA in the field of multicarrier communications during the time period around the priority date of the '158 patent.

18. In my opinion, the level of a POSITA needed to have the capability of understanding multicarrier communications and engineering principles applicable

to the '158 patent is (i) a Master's degree in Electrical and/or Computer Engineering, or equivalent training, and (ii) approximately five years of experience working with multicarrier communications systems. Lack of work experience can be remedied by additional education, and vice versa. This level of education and experience, in my opinion, represents the average education and experience level of the engineers working on multicarrier communications around November 1999. Such academic or 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 '158 patent requires an appreciation of digital communications using discrete multitone (DMT) signals, and an appreciation for the potential for such multicarrier signals to have a high peak-to-average ratio, causing clipping during transmission. 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 '158 patent.

19. 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 November 1999.

IV. RELEVANT LEGAL STANDARDS

20. I understand that prior art to the '158 patent includes patents and printed publications in the relevant art that predate the earliest claimed priority date of the alleged invention recited in the '158 patent.

21. I understand that a claim is invalid if it is anticipated. Anticipation of a claim requires that every element of a claim be disclosed expressly or inherently in a single prior art reference, arranged in the prior art reference as arranged in the claim.

22. I also 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.

23. 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.

24. 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.

25. 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. 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 would have directed a POSITA to combine multiple prior art references or add missing features to reproduce the alleged invention recited in the claims.

26. I am not aware of any allegations by the named inventor of the '158 patent or any assignee of the '158 patent that any secondary considerations tend to rebut the obviousness of any Challenged Claim of the '158 patent.

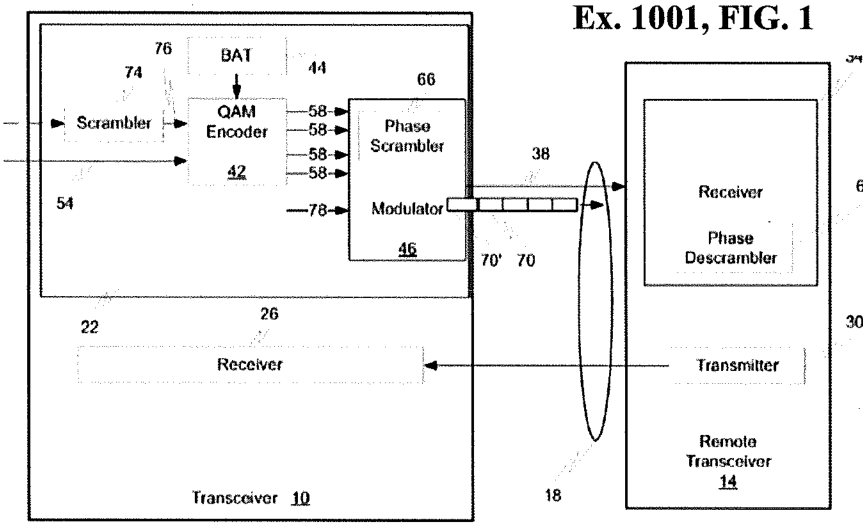
V. THE '158 PATENT

A. Overview

27. The '158 patent relates "to communications systems using multicarrier modulation." Ex. 1001, 1:28-29. More specifically, the '158 patent states that "the present invention features a system and a method that scrambles the phase characteristics of the modulated carrier signals in a transmission signal." Ex. 1001, 2:36-38. This phase scrambling is described in the context of a digital subscriber line (DSL) communication system that includes a discrete multitone (DMT) transmitter. Ex. 1001, 3:27-31. While the purpose of the phase scrambling is not identified in the claims, the specification states that the phase scrambling is used to "produce a transmission signal with a reduced PAR." Ex. 1001, Abstract.

28. Fig. 1 of the '158 patent illustrates a functional block diagram of an exemplary communication system capable of the claimed techniques.

Ex. 1001, FIG. 1

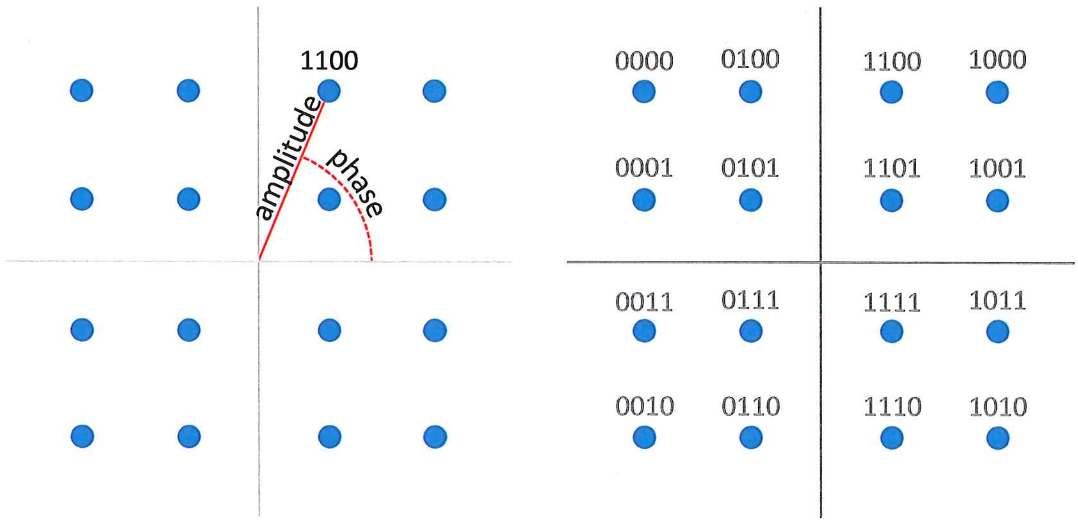


29. In the '158 patent, the "conventional multicarrier communication systems" employ "multicarrier modulation or Discrete Multitone Modulation (DMT)." Ex. 1001, 1:35-38. Multicarrier modulation and Discrete Multitone Modulation are described as communications that use a transmission signal "having a plurality of carrier signals." Ex. 1001, 3:27-31. The plurality of carrier signals used for the transmission are also referred to interchangeably as "carriers," "sub-channels" or "tones." Ex. 1001, 1:38 ("carrier signals (carriers) or subchannels"), 3:34-36 ("Although described with respect to discrete multi*tone* modulation, the principles of the invention also apply to other types of multi*carrier* modulation….") (emphasis added).

30. The '158 patent describes in its Background section that "generating a transmission signal with a Gaussian probability distribution is important in order to transmit a transmission signal with a low peak-to-average ratio (PAR), or peak-to-

average power ratio." Ex. 1001, 1:64-67. And, in the Background section, the '158 patent indicates that a low PAR is desirable because "[a]n increased PAR can result in a system with high power consumption and/or with high probability of clipping the transmission signal." Ex. 1001, 2:27-29. Accordingly, in conventional multicarrier communication systems, the PAR of a transmission signal "is an important consideration in the design of the DMT communication system because the PAR of a signal affects the communication system's total power consumption." Ex. 1001, 2:12-16.

31. As part of DMT modulation, the communication systems in the '158 patent employ quadrature amplitude modulation or QAM. Ex. 1001, 3:65-4:11. The '158 patent describes how each of the multiple carrier signals is modulated to convey data using quadrature amplitude modulation (QAM). Ex. 1001, 3:65-4:11. QAM is a prior art technique, which a POSITA would have been familiar with, that manipulates both the amplitude and phase of the carrier. By using multiple amplitudes and phase shifts, one or more bits of data can be modulated onto the carrier simultaneously. A specific amplitude and phase combination is sometimes referred to as a QAM symbol, and the relationship between these QAM symbols and the data that they represent is called a constellation. Depicted below is an example of a 16-level QAM constellation showing 16 different combinations of phase and amplitude, each of which would represent a distinct 4-bit value.



32. The transceiver of the '158 patent includes a QAM encoder 42. Ex. 1001, Fig. 1. The QAM encoder 42 receives "an input serial data bit stream 54" and uses the data bit stream to generate "QAM symbols 58." Ex. 1001, 3:65-67. For instance, the '158 patent describes that "the QAM encoder 42 maps the input serial data bit stream 54 into N parallel quadrature amplitude modulation (QAM) constellation points 58, or QAM symbols 58" where "N represents the number of carrier signals generated by the modulator 46." Ex. 1001, 4:3-7. The '158 patent also describes that the QAM encoder 42 can vary the number of bits per symbol using BAT 44 component which "is in communication with the QAM encoder 42 to specify the number of bits carried by each carrier signal." Ex. 1001, 4:7-9. And, like other conventional DMT systems, the '158 patent acknowledges that the "QAM symbols 58 represent the amplitude and the phase characteristic of each carrier signal." Ex. 1001, 4:9-11.

33. In order to modulate the QAM symbols 58 onto the N carrier signals, the '158 patent employs modulator 46. Ex. 1001, 4:12-30. Modulator 46 is another component of the transceiver shown in Fig. 1 and "modulates each carrier signal with a different QAM symbol 58." Ex. 1001, 4:15-16. And, according to the '158 patent, this modulation yields a conventional result where "carrier signals have phase and amplitude characteristics based on the QAM symbol 58 and therefore based on the input-bit stream 54." Ex. 1001, 4:16-19.

34. The '158 patent further describes how a "bit scrambler is often used in the DMT transmitter to scramble the input data bits before the bits are modulated to assure that the transmitted data bits are random and, consequently, that the modulation of those bits produces a DMT transmission signal with a Gaussian probability distribution." Ex. 1001, 1:57-61.

35. The '158 provisional patent Application (Ex. 1008) describes in its Background that phases of the modulated carriers "may not be random enough to generate a 'Gaussian distributed' transmitted signal." Ex. 1008, p. 1. The '158 patent allegedly addresses this problem by including "a phase scrambler." Ex. 1001, 1:62-3:5. The "phase scrambler" "combines a phase shift computed for each QAM-modulated carrier signal with the phase characteristic of that carrier signal. Ex. 1001, 4:31-34.

36. Independent claim 1 is generally representative of the Challenged Claims:

> 1. In a multicarrier modulation system including a first transceiver in communication with a second transceiver using a transmission signal having a plurality of carrier signals for modulating a plurality of data bits, each carrier signal having a phase characteristic associated with at least one bit of the plurality of data bits, a method for scrambling the phase characteristics of the carrier signals comprising:
>
> transmitting the plurality of data bits from the first transceiver to the second transceiver;
>
> associating a carrier signal with a value determined independently of any bit of the plurality of data bits carried by the carrier signal, the value associated with the carrier signal determined by a pseudo-random number generator;
>
> determining a phase shift for the carrier signal at least based on the value associated with the carrier signal;
>
> modulating at least one bit of the plurality of data bits on the carrier signal;
>
> modulating the at least one bit on a second carrier signal of the plurality of carrier signals.

B. Prosecution History of the '158 Patent

37. I have reviewed the prosecution history of the '158 patent and it is my understanding that none of the references cited in this declaration have been substantively considered by the United States Patent Office.

C. Priority Date of the '158 Patent

38. I have been informed that the earliest claimed priority date for the '158 patent is November 9, 1999.

VI. CLAIM CONSTRUCTION

39. It is my understanding that in order to properly evaluate the '158 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.

40. In order to construe the claims, I have reviewed the entirety of the '158 patent along with its prosecution history.

A. "multicarrier"

41. The term "multicarrier" appears in each of claims 1-30 either directly or by dependency.

42. The '158 patent's specification does not provide an express definition for the term "multicarrier." However, the background of the '158 patent states:

> "In a ***conventional multicarrier communications system***, transmitters communicate over a communication channel using multicarrier modulation or Discrete Multitone Modulation (DMT). ***Carrier signals (carriers) or sub-channels spaced within a usable frequency band of the communication channel*** are modulated at a symbol (i.e., block) transmission rate of the system. An input signal, which includes input data bits, is sent to a DMT transmitter, such as a DMT modem. The DMT transmitter typically modulates the phase characteristic, or phase, and amplitude of the carrier signals using an Inverse Fast Fourier Transform (IFFT) to generate a time domain signal, or transmission signal, that represents the input signal. The DMT transmitter transmits the transmission signal, which is a linear ***combination of the multiple carriers***, to a DMT receiver over the communication channel."

Ex. 1001, 1:35-49.

43. A POSITA would have been familiar with the concept of an Inverse Fast Fourier Transform (IFFT) based multicarrier, which is described by the '158 patent as a "conventional multicarrier communication system." Ex. 1001, 1:35-47. The general purpose of a multicarrier—as the specification suggests—is to communicate using multiple carrier signals. As identified by the '158 patent, it

was known that Discrete Multitone (DMT) used multiple carriers for data transmission.

44. While the '158 patent uses the term "multicarrier" in the context of DMT, a multicarrier is not limited to DMT. For example, as described by the '158 patent's specification, a multicarrier may also be implemented in technologies other than DMT:

> ***Although described with respect to discrete multitone modulation, the principles of the invention apply also to other types of multicarrier modulation***, such as, but not limited to, orthogonally multiplexed quadrature amplitude modulation (OQAM), discrete wavelet multitone (DWMT) modulation, and orthogonal frequency division multiplexing (OFDM).

Ex. 1001, 3:34-39.

45. Consistent with these statements, I believe that a POSITA would have understood that the broadest reasonable interpretation of "multicarrier" includes "multiple carriers" that are not limited to any particular modulation technology.

B. "transceiver"

46. The term "transceiver" appears in claims 1-28.

47. Claims 1 refers to the claimed transceiver "transmitting" a plurality of data bits.

48. The '158 patent's specification does not provide an express definition for the term "transceiver." However, the '158 patent specification states that a "transceiver" may include a discrete multitone (DMT) transmitter and receiver, but that the transceiver may also be implemented using modulation technology other than DMT:

> FIG. 1 shows a digital subscriber line (DSL) communication system 2 including a discrete multitone (DMT) transceiver 10 in communication with a remote transceiver 14 over a communication channel 18 using a transmission signal 38 having a plurality of carrier signals. ***The DMT transceiver 10 includes a DMT transmitter 22 and a DMT receiver 26***. The remote transceiver 14 includes a transmitter 30 and a receiver 34. ***Although described with respect to discrete multitone modulation, the principles of the invention apply also to other types of multicarrier modulation***, such as, but not limited to, orthogonally multiplexed quadrature amplitude modulation (OQAM), discrete wavelet multitone (DWMT) modulation, and orthogonal frequency division multiplexing (OFDM).

Ex. 1001, 3:27-39.

49. The '158 patent specification also states that a "transceiver" may be a modem, such as a wireless modem that uses an air communication channel:

> The communication channel 18 provides a downstream transmission path from the DMT transmitter 22 to the remote receiver 34, and an upstream transmission path from the remote

> transmitter 30 to the DMT receiver 26. In one embodiment, the communication channel 18 is a pair of twisted wires of a telephone subscriber line. In other embodiments, the communication channel 18 can be a fiber optic wire, a quad cable, consisting of two pairs of twisted wires, or a quad cable that is one of a star quad cable, a Dieselhorst-Martin quad cable, and the like. In a wireless communication system wherein the ***transceivers 10, 14 are wireless modems, the communication channel 18 is the air*** through which the transmission signal 38 travels between the transceivers 10, 14.

Ex. 1001, 3:40-53.

50. The '158 patent specification also refers to transmitting data using a DMT modem:

> An input signal, which includes input data bits, is sent to a ***DMT transmitter, such as a DMT modem***. The DMT transmitter typically modulates the phase characteristic, or phase, and amplitude of the carrier signals using an Inverse Fast Fourier Transform (IFFT) to generate a time domain signal, or transmission signal, that represents the input signal. The ***DMT transmitter transmits the transmission signal***, which is a linear combination of the multiple carriers, to a DMT receiver over the communication channel.

Ex. 1001, 1:41-49.

51. A POSITA would have understood that the word "transceiver" is a combination of the words <u>trans</u>mitter and re<u>ceiver</u>. Consistent with this

understanding, a contemporary technical dictionary, *Newton's Telecom Dictionary* (13th ed.), defines a "transceiver" as "any device that transmits and receives." Ex. 1016, p. 709.

52. Based on this evidence, I believe that a POSITA would have understood that the broadest reasonable interpretation of "transceiver" includes a "device, such as a modem, with a transmitter and a receiver."

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

VII. CHALLENGE #1: CLAIMS 1, 2, 4, 15, 16, & 18 ARE UNPATENTABLE OVER SHIVELY AND STOPLER

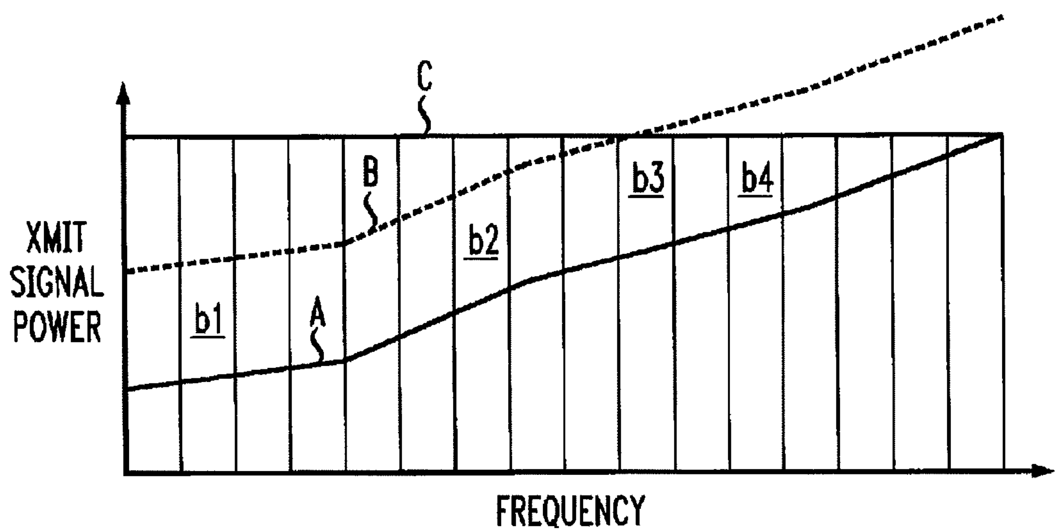
54. It is my opinion that the Shively and Stopler references would have rendered obvious to a POSITA the subject matter of claims 1, 2, 4, 15, 16, and 18 of the '158 patent.

A. Overview of Shively

55. "Shively" is U.S. Patent No. 6,144,696 (Ex. 1011). Shively describes the "discrete multitone transmission (DMT) of data by digital subscriber line (DSL) modems." Ex. 1011 at 1:5-6.

56. Shively explains that communications standards, such as ANSI T1.413-1995, establish upper limits on the power for each frequency sub-band of the communication channel. Ex. 1011, 2:12-15. This limit, known as the power spectral density mask, refers to the power as a function of frequency, or tone. Ex.

1011, 1:48-50, 1:60-65. External standards may also "impose limits on the aggregate power of a signal (the power applied in all the sub-band channels." Ex 1011, 1:46-48. In some subchannels, it is possible for the interaction among the subchannel power limit, the aggregate power limit, the existing noise, and the attenuation of transmitted signals to leave little or no room for data to be transmitted. Shively illustrates interaction in Fig. 1, where line A is the combined effect of noise and attenuation across the subchannels, line B is the transmit power required to effectively send one bit per subchannel, and line C is the power limit imposed by an external communication standard. Ex. 1011, 2:1-12.



Ex. 1011, FIG. 1

57. As the figure shows, there are some subchannels (such as b4) where a signal could be transmitted, but there is insufficient room between the attenuation/noise floor (line A) and the power limit (line C) for the signal to

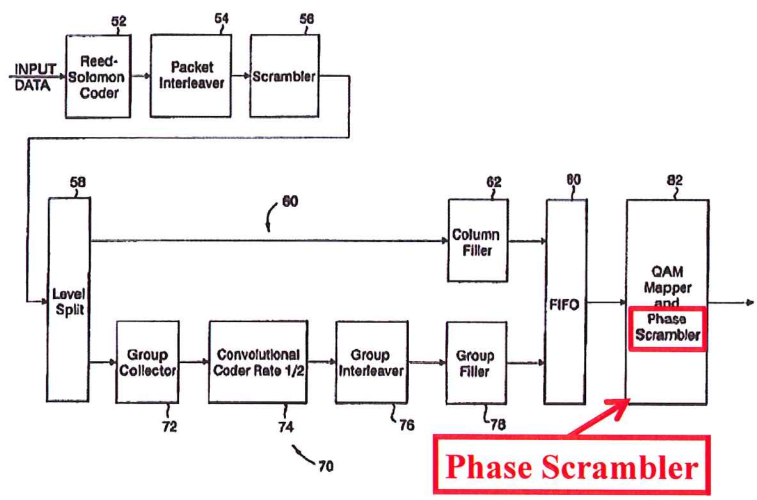
reliably transmit even a single bit. Shively teaches a mechanism for exploiting such power-limited subchannels by transmitting the same bit on two or more such subchannels. By summing the signals across the two subchannels, the receiver can achieve the signal-to-noise ratio necessary to reliably decode the transmitted bit. Ex. 1011, 11:4-25, 16:21-29. Thus, Shively provides a "method for increasing a data rate in a communication channel" by transmitting data on "those parts of the band where transmission would otherwise be impossible." Ex. 1011, 8:2-3, 16:6-7.

B. Overview of Stopler

58. "Stopler" is U.S. Patent No. 6,625,219 (Ex. 1012). Like Shively, Stopler describes multicarrier data transmission, including specifically the use of discrete multitone transmission (DMT). Ex. 1012, 1:50-51. Stopler explains that DMT is one type of multitone modulation, which involves "a number of narrow-band carriers positioned at different frequencies, all transmitting simultaneously in parallel." Ex. 1012, 1:9-11 & 1:42-45.

Stopler explains that its multitone modulation techniques are compatible with various signal modulation technologies, an example of which employs 256 carriers positioned at different frequencies. Ex. 1012, 1:42-61; 12:55-57. Stopler also explains that its signal transmission scheme may implement techniques of DSL standards such as "ADSL (Asymmetric Digital Subscriber Line)." Ex. 1012, 9:37-41, 12:21-24.

59. Stopler also explains that some of the available carriers may be reserved for the transmission of overhead signals (also called overhead symbols), such as pilot tones. Ex. 1012, 10:60-62 & 12:51-54. To randomize these overhead channels, Stopler employs a phase scrambler. Ex. 1012, 12:24-26. A POSITA would have understood that the values transmitted in an overhead channel may not be random, and in fact, may be highly structured. Without the phase scrambler, the structured nature of the overhead channel could contribute to an increase in the peak-to-average power ratio of the transmitter. Stopler illustrates its phase scrambler, as shown in FIG. 5, below:



Ex. 1012, FIG. 5 (Annotated)

60. The phase scrambler as described by Stopler is implemented to "randomize" all symbols, including the data symbols. Ex. 1012, 9:34-47, 12:24-45. A POSITA would have recognized that a purpose for implementing the phase

scrambler to randomize the data symbols would be to reduce the PAR of transmitted signals.

61. Stopler is analogous art to the '158 Patent because both Stopler and the '158 Patent are in the same field of endeavor (data communications and processing). Ex. 1012, 1:7-8; Ex. 1001, Abstract.

C. Reasons to Combine Shively and Stopler

62. It would have been obvious to a POSITA to combine Shively and Stopler because the combination is merely the use of a known technique to improve a similar device, method or product in the same way.

63. A POSITA would have recognized that by transmitting redundant data symbols on multiple carriers, Shively's transmitter would suffer from an increased peak-to-average power ratio. This increase is due to the fact that the overall transmitted signal in a multicarrier system is essentially the sum of its multiple subcarriers. When N subcarrier signals with the same phase and amplitude are added together, they have a peak power which is N times greater than their individual maximum powers.

64. Since Shively's subcarriers use quadrature amplitude modulation (QAM)—which encodes bits to be transmitted by modulating the phase and amplitude of the subcarrier—transmitting the same one or more bits on two different subcarriers causes those subcarriers to have the same phase and

amplitude. By transmitting the same bits on multiple subcarriers, Shively creates a situation where those multiple subcarriers will be phase-aligned. Having phase-aligned subcarriers causes a high peak-to-average power ratio (PAR), since all of the subcarriers add up coherently at the same time. I note that the '158 patent acknowledges that it was known for a high PAR to result from transmitting the same data on multiple carriers:

> If the phase of the modulated carriers is not random, then the PAR can increase greatly. Examples of cases where the phases of the modulated carrier signals are not random are when bit scramblers are not used, ***multiple carrier signals are used to modulate the same input data bits***, and the constellation maps, which are mappings of input data bits to the phase of a carrier signal, used for modulation are not random enough (i.e., a zero value for a data bit corresponds to a 90 degree phase characteristic of the DMT carrier signal and a one value for a data bit corresponds to a -90 degree phase characteristic of the DMT carrier signal).

Ex. 1001, 2:17-27.

65. I agree that a POSITA would have immediately recognized that Shively's redundant transmission technique would negatively impact the PAR.

66. A POSITA would have been familiar with the problems created by a high PAR. Among the problems is the need for transmission components, such as amplifiers and digital-to-analog converters, with a linear response over a large

dynamic range. To the extent that such components existed, they were expensive and highly inefficient. Less capable components would cause non-linear signal distortion, such as from amplitude clipping, resulting in data transmission errors. Since a high PAR brings numerous disadvantages, a POSITA would have sought out an approach to reduce the PAR of Shively's transmitter.

67. Stopler provides a solution for reducing the PAR of a multicarrier transmitter. Specifically, Stopler teaches that a bit scrambler followed by a phase scrambler can be employed to randomize the phase of the individual subcarriers. Ex. 1012, 12:24-28. A POSITA would have recognized that by randomizing the phase of each subcarrier, Stopler provides a technique that allows two or more subcarriers in Shively's system to transmit the same one or more bits, but without those two or more subcarriers having the same phase. Since the two subcarriers are out-of-phase with one another, the subcarriers will not add up coherently at the same time, and thus the peak-to-average power ratio for the overall system will be less than in Shively's original system.

68. Combining Stopler's phase scrambler into Shively's transmitter would have been a relatively simple and obvious solution to reduce Shively's PAR.

69. Market forces would have prompted the development of multicarrier communications devices, such as Digital Subscriber Line (DSL) modems, employing both redundant bit transmission and phase scrambling. As Shively

explains, effective use of redundant bit transmission actually *increases* the available bandwidth by exploiting subcarriers that would otherwise be wasted (unused). Ex. 1011, 16:7-10. Combining redundant bit transmission with Stopler's phase scrambling technique would have allowed the development of faster DSL modems *without* requiring more complex (and expensive) circuitry for handling an increased peak-to-average power ratio.

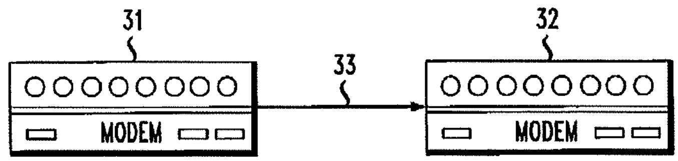
70. Thus, it would have been obvious to combine Shively with Stopler as the combination is merely the use of a known technique to improve a similar device, method or product in the same way.

D. Detailed Analysis

71. The following claim chart describes how Shively in view of Stopler renders obvious each and every element of claims 1, 2, 4, 15, 16 and 18 of the '158 patent.

U.S. Patent No. 8,718,158	Shively in view of Stopler
Claim 1	
[1.0] In a multicarrier modulation system including a first transceiver in communication with a second transceiver	Both Shively and Stopler independently render obvious this preamble. **First,** Shively teaches performing a method in a multitone communication system: It is an object of the invention to provide a ***method for transmission in a multitone communication system*** together with an algorithm for allocating bits in the system.

	Ex. 1011, 3:28-29. Shively teaches that it was known to employ multicarrier communications techniques, such as discrete multitone (DMT) modulation, using a DSL modem: > This invention relates to ***discrete multitone transmission (DMT) of data by digital subscriber loop (DSL) modems*** and more specifically to the allocation of bits, respectively, to the discrete multitones. Ex. 1011, 1:5-8. As I discuss above regarding the claim construction of "transceiver," a modem is an example of a transceiver. Shively further teaches that modems communicate by both transmitting *and* receiving data: > Referring now also to FIG. 3, ***Modems 31 and 32 contain*** a source encoder 11, a channel decoder 12, ***a digital modulator 14, to take in and transmit data from a data source 11. Modems 31 and 32 also contain*** a digital demodulator 16, a channel decoder 17, and ***a source decoder 18 to receive the data*** and supply it to a data sink 19. Ex. 1011, 10:9-14. Shively illustrates two modems in communication in Fig. 2: > Referring to FIGS. 1 and 2, a ***transmitting modem 31 is connected to a receiving modem 32*** by a cable 33 having four twisted pairs of conductors. Ex. 1011, 9:63-65.



Ex. 1011, Fig. 2.

Accordingly, it would have been obvious to a POSITA that Shively's transmitting modem is a "first transceiver" and the receiving modem is a "second transceiver."

Second, Stopler teaches an apparatus and method in a multicarrier modulation system:

> The present invention generally relates to the field of data communications and processing. Specifically, the present invention relates to ***a method and apparatus for encoding/framing a data stream of multitone modulated signals*** to improve impulse burst immunity.

Ex. 1012, 1:7-12.

> ***Multitone modulation is a signal transmission scheme which uses a number of narrow-band carriers positioned at different frequencies,*** all transmitting simultaneously in parallel. Each narrow band carries a fraction of the total information being transmitted. ***The discrete bands or subchannels are independently modulated,*** and ***each have a carrier frequency*** at the center frequency of the particular band.

Ex. 1012, 1:42-49.

Stopler teaches that the multicarrier technology may be discrete multitone ("DMT") which is implemented in a multicarrier modulation system:

> ***<u>One type of multitone transmission scheme</u>***

	> ***is discrete multitone, often referred to as DMT. In DMT, a 1.1 MHZ channel is broken down into 256 sub-channels or bands***, each of which is 4 KHZ. ***Each of the sub-channels has its own carrier frequency***, and the signal to noise ratio for each of the sub-channels is monitored by the DMT system to 55 determine how many bits per signal may be carried in each of the sub-channels. Each of the sub-channels transmits a number of information bits in a single symbol or signal period. Ex. 1012, 1:50-58. The DMT technology described in Stopler is the same multicarrier communication technology described in the '158 Patent: > FIG. 1 shows a digital subscriber line (DSL) communication system 2 including ***a discrete multitone (DMT) transceiver*** 10 in communication with a remote transceiver 14 over a communication channel 18 using a transmission signal 38 having a plurality of carrier signals. ***The DMT transceiver 10 includes a DMT transmitter 22 and a DMT receiver 26.*** Ex. 1001, 1:25-30. It would have been obvious to a POSITA that Stopler's method for encoding multitone modulated signals is a method used with "multicarrier modulation system" because it transmits signals using multiple carriers. Stopler also teaches transmitting and receiving data between two locations: > ***Digital data communications systems are commonly used to transmit and***/or ***receive data*** between ***remote*** transmitting and

	receiving locations. Ex. 1012, 1:14-16. **Accordingly,** it would have been obvious for Stopler's multicarrier communications apparatus to both transmit data and receive data. The transmitter to transmit data and the receiver to receive data at the communications apparatus would have been understood to be a "transceiver." The combination of transmitter and receiver at one location is a "first transceiver," and the combination of transmitter and receiver at the remote location is a "second transceiver." **Thus**, a POSITA would have recognized that both Shively and Stopler describe multicarrier communications apparatuses, such as modems, and that Shively and Stopler further describe methods performed by such modems. Shively and Stopler therefore render obvious a method performed in a "multicarrier modulation system including a first transceiver in communication with a second transceiver."
[1.1] using a transmission signal having a plurality of carrier signals for modulating a plurality of data bits,	Both Shively and Stopler independently render obvious this limitation. **First**, Shively teaches transmitting data by modulating multiple separate carriers with digital data: According an embodiment, the invention provides a transmitting modem that receives digital data from a data source and ***modulates separate carriers to represent the digital data***. The modulated signal is applied to a channel connected to a receiving modem. Ex. 1011, 5:22-26. Shively further explains its use of multiple carriers,

	explaining that the available frequency spectrum is divided into multiple QAM channels: > Referring to FIG. 4, In a QAM multitone modulation, the spectrum is broken into ***multiple sub-bands or QAM channels***. Digital modulator 14 generates N QAM signal tones, one for each QAM channel. Each i^{th} QAM channel carries k_i bits of data. Ex. 1011, 10:27-32. Shively also refers to these multiple QAM channels as "subchannels," and explains that a carrier signal is modulated for each subchannel to transmit at least one bit: > The method follows these steps: (1) detecting a transfer characteristic indicating a required minimum power of a respective ***carrier modulated to transmit one bit*** in each of a plurality of multitone subchannels of the channel; (2) supplying a data stream to a modulator; (3) ***modulating a first set of respective carriers*** to represent respective unique portions of the data stream ***in at least a subset of those of the multitone subchannels*** for which, in the step of detecting indicates the minimum power falls below a power limit imposed by the power spectral density mask[.] Ex. 1011, 8:3-13. From Shively's explanation of the multiple QAM channels (also referred to as subchannels), a POSITA would have understood that the modulated signal output by Shively's transmitting modem is a "transmission signal having a plurality of carrier signals."

	Shively also refers to the digital data being transmitted as being composed of "bits": > The serial-to-parallel converter is programmed to feed ***a first bit of the digital data*** to the first signal modulator to represent the first bit by modulating in the first frequency sub-band at a first power level at least as high as the first minimum power. The serial-to-parallel converter is also programmed to feed ***a second bit of the digital data*** to the second and third modulators to represent the second bit by coherently modulating in both the second and the third frequency sub-bands at a second power level below the first power level, whereby resulting signals applied in the second and third frequency sub-bands may be combined by the receiving modem to retrieve the second bit. Ex. 1011, 5:47-58. **Thus**, a POSITA would have recognized that Shively's transmission of a carrier modulated to transmit one or more bits on each of the plurality of multitone subchannels renders obvious "using a transmission signal having a plurality of carrier signals for modulating a plurality of data bits." **Second,** Stopler teaches a transmission signal having a plurality of carrier signals: > Multitone modulation is a ***signal transmission scheme which uses a number of narrow-band carriers positioned at different frequencies, all transmitting simultaneously in parallel***. Each narrow band carries a fraction of the total information being transmitted. ***The discrete***

	bands or subchannels are independently modulated, and each have a carrier frequency at the center frequency of the particular band. Ex. 1012, 1:42-49. The modulation of the data bits is performed by applying the bits to carrier signals (which are also referred to as sub-channels), and transmitting the bits (which are referred to as information bits) using carrier frequencies that are assigned to the sub-channels: One type of multitone transmission scheme is discrete multitone, often referred to as DMT. In DMT, ***a 1.1 MHz channel is broken down into 256 sub-channels or bands, each of which is 4 KHz. Each of the sub-channels has its own carrier frequency***, and the signal to noise ratio for each of the sub-channels is monitored by the DMT system to determine how many bits per signal may be carried in each of the sub-channels. ***Each of the sub-channels transmits a number of information bits*** in a single symbol or signal period. ***The number of bits per signal (or symbol) in a sub-channel is typically referred to as the "loading" of the sub-channel.*** Ex. 1012, 1:50-61. Accordingly, Stopler teaches that the data bits (information bits in Stopler) are modulated onto the narrow band carriers (sub-channels) for transmission. **Thus**, a POSITA would have recognized that Stopler's use of narrow-band carriers, which are independently modulated to transmit information bits, renders obvious "using a transmission signal having a plurality of carrier signals for modulating a plurality of data bits."

[1.2] each carrier signal having a phase characteristic associated with at least one bit of the plurality of data bits,	Both Shively and Stopler independently render this limitation obvious because they teach transmitting data bits using quadrature amplitude modulation (QAM), which modulates bits onto a carrier signal by changing a phase characteristic of the carrier signal. **First**, Shively describes quadrature amplitude modulation (QAM), including explaining how QAM transmits data bits (referred to as data) by using the phase of a carrier signal to convey data bits: QAM, a form of combined amplitude and phase modulation, represents k-bit sets of data by modulating two (orthogonal) quadrature carriers, cos $2\pi f_c$ t and sin $2\pi f_c$ t to generate a pulse whose ***phase and amplitude convey the encoded k-bits of information***. Ex. 1011, 1:25-30. A POSITA would have understood that the phase of a signal (which is used in QAM to convey bits) is a "phase characteristic." I note that the '158 patent refers to phase as a phase characteristic. Ex. 1001, 1:43-44. Shively further explains that in a system employing QAM and multitone modulation, each channel, or tone, is separately modulated to carry bits of data: In a DMT modem, a transmission frequency band is separated into N sub-bands or frequency bins, each corresponding to one QAM channel. Ex. 1011, 1:42-44. Since Shively also refers to the use of "separate carriers to represent the digital data" (Ex. 1011, 5:24), a POSITA would have understood that Shively's sub-bands, frequency bins, and QAM channels correspond

	to the "plurality of carriers" analyzed above in portion [1.1]. Shively further explains how each QAM channel (corresponding to a carrier signal) is associated with data bits: > Referring to FIG. 4, In a QAM multitone modulation, the spectrum is broken into multiple sub-bands or QAM channels. Digital modulator 14 generates N QAM signal tones, one for each QAM channel. ***Each i^{th} QAM channel carries k_i bits of data.*** Ex. 1011, 10:27-32. **Thus,** because each QAM channel carries one or more bits of data using QAM, and because QAM modulates data onto a carrier signal by changing the phase and amplitude of the carrier signal, a POSITA would have recognized that Shively renders obvious "each carrier signal having a phase characteristic associated with at least one bit of the plurality of data bits." **Second**, as discussed above in portion [1.1], Stopler teaches a transmission signal having a plurality of carrier signals: > Multitone modulation is a ***signal transmission scheme which uses a number of narrow-band carriers positioned at different frequencies, all transmitting simultaneously in parallel***. Each narrow band carries a fraction of the total information being transmitted. ***The discrete bands or subchannels are independently modulated, and each have a carrier frequency*** at the center frequency of the particular band. Ex. 1012, 1:42-49.

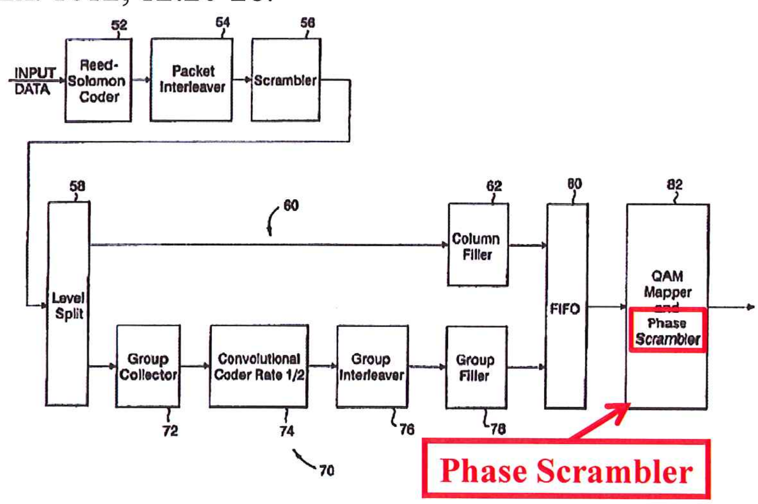
	A POSITA would have understood from Stopler's description of multitone modulation that Stopler uses the word "tone" to refer to a carrier signal. The tone in Stopler has a phase characteristic associated with at least one bit of the data bits. Stopler teaches that the data bits (which is data in a form of m-tuples in Shively) is delivered to the QAM mapper and phase scrambler 82: > ***The outputs of the upper stream 60 and the lower stream 70 are combined into m-tuples*** (QAM symbols), and temporarily stored in a FIFO buffer 80. ***The data is then delivered from the FIFO buffer 80 to a QAM mapper [and phase scrambler] 82.*** The FIFO buffer 80 introduces the appropriate delay required to output the m-tuples according the diagonalization principle of the present invention. Ex. 1012, 11:51-54. Stopler then teaches that the QAM mapper and phase scrambler 82 map the m-tuples into the QAM symbols that are phase scrambled and provided to the modulator: > ***The input to the QAM mapper [and phase scrambler] 82 is data in the form of m-tuples which are to be mapped into QAM symbols, for example, ranging from QPSK to 256-QAM, tone by tone.*** The constellation mapping may be the same as that used in ADSL. In order to randomize the overhead channel symbols, a phase scrambling sequence is applied to the output symbols. However, to simplify implementation, ***the phase scrambler is applied to all symbols***, not just the overhead symbols. Ex. 1012, 12:20-28. > The output from the QAM mapper [and phase

	scrambler] 82 is provided to a modulator (not shown) which implements the particular signal modulation desired, e.g., VCMT, CDMA, etc. Ex. 1012, 12:55-57. Stopler further describes how the modulator independently modulates each tone using quadrature phase shift keying (QPSK) or quadrature amplitude modulation (QAM): The ***tones are independently modulated from QPSK (quadrature phase shift keying) to 256-QAM (quadrature amplitude modulation)***, depending on the noise measured for each tone. Ex. 1012 2:15-17. A POSITA would have recognized that QPSK and QAM modulation schemes for tones associate a phase with a QAM symbol, which represents the m-tuples (i.e., the data bits). Additionally, a POSITA would have understood that the phase of a signal is a "phase characteristic." Notably, the '158 patent refers to phase as a "phase characteristic." Ex. 1001, 1:43-44. **Thus**, Stopler teaches that each tone, or carrier signal, is independently modulated so that the phase of each tone conveys encoded bits of information. Because the phase of each tone conveys bits of information or data, it would have been obvious to a POSITA that Stopler renders obvious "each carrier signal having a phase characteristic associated with at least one bit of the plurality of data bits."
[1.3] a method for scrambling the phase characteristics of the carrier signals comprising:	Stopler renders this limitation obvious. **First**, Stopler describes a "phase scrambler" that scrambles the phase characteristics of the data symbols that are subsequently provided to a modulator for signal

modulation on to carrier frequencies. Stopler teaches that Quadrature Amplitude Modulation (QAM) data symbols are randomized by applying a phase scrambling sequence to the symbols:

> The input to the QAM mapper 82 is ***data in the form of m-tuples which are to be mapped into QAM symbols, for example, ranging from QPSK to 256-QAM***, tone by tone. The constellation mapping may be the same as that used in ADSL. In order to randomize the overhead channel symbols, ***a phase scrambling sequence is applied to the output symbols***. However, to simplify implementation, ***the phase scrambler is applied to all symbols***, not just the overhead symbols.

Ex. 1012, 12:20-28.

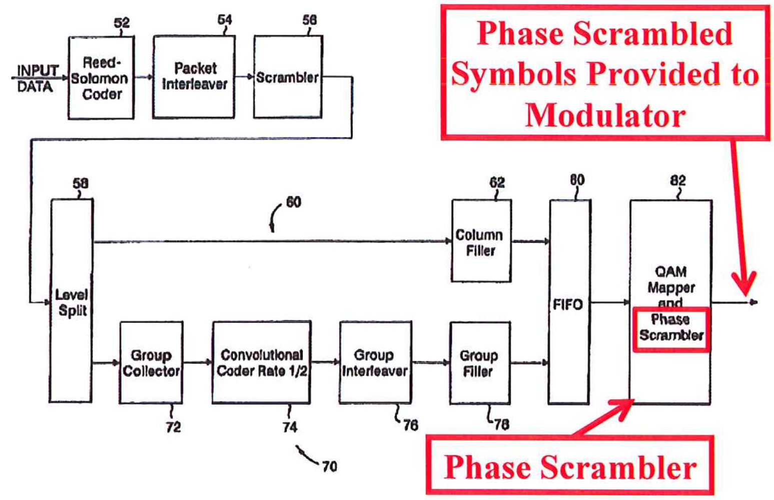


Ex. 1012, FIG. 5 (Annotated)

Stopler then teaches that the phase scrambled symbols are provided to a modulator that performs signal modulation. The signal modulation includes applying the phase shifted data in a form of QAM symbols onto carrier signals and transmitting the data bits via the carrier signals. The phase scrambled symbols are output from the QAM Mapper and Phase Scrambler 82 to a modulator that provides signal modulation:

> The ***output from the QAM mapper 82 is provided to a modulator (not shown) which implements the particular signal modulation*** desired, e.g., VCMT, CDMA, etc.

Ex. 1012, 12:55-57.



Ex. 1012, FIG. 5 (Annotated)

The mapped and modulated symbols are transmitted as information bits using carrier frequencies that are assigned to the sub-channels:

> One type of multitone transmission scheme is discrete multitone, often referred to as DMT. In DMT, ***a 1.1 MHz channel is broken down into 256 sub-channels or bands, each of which is 4 KHz. Each of the sub-channels has its own carrier frequency***, and the signal to noise ratio for each of the sub-channels is monitored by the DMT system to determine how many bits per signal may be carried in each of the sub-channels. ***Each of the sub-channels transmits a number of information bits in a single symbol or signal period. The number of bits per signal (or***

	symbol) in a sub-channel is typically referred to as the "loading" of the sub-channel. Ex. 1012, 1:50-61. Multitone modulation is a ***signal transmission scheme which uses a number of narrow-band carriers positioned at different frequencies, all transmitting simultaneously in parallel***. Each narrow band carries a fraction of the total information being transmitted. ***The discrete bands or subchannels are independently modulated, and each have a carrier frequency*** at the center frequency of the particular band. Ex. 1012, 1:42-49. A POSITA would have understood that the phase scrambling that Stopler's apparatus applies to the symbols results in a scrambling of the carrier phases following modulation of the symbols onto the carrier frequencies. For example, Stopler provides the following table used to select the amount of rotation to be applied to a symbol. The table shows exemplary phase rotation values between –π/2 and π: <table><tr><th>2a + b</th><th></th><th>Phase Rotation</th></tr><tr><td>0</td><td>→</td><td>0</td></tr><tr><td>1</td><td>→</td><td>+π/2</td></tr><tr><td>2</td><td>→</td><td>π</td></tr><tr><td>3</td><td>→</td><td>–π/2</td></tr></table>Ex. 1012, 12:38-44. A POSITA would have understood that selecting a phase rotation value of π/2 for a symbol will cause the carrier assigned to that symbol to be phase shifted by an additional π/2 when the symbol is modulated onto the carrier. In other words, rotating the phase of a

<table>
<tr><td></td><td>symbol, as described in Stopler, results in the phase shifting of the carrier assigned to the symbol when the symbol is modulated onto the carrier.

Second, it would have been obvious to a POSITA to employ Stopler's phase scrambling techniques in Shively's transmitter. Since Shively's use of redundant data transmissions could negatively impact the transmitter's PAR, it would have been obvious to randomize the carrier phases using Stopler's techniques in order to reduce Shively's PAR.

Thus, Stopler renders obvious "a method for scrambling the phase characteristics of the carrier signals."</td></tr>
<tr><td>[1.4] transmitting the plurality of data bits from the first transceiver to the second transceiver;</td><td>Both Shively and Stopler independently render obvious this limitation.

First, Shively teaches (as analyzed above in portion [1.0]) a transmitting modem that is a "first transceiver" and a receiving modem that is a "second transceiver." Shively further teaches that the transmitting modem sends digital data to the receiving modem:
<blockquote>[T]he invention provides a transmitting modem receiving digital data from a data source, modulating carriers to represent the digital data, and applying a resulting modulated signal to a channel connectable to a receiving modem.</blockquote>Ex. 1011, 8:56-60.

Shively further teaches multicarrier communications techniques, such as discrete multitone transmission (DMT) of digital data:
<blockquote>This invention relates to discrete multitone transmission (DMT) of data by digital subscriber loop (DSL) modems and more</blockquote></td></tr>
</table>

	specifically to the allocation of bits, respectively, to the discrete multitones. Ex. 1011, 1:5-8. As previously analyzed in [1.0], Shively's transmitting modem is a "first transceiver" and the receiving modem is a "second transceiver." And as analyzed in portion [1.1], a POSITA would have understood that Shively's "digital data" refers to the data bits being transmitted. **Thus**, Shively would have rendered obvious to a POSITA "transmitting the plurality of data bits from the first transceiver to the second transceiver." **Second,** as described above in [1.3], Stopler describes discrete multitone modulation: One type of multitone transmission scheme is discrete multitone, often referred to as DMT. In DMT, a 1.1 MHz channel is broken down into 256 sub-channels or bands, each of which is 4 KHz. Each of the sub-channels has its own carrier frequency, and the signal to noise ratio for each of the sub-channels is monitored by the DMT system to determine how many bits per signal may be carried in each of the sub-channels. ***Each of the sub-channels transmits a number of information bits in a single symbol or signal period. The number of bits per signal (or symbol) in a sub-channel is typically referred to as the "loading" of the sub-channel.*** Ex. 1012, 1:50-61. ***Multitone modulation is a signal <u>transmission</u> scheme which uses a***

	> ***number of narrow-band carriers positioned at different frequencies, all <u>transmitting</u> simultaneously in parallel. Each narrow band carries a fraction of the total information being <u>transmitted</u>***. The discrete bands or sub-channels are independently modulated, and each have a carrier frequency at the center frequency of the particular band. Ex. 1012, 1:42-49. **Accordingly**, a POSITA would have recognized that Stopler transmits the plurality of data bits. Stopler also teaches transmitting and receiving data between two locations: > Digital data communications systems are commonly ***used to transmit and/or receive data between remote transmitting and receiving locations***. Ex. 1012, 1:14-16. It would have been obvious to a POSITA that the transmitting location and the receiving location would each be equipped with a transceiver. **Thus**, Stopler renders obvious "transmitting the plurality of data bits from the first transceiver to the second transceiver."
[1.5] associating a carrier signal with a value determined independently of any bit of the plurality of data bits carried by the carrier signal, the value associated with the carrier signal	Stopler renders obvious this limitation. **First,** Stopler describes employing a pseudo-random number generator to select a value between 0 and 3: > For example, the phase scrambling sequence may be generated by ***a pseudo-random generator*** composed of a linear feedback shift register of length 21, and ***initialized by a user programmable seed. Consecutive***

determined by a pseudo-random number generator;	***output pairs from the pseudo-random generator***, e.g., (n, n+1), (n+2, n+3), ... denoted (a, b) ***are converted into numbers 2a+b*** (the sum is "2a+b" because the "a" bit is the MSB, i.e., 2^1) and the sum (2a +b) is used to select the amount of rotation to be applied to the symbol, according to the following table: 2a + b — Phase Rotation 0 → 0 1 → +π/2 2 → π 3 → −π/2 Ex. 1012 12:28-45. The value 2a+b calculated by Stopler is a "value determined independently of any bit of the plurality of data bits carried by the carrier signal" and is a value "determined by a pseudo-random number generator" as claimed. **Second,** Stopler further describes how the value 2a+b is associated with a symbol: "… the sum (2a+b) is used to select the amount of rotation to be applied to the symbol…." Ex. 1012, 12:34-36. The symbol is used to "transmit[] a number of information bits" on a sub-channel (Ex. 1012, 1:57-59), and the sub-channel has a carrier frequency. Ex. 1012, 1:46-49. It would have been obvious to a POSITA, therefore, that each symbol is associated with the carrier on which it will be transmitted. Additionally, because the sum (2a+b) is derived from a pseudo-random number generator, the sum (2a+b) is independent of the data bits being transmitted. **Accordingly**, associating the value 2a+b with a symbol also associates the value 2a+b with the carrier on which the symbol is to be transmitted.

<table>
<tr><td></td><td>Thus, Stopler renders obvious "associating a carrier signal with a value determined independently of any bit of the plurality of data bits" as claimed.</td></tr>
<tr><td>[1.6] determining a phase shift for the carrier signal at least based on the value associated with the carrier signal;</td><td>Stopler renders obvious this limitation.

As analyzed above in portion [1.5], Stopler teaches determining a value 2a+b, which is the claimed "value associated with the carrier signal". Stopler further teaches that the 2a+b value is used to determine a rotation applied to a symbol:

Consecutive output pairs from the pseudo-random generator, e.g., (n, n+1), (n+2, n+3), ... denoted (a, b) are converted into numbers 2a+b (the sum is "2a+b" because the "a" bit is the MSB, i.e., 2^1) and the sum (2a +b) is used to select the amount of rotation to be applied to the symbol, according to the following table:

<table>
<tr><th>2a + b</th><th></th><th>Phase Rotation</th></tr>
<tr><td>0</td><td>→</td><td>0</td></tr>
<tr><td>1</td><td>→</td><td>$+\pi/2$</td></tr>
<tr><td>2</td><td>→</td><td>π</td></tr>
<tr><td>3</td><td>→</td><td>$-\pi/2$</td></tr>
</table>

Ex. 1012 12:28-45.

A POSITA would have understood that applying a rotation to the symbol results in a phase shift of the carrier signal after the symbol is modulated onto the carrier (as discussed further in [1.7] below). This phase shift resulting from a symbol rotation is in addition to the phase shift of the carrier signal that encodes or conveys the data bits being transmitted.

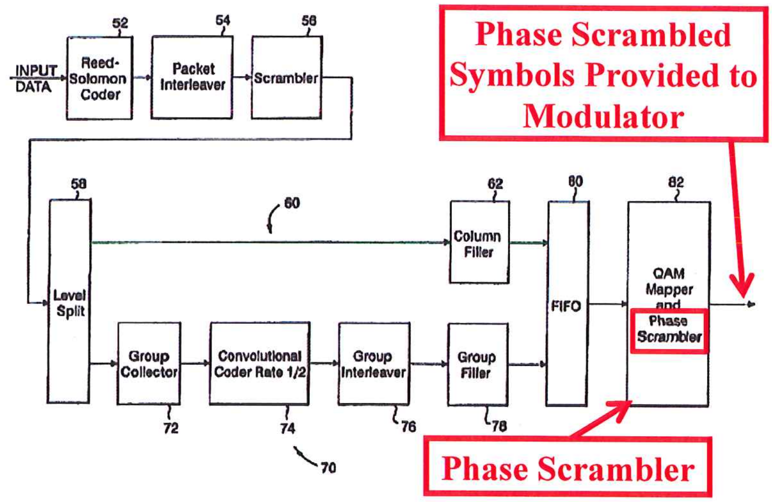
Thus, Stopler renders obvious "determining a phase shift for the carrier signal at least based on the value associated with the carrier signal."</td></tr>
<tr><td>[1.7] modulating at</td><td>Both Shively and Stopler independently render this</td></tr>
</table>

least one bit of the plurality of data bits on the carrier signal; and	limitation obvious. As analyzed above in portion [1.4], Shively describes modulating data bits onto a carrier: > The method follows these steps: (1) detecting a transfer characteristic indicating a required minimum power of ***a respective carrier modulated to transmit one bit in each of a plurality of multitone subchannels of the channel***; (2) supplying a data stream to a modulator; (3) ***modulating a first set of respective carriers to represent respective unique portions of the data stream in at least a subset of those of the multitone subchannels*** for which, in the step of detecting indicates the minimum power falls below a power limit imposed by the power spectral density mask[.] Ex. 1011, 8:3-13. To modulate the carriers, Shively describes using quadrature amplitude modulation (QAM) multitone modulation: > In a QAM multitone modulation, the spectrum is broken into multiple ***sub-bands or QAM channels***. Digital modulator 14 generates N QAM signal tones, one for each QAM channel. Each i^{th} QAM channel carries k_i bits of data. A serial-to-parallel buffer 41 segments a serial stream of digital data into N frames, each having allocated to it k_i bits of data. These are applied to respective inputs of a multi-carrier modulator 42 which generates a ***QAM tone for each channel***. Multi-carrier modulator generates N QAM tones, one for each channel, at the same symbol rate but with a respective constellation for each channel. That is, the i^{th}

	QAM channel carries an 2^{ki} -ary QAM tone, a tone with 2^{ki} signal points. Multi-carrier modulator modulates N subcarriers by corresponding symbols to generate the N QAM signal tones using an inverse digital Fourier transform. Ex. 1011, 10:28-42. Shively uses the terms "sub-band," "QAM channel," and "subcarrier" to refer to the independently modulated portions of the frequency spectrum used for communication. It would have been obvious to a POSITA, therefore, that all of these terms correspond to the claimed "plurality of carrier signals." **Accordingly**, by teaching that a carrier is modulated to transmit one or more bits, Shively renders obvious "modulating at least one bit of the plurality of data bits on the carrier signal." Stopler also describes using quadrature amplitude modulation (QAM) to transmit data in the form of m-tuples (data bits): ***The input to the QAM mapper [and phase scrambler] 82 is data in the form of m-tuples which are to be mapped into QAM symbols, for example, ranging from QPSK to 256-QAM, tone by tone.*** The constellation mapping may be the same as that used in ADSL. In order to randomize the overhead channel symbols, a phase scrambling sequence is applied to the output symbols. However, to simplify implementation, ***the phase scrambler is applied to all symbols***, not just the overhead symbols. Ex. 1012, 12:20-28. The output from the QAM mapper [and phase scrambler] 82 is ***provided to a modulator (not***

> ***shown) which implements the particular signal modulation desired***, e.g., VCMT, CDMA, etc.

Ex. 1012, 12:55-57.



Ex. 1012, FIG. 5 (Annotated)

As described in [1.1], the modulation of the symbols is performed by loading the bits corresponding to the symbols to sub-channels, which is another term for carrier signals, and transmitting the bits using carrier frequencies that are assigned to the sub-channels:

> One type of multitone transmission scheme is discrete multitone, often referred to as DMT. In DMT, ***a 1.1 MHz channel is broken down into 256 sub-channels or bands, each of which is 4 KHz. Each of the sub-channels has its own carrier frequency***, and the signal to noise ratio for each of the sub-channels is monitored by the DMT system to determine how many bits per signal may be carried in each of the sub-channels. ***Each of the sub-channels transmits a number of information bits in a single symbol or signal period. The number of bits per signal (or symbol) in a sub-channel is typically***

	referred to as the "loading" of the sub-channel. Ex. 1012, 1:50-61. Multitone modulation is a ***signal transmission scheme which uses a number of narrow-band carriers positioned at different frequencies, all transmitting simultaneously in parallel.*** Each narrow band carries a fraction of the total information being transmitted. ***The discrete bands or subchannels are independently modulated, and each have a carrier frequency*** at the center frequency of the particular band. Ex. 1012, 1:42-49. **Accordingly,** the phase scrambled symbol output by Stopler's phase scrambler (which is data in the form of m-tuples mapped onto QAM symbols) is associated with the at least one bit in the plurality of bits. The phase scrambled symbol output is modulated onto carrier frequencies for transmission. Because each subchannel, which is another word for a carrier signal, has its own carrier frequency, Stopler renders obvious "modulating at least one bit of the plurality of data bits on the carrier signal." **Thus,** it would have been obvious to a POSITA to employ the techniques of Shively and Stopler to modulate at least one bit of the plurality of data bits on the carrier signal.
[1.8] modulating the at least one bit on a second carrier signal of the plurality of carrier signals.	Shively renders this limitation obvious. This limitation is similar to that recited in [1.7] except that [1.8] requires that the at least one bit be modulated on a ***second*** carrier signal. Thus, the limitations of [1.7] and [1.8] together require a redundant copy of the "at

	least one bit" to be modulated. I note that the '158 Provisional Application states that "send[ing] the same data bits on different carriers" was a "well-known method." Ex. 1008, p.2. Shively teaches that a "digital modulator 14 replicates ('spreads') a k-bit symbol over multiple adjacent bands with correspondingly less energy in each band." Ex. 1011, 11:16-19. In this way, Shively's modulator can "transmit information by spreading a single block of data (one or more bits) over multiple channels." Ex. 1011, 4:32-34. As described in [1.7], "channels" in Shively are "QAM channels" (also referred to as "sub-bands") for which a "QAM tone" is generated. Ex. 1011, 10:28-42. A POSITA would have understood that in Shively's context, QAM channels or sub-bands is another term for sub-channels or a carrier signals. Shively also teaches modulating a second set of carriers to transmit a portion of the data stream in a redundant fashion (i.e. with the same bits transmitted on multiple carriers): The method follows these steps: (1) detecting a transfer characteristic indicating a required minimum power of a respective carrier modulated to transmit one bit in each of a plurality of multitone subchannels of the channel; (2) supplying a data stream to a modulator; (3) modulating a first set of respective carriers to represent respective unique portions of the data stream in at least a subset of those of the multitone subchannels for which, in the step of detecting indicates the minimum power falls below a power limit imposed by the power spectral density mask; (4) ***modulating a second set of respective carriers to represent redundantly at least one portion of the data stream*** in at least a subset of those of the

	multitone subchannels for which the step of detecting indicates the minimum power exceeds a power limit imposed by the power spectral density mask[.] Ex. 1011, 8:3-18. Shively teaches that the redundant transmission includes allocating bits to more than one frequency: The circuitry also calculates a stored total power level for the initial bits allocated to a plurality of transmit frequencies, and if the stored total power level is not exceeded, allocate further bits to frequencies for which no initial bits are allocated, such that ***each of the further bits is redundantly allocated to more than one of the frequencies***. Ex. 1011, 7:2-8-12. **Accordingly**, a POSITA would have found it obvious to employ the techniques of Shively for modulating one or more bits onto a second carrier signal. **Thus,** Shively renders obvious "modulating the at least one bit on a second carrier signal of the plurality of carrier signals."
Claim 2	
[2.0] The method of claim 1, wherein one or more of the first transceiver and second transceiver are cable transceivers.	Shively and Stopler together render this limitation obvious. As discussed in portion [1.0], Shively's transmitting modem and receiving modem render obvious a first transceiver and a second transceiver. Stopler discloses that the discrete multitone transmission (DMT) and quadrature amplitude modulation (QAM) techniques employed by Shively and Stopler can be applied to transmit data over a cable

	television network: Variable Constellation Multitone (VCMT) modulation is a transmission scheme specifically designed to effectively combat the high ingress and burst impairments ***in cable TV channels***, and also to maximize the throughput capacity of such channels. VCMT uses variable bit loading per tone, along with coding and interleaving. The tones are independently modulated from QPSK (quadrature phase shift keying) to 256-QAM (quadrature amplitude modulation), depending on the noise measured for each tone. The SNR (signal to noise ratio) across the channel is monitored for each tone, and the headend receiver accordingly instructs the upstream ***transmitter in the cable modem*** to modify the QAM constellation for each tone to maintain a desired BER (bit error rate). Ex. 1012, 2:9-22. With respect to the transmission medium, these types of data errors are usually attributed to the less than ideal conditions associated with the particular transmission medium. An example of such a communication medium or channel is the ***hybrid fiber coaxial cable television network, HFC CATV***. Ex. 1012, 1:28-33. A POSITA would have recognized that a cable modem, or more generally a communication device attached to a cable television network, is a "cable transceiver." **Thus,** it would have been obvious to a POSITA to employ the techniques of Stopler with a "cable transceiver" as claimed.

Claim 4	
[4.0] The method of claim 1, wherein the first and second transceivers are multicarrier DSL transceivers.	Both Shively and Stopler independently render obvious this limitation. **First,** Shively teaches discrete multitone (DMT) transmission using DSL modems: This invention relates to ***discrete multitone transmission (DMT) of data by digital subscriber loop (DSL) modems*** and more specifically to the allocation of bits, respectively, to the discrete multitones. Ex. 1011, 1:5-8. A POSITA would have understood that Shively's mention of "discrete multitone transmission" refers to multicarrier communications. Shively expressly states that its techniques are generally applicable to multicarrier systems: For convenience of description, the details of digital modulator 14 and digital demodulator 16 are described in terms of a QAM multitone system, although the invention is applicable to other kinds of ***multi-carrier and multi-channel signaling*** as will be understood by those skilled in the art in light of the teachings disclosed herein. Ex. 1011, 10:3-8. Accordingly, it would have been obvious to a POSITA that Shively's transmitting modem and receiving modem (the first and second transceivers, respectively) could be multicarrier DSL modems. **Second**, Stopler teaches that its scrambler 56 and QAM mapper and Phase Scrambler 82 may be implemented in accordance with the ADSL standards:

	Scrambler 56 may, for example, be implemented in accordance with the scrambler defined in the ADSL (Asymmetric Digital Subscriber Line) specification, TIEI.4/98-007R1, promulgated by the American National Standards Institute (ANSI) (1998). Ex. 1012, 9:37-41. The ***input to the QAM mapper 82 is data in the form of m-tuples which are to be mapped into QAM symbols***, for example, ranging from QPSK to 256-QAM, tone by tone. The constellation ***mapping may be the same as that used in ADSL***. Ex. 1012, 12:20-24. It would have been obvious to a POSITA that Stopler's transmitting and receiving devices could be ADSL modems. A POSITA would have understood that ADSL is a type of DSL. **Thus,** because Shively and Stopler teach implementing their multicarrier communications techniques using DSL technologies and DSL modems, it would have been obvious to a POSITA to employ the techniques of Shively and Stopler with "multicarrier DSL transceivers" as claimed.
Claim 15	
[15.0] A multicarrier modulation system including a first transceiver in communication with a second transceiver	Shively and Stopler render obvious a "multicarrier modulation system" with "a first transceiver" in communication with "a second transceiver" as described in [1.0].
[15.1] using a transmission signal having a plurality of	Shively and Stopler render this limitation obvious for the reasons described in [1.1].

carrier signals for modulating a plurality of data bits,	
[15.2] each carrier signal having a phase characteristic associated with at least one bit of the plurality of data bits,	Shively and Stopler render this limitation obvious for the reasons described in [1.2].
[15.3] the first transceiver capable of transmitting to the second transceiver the plurality of bits and operable to:	Shively and Stopler render obvious transmitting the data bits from the first transceiver to the second transceiver, as analyzed above in [1.4]. This portion [15.3] is very similar to the language recited in portion [1.4]. The difference between [1.4] and [15.3] is that [1.4] recites "transmitting the plurality of <u>data</u> bits" while [15.3] recites "transmitting the plurality of bits." I do not believe that this minor difference in language affects the mapping of the prior art onto the claim language. **Thus,** Shively and Stopler render obvious a "first transceiver capable of transmitting to the second transceiver the plurality of bits" for the reasons given above for portion [1.4].
[15.4] associate a carrier signal with a value determined independently of any bit of the plurality of data bits carried by the carrier signal, the value associated with the carrier signal determined by a pseudo-random number generator;	Stopler renders obvious associating a carrier signal with a value determined by a pseudo-random number generator, as analyzed above in [1.5]. This portion [15.4] is very similar to the language recited in portion [1.5]. The difference between [15.4] and [1.5] is that [15.4] cites "associate" while portion [1.5] recites "associating." I do not believe that this minor different in language affects the mapping of the prior art onto the claim language. **Thus**, Stopler renders obvious this limitation for the reasons given above for portion [1.5].
[15.5] determine a	Stopler renders obvious determining a phase shift for

phase shift for the carrier signal at least based on the value associated with the carrier signal;	the carrier signal based on the value associated with the carrier signal, as analyzed above in [1.6]. This portion [15.5] is very similar to the language recited in portion [1.6]. The difference between [15.5] and [1.6] is that [15.5] cites "determine" while portion [1.6] recites "determining." I do not believe that this minor different in language affects the mapping of the prior art onto the claim language. **Thus**, Stopler renders obvious this limitation for the reasons given above for portion [1.6].
[15.6] modulate at least one bit of the plurality of data bits on the carrier signal; and	Shively and Stopler render obvious modulating a bit on the carrier signal, as analyzed above in portion [1.7]. This portion [15.6] is very similar to the language recited in portion [1.7]. The difference between [15.6] and [1.7] is that [15.6] cites "modulate" while portion [1.7] recites "modulating." I do not believe that this minor different in language affects the mapping of the prior art onto the claim language. **Thus**, Shively and Stopler render obvious this limitation for the reasons given above for portion [1.7].
[15.7] modulate the at least one bit on a second carrier signal of the plurality of carrier signals.	Shively renders obvious modulating the bit on a second carrier signal, as analyzed above in portion [1.8]. This portion [15.7] is very similar to the language recited in portion [1.8]. The difference between [15.7] and [1.8] is that [15.7] cites "modulate" while portion [1.8] recites "modulating." I do not believe that this minor different in language affects the mapping of the prior art onto the claim language. **Thus**, Shively renders obvious this limitation for the reasons given above for portion [1.8].
Claim 16	
[16.0] The system of claim 15, wherein one or more of the first	Stopler discloses this limitation for the reasons described in [2.0].

transceiver and second transceiver are cable transceivers.	
Claim 18	
[18.0] The system of claim 15, wherein the first and second transceivers are multicarrier DSL transceivers.	Shively and Stopler render obvious this limitation for the reasons described in [4.0].

VIII. CHALLENGE #2: CLAIMS 3, 5, 14, 17, 19, AND 28-30 ARE UNPATENTABLE OVER SHIVELY, STOPLER, AND GERSZBERG

72. It is my opinion that the Shively, Stopler, and Gerszberg references would have rendered obvious to a POSITA the subject matter of claims 3, 5, 14, 17, 19, and 28-30 of the '158 patent.

A. Overview of Gerszberg

73. Gerszberg is U.S. Patent No. 6,424,646 (Ex. 1013). Like Shively and Stopler, Gerszberg is also in the field of data communications. Ex. 1013, 2:12-23.

74. Gerszberg also describes "discrete multi-tone (DMT) modulation" as used by "DSL modems." Ex. 1013, 11:66-12:9. Gerszberg teaches using a Digital Subscriber Line (DSL) modem, such as an ADSL modem, to transmit and receive modulated data. Ex. 1013, 11:66-12:7. And, similar to Shively and Stopler, the modem uses "discrete multi-tone (DMT) modulation" to transmit the data in both directions. Ex. 1013, 12:7-9.

75. Gerszberg teaches that various data services may be provided to subscriber premises by a DSL modem that uses discrete multi-tone (DMT) modulation. Ex. 1013, 7:40-60, 8:16-36, 10:63-11:3. For example, Gerszberg describes how these technologies can provide features to subscribers such as high-speed internet access, video transmission, and other services. *Id.* Additionally, Gerszberg explains that a DSL modem can be used in various DSL communications, such as HDSL, ADSL, SDSL, and VDSL. Ex. 1013, 9:66-10:3.

76. Thus, Gerszberg generally describes additional details about the various data services that may be provided using multicarrier communication technologies referenced in Shively and Stopler.

B. Reasons to Combine Shively and Stopler with Gerszberg

77. A POSITA would have combined Gerszberg with Shively and Stopler because Shively explicitly informs a POSITA to combine the teachings of Gerszberg into the Shively disclosure, and incorporates Gerszberg by reference. Ex. 1011, 18:7-9; Ex. 1013, 16:52-53. Thus, Shively and Gerszberg are expressly combined, and it would have been obvious to combine Shively and Gerszberg with Stopler for the same reasons as discussed above with regard to Shively in view of Stopler.

78. In addition, it is my opinion that a POSITA would have found it obvious to combine the teachings of Gerszberg with the teachings of Shively and

Stopler because the combination is merely the use of a known technique to improve a similar device, method or product in the same way.

79. Shively and Stopler describe transmitting data using DSL and multitone communication technologies. Ex. 1011, 1:5-8; Ex. 1012, 1:50-61; 12:55-57, 9:37-41, 12:21-24. A POSITA would have recognized that DSL was intended to provide data services such as high-speed internet and video to telephone subscribers. For example, a 1996 article on DSL technology by Kim Maxwell[1] illustrates in FIG. 1 below that "Service Systems" offered by DSL technologies include "Internet access," "Interactive video" and "Videoconference":

[1] Kim Maxwell, "Asymmetric Digital Subscriber Line: Interim Technology for the Next Forty Years," IEEE Communications Magazine (Oct. 1996) (Ex. 1015).

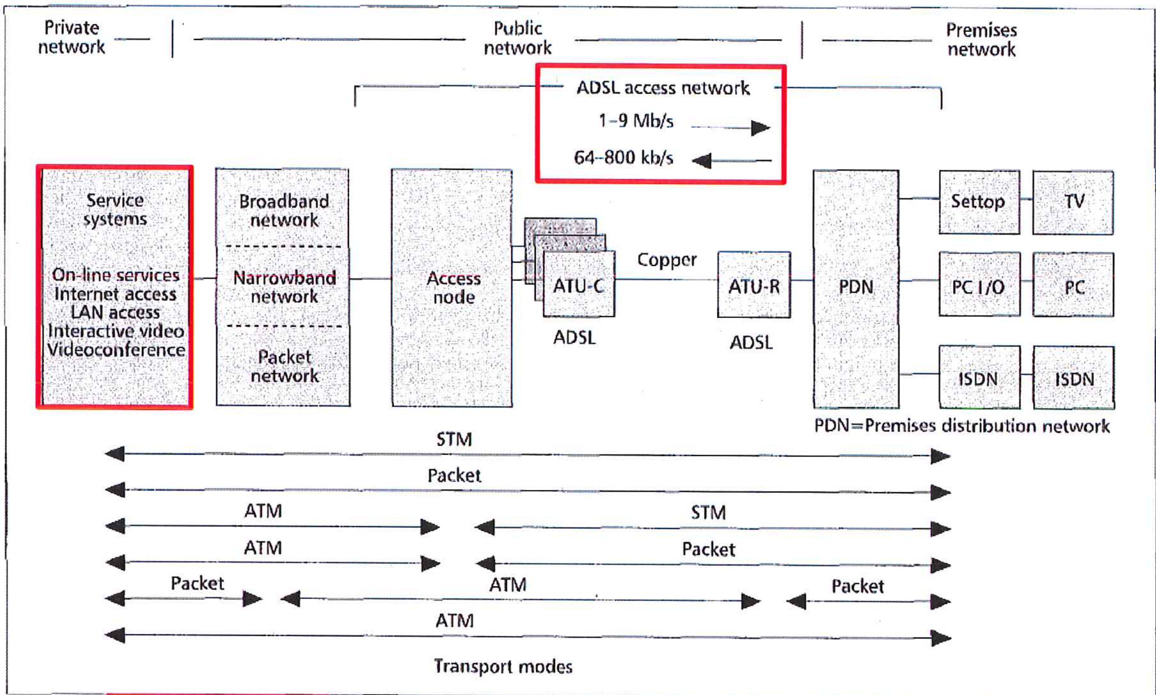


Figure 1 *ADSL network diagram.*

Ex. 1015, FIG. 1 (Annotated).

80. Maxwell explains that by 1996 (and prior to the '158 patent's earliest claimed priority date of November 9, 1999), consumer demand for sophisticated residential communications services was rising. Ex. 1015, p. 100. In particular, Maxwell describes that consumers sought improved broadband access to the Internet, and that telephone companies also sought to expand beyond basic telephone service with videoconferencing and television services. Ex. 1015, FIG. 1, p. 100, 102, 104. Market forces would have motivated a POSITA to use the data transmission techniques described by Shively and Stopler to provide high-speed

Internet access and video services in order to meet demands of consumers for such services.

81. Gerszberg acknowledges that "there is a need to offer new and innovative services that distinguish common carriers from their competitors." Ex. 1013, 1:12-15. Gerszberg addresses this need by integrating services such as high-speed internet, video, and various other services. Ex. 1013, 7:44-60, 8:16-36, 9:66-10:3, 10:63-11:3. Gerszberg teaches that these services are provided by different types of DSL (including VDSL) and multitone communication technologies, which are the same technologies referenced by Shively and Stopler. *Id.* A POSITA would therefore have recognized that Gerszberg is complementary to Shively and Stopler because Gerszberg teaches using the technologies referenced by Shively and Stopler to provide services that are desired by consumers.

82. In combination, this known technique for providing Internet and video services using different DSL technologies, such as VDSL, as disclosed by Gerszberg, would be applied to the combination of Shively and Stopler to provide the advantage of addressing the market need for such services. Ex. 1013, 7:44-60, 8:16-36, 10:63-11:3. A POSITA would have understood that combining these teachings of Gerszberg with the teachings of Shively and Stopler would allow Shively and Stopler's communication systems to be improved in the same way that

Gerszberg's communication system is improved. This result would have been predictable to one of ordinary skill in the art.

83. Thus, it would have been obvious to combine Gerszberg with Shively and Stopler as the combination is merely the use of a known technique to improve a similar device, method and product in the same way.

C. Detailed Analysis

84. The following claim chart describes how Shively in view of Stopler and further in view of Gerszberg renders obvious each and every element of at least claims 5, 14, 19, and 28-30 of the '158 patent.

U.S. Patent No. 9,014,158	Shively and Stopler in view of Gerszberg
Claim 3	
[3.0] The method of claim 1, wherein one or more of the first transceiver and second transceiver are VDSL transceivers.	The combination of Shively, Stopler, and Gerszberg render this limitation obvious. As discussed above in portion [1.1], Shively teaches a transmitting modem and a receiving modem, which correspond to the claimed "first transceiver" and "second transceiver." Stopler teaches transmitting data using DSL techniques standardized by the American National Standards Institute (ANSI) in the "ADSL (Asymmetric Digital Subscriber Line) specification." Ex. 1012, 9:62-10:3. Shively also refers to "ANSI Standard T1.413-1995" (Ex. 1011, 2:14), which defines the "Asymmetric Digital Subscriber Line (ADSL) Metallic Interface." Ex. 1011, Title.

	Thus, both Shively and Stopler contemplate transmitting data using ADSL techniques. Gerszberg teaches various DSL technologies that use a DSL modem: ***The DSL modem may be constructed using any of the techniques described in the applications incorporated by reference below.*** Within the scope of the current document, the term XDSL will be used to represent any member of the DSL family. This family comprises, High Speed Digital Subscriber Line (HDSL), Asymmetric Digital Subscriber Line (ADSL), Symmetrical Digital Subscriber Line (SDSL) and ***Very high data rate Digital Subscriber Line (VDSL).*** Ex. 1013, 9:62-10:3. It would have been obvious to a POSITA to replace Shively's ADSL modems with VDSL modems taught in Gerszberg. In fact, a POSITA would have been motivated to make such a substitution, for example, to achieve higher bandwidth. **Thus,** the art renders obvious "wherein one or more of the first transceiver and second transceiver are VDSL transceivers."
Claim 5	
[5.0] The method of claim 1, wherein the first and second transceivers are used for high speed internet access.	Shively, Stopler, and Gerszberg together render this limitation obvious. Gerszberg teaches communication technology that provides high speed internet access: ***When applied to telecommunications access, these advances enable*** a revolutionary change in service delivery, that makes the telephone companies network a

	much more valuable asset than ever before. Coupled with the introduction of low-cost premises devices (e.g., browser based touch-screen phones), the technology enables … ***High-speed access to the Internet*** even without a PC[.] Ex. 1013, 7:44-60. For high end residential consumers who want more convenience and simplicity in their daily lives and convenient access to more information devices coupled to the ISD provide, for example: easier delivery of a wider range of telephony services (e.g., customer care, marketing, operator services) with cost savings due to automation; new service opportunities such as interactive electronic catalog shopping from the home, and advertising; ***ability to offer ultra fast Internet access*** to every household[.] Ex. 1013, 8:16-24. A POSITA would have recognized from the teachings of Gerszberg that the multicarrier communication technology of Shively and Stopler can be used to offer high-speed internet access. **Thus**, it would have been obvious to a POSITA to employ the transceivers of Shively and Stopler to offer "high-speed internet access" as claimed.
Claim 14	
[14.0] The method of claim 1, wherein the first and the second transceivers include digital signal processors.	Shively, Stopler, and Gerszberg together render this limitation obvious. As analyzed above in portion [1.1], Shively teaches transmitting and receiving modems that are the "first and second transceivers." Gerszberg teaches that DSL modems, which are transceivers, may be implemented using digital signal processors (DSPs):

	The DSL modems shown as 114 may be implemented using a Tethered Virtual Radio Channel (TVRC) modem as discussed in the applications incorporated herein by reference. The TVRC (Tethered Virtual Radio Channel) engine may be implemented using a simultaneous voice-data modem which may be a full-duplex Variable Rate—Adaptive Digital Subscriber Line (VR-ADSL) modem. The modem may transmit and receive the modulated voice+data bit stream via the twisted pair. The modem uses discrete multi-tone (DMT) modulation to achieve at least 1.5 Mbps data rate in both directions. Some of the TVRC engine functions include forward error control (Reed Solomon), channel coding (Turbo or Wei Convolution), TVRC spreading, echo cancellation and analog transmit/receive line interfacing. ***The TVRC modem may be implemented using one or more programmable DSPs*** which may be utilized to provide the modem transmit FFT and/or receive IFFT engine. However, the embodiments of aspects of the instant invention are not limited to the use of TVRC modulation technology. However, TVRC may be desirable as an alternate to interleaving in order to overcome impairments such as noise and interference and which results in unacceptable delays. Ex. 1013, 11:66-12:21. A POSITA would have recognized from the teachings of Gerszberg that modems, which are transceivers, can include one or more digital signal processors, or DSPs.

	Thus, it would have been obvious to a POSITA that the transceivers of Shively and Stopler could include "digital signal processors" to process the data.
Claim 17	
[17.0] The system of claim 15, wherein one or more of the first transceiver and second transceiver are VDSL transceivers.	Shively, Stopler, and Gerszberg render obvious this limitation as described in [3.0].
Claim 19	
[19.0] The system of claim 15, wherein the first and second transceivers are used for high speed internet access.	Shively, Stopler, and Gerszberg render obvious this limitation as described in [5.0].
Claim 28	
[28.0] The method of claim 15, wherein the first and second transceivers each include digital signal processors.	Shively, Stopler, and Gerszberg render obvious this limitation as described in [14.0].
Claim 29	
[29.0] The method of claim 1, wherein the video is video-on demand.	The meaning of this claim is unclear, as there is no "video" reference in claim 1, and therefore it is unclear what "the video" in claim 29 refers to. To the extent the claim can be understood, however, the combination of Shively, Stopler, and Gerszberg render this limitation obvious because Gerszberg teaches communication technology that is operable to transport video. Gerszberg teaches communications technology that is operable to transport video:

	Similarly, the processor 102 in the ISD 22 may include a subscriber signaling subsystem as part of an external routing subsystem. In this manner, packets received from the FMP in the network-CPE direction (including voice, data, ***video***, and control packets) may be demultiplexed, reformatted with an appropriate protocol, and output to an attached peripheral device connected to the premise distribution network 500. Ex. 1013, 10:63-11:3. Gerszberg also teaches that the video can be video on-demand. In still further embodiments, the ISD 22 may be compatible with multicast broadcast services where ***multicast information is broadcast by a central location and/or other server on one of the networks*** connected to the FMP 32, e.g., an ATM-switched network. The ISD 22 may download the multicast information via the FMP 32 to any of the devices connected to the ISD 22. The ISD 22 and/or CPE 10 devices may selectively filter the information in accordance with a specific customer user's preferences. For example, one user may select all country music broadcasts on a particular day while another user may select financial information. The ISD 22 and/or any of the CPE 10 devices may also be programmed to store information representing users' preferences and/or the received uni-cast or multicast information in memory or other storage media for later replay. Thus, for example, ***video clips or movies may be multicast to all customers in the community with***

	certain users being preconfigured to select the desired video clip/movie in real time for immediate viewing and/or into storage for later viewing. Ex. 1013, 5:34-52. A POSITA would have recognized from the teachings of Gerszberg that the delivery of video data in real time for immediate viewing would enable services such as "video on-demand." **Thus**, it would have been obvious to a POSITA to employ the transceivers of Shively and Stopler to provide the types of video services described in Gerszberg, including where "the video is video-on demand."
Claim 30	
[30.0] The method of claim 15, wherein the video is video-on demand.	The meaning of this claim is unclear, as there is no "video" reference in claim 15, and therefore it is unclear what "the video" in claim 30 refers to. To the extent the claim can be understood, however, Shively, Stopler, and Gerszberg renders obvious this limitation for the reasons described for portion [29.0].

IX. CHALLENGE #3: CLAIMS 6, 9, 10, 12, 20, 23, 24, AND 26 ARE UNPATENTABLE OVER SHIVELY, STOPLER, AND BREMER

85. It is my opinion that the Shively, Stopler, and Bremer references would have rendered obvious to a POSITA the subject matter of claims 6, 9, 10, 12, 20, 23, 24, and 26 of the '158 patent.

A. Overview of Bremer

86. Bremer is U.S. Patent No. 4,924,516 (Ex. 1017). Bremer, like Shively and Stopler is a patent in the field of data communications. Ex. 1017, 1:7-12. Bremer relates to encoding and decoding techniques for a data signal that is transmitted over a communications channel. Ex. 1017, 1:41-67. In particular, Bremer uses a pseudo-random generator to encode the gain or phase of a signal prior to the transmission. Ex. 1017, 1:53-60. On the receiver side of the communication channel, Bremer uses a second pseudo-random generator to decode the encoded data signal. Ex. 1017, 1:60-64.

87. Like Stopler, Bremer describes that the above techniques can be applied to carrier signals carrying QAM symbols. For example, Bremer describes "pseudorandomly select[ing] a QAM signal space for each data symbol from a limited set of signal spaces" before the signals are transmitted over the communication channel. Ex. 1017, 1:65-67. Thus, Bremer generally describes techniques for encoding and decoding data in a communication system, such as those described in Shively and Stopler.

B. Reasons to Combine Shively and Stopler with Bremer

88. Stopler states that a general goal of a data communication system is to reliably communicate data from one location to another: "Ideally, the data which is being transmitted from the transmitting location should be identical to the data

which is being received at the receiving location." Ex. 1012, 1:18-21. Market forces would have motivated a POSITA creating a transmitter in accordance with Stopler's teachings to also create a suitable receiver, since there would be little use for a transmitter that transmits data that cannot be received.

89. In describing his invention, Stopler primarily focuses on describing a transmitter in a communication system. Stopler describes the details of a receiver only occasionally. For example, Stopler notes that where a transmitter includes a "simple interleaver," the corresponding receiver will include a "de-interleaver." Ex. 1012, 4:62-65. Shively is similar, describing the pairing of a transmitter and a receiver in examples such as "spreading a single block over each of four carriers to transmit, and then despreading at the receiver." Ex. 1011, 4:41-43; *see also id.* 5:15-21 ("the transmitter and receiver must also share the orthogonal codes"). A POSITA would have recognized that these are examples of a general principal that a transmitter and a receiver operate as a matched pair, and thus that the techniques that a transmitter uses to encode data for transmission are paralleled by the techniques used by a receiver to decode the data.

90. Bremer explicitly states this general principle. Like Shively and Stopler, Bremer is also in the field of data communications and more specifically, the transmission of data using quadrature amplitude modulation (QAM). Ex. 1012, 1:7-8; Ex. 1011, 1:22-25; Ex. 1017, 1:6-12. Like Stopler, Bremer employs a

pseudo-random number generator whose output is used by a QAM signal point mapper to modify the phase of the signal output. Ex. 1017, Abstract; Ex. 1012, 12:20-31. Bremer further teaches that the "receiver at the other end of the communications channel must, of course, be equipped to perform changes on the received signal which are complementary" to those in the transmitter. Ex. 1017, 1:60-63. In other words, the receiver must be able to reverse the phase modification applied by the transmitter. This is because receiving the phase-manipulated data is "difficult or impossible unless the identical, synchronized, complementary changes are provided in the receiver." Ex. 1017, 1:34-36.

91. It would have been obvious to a POSITA to combine the teachings of Bremer with those of Shively and Stopler, because Bremer explains the necessary relationship between a transmitter and a receiver. Bremer's high-level guidelines on how to match the design of a receiver to the design of a transmitter would have been useful to the POSITA in designing a receiver to work with Stopler's transmitter. By applying Bremer's teaching that a receiver must be equipped to reverse the phase modifications of a transmitter, a POSITA would have been able to design a receiver to match with Stopler's transmitter. A POSITA would have recognized that adding a receiver matched to Stopler's transmitter would benefit Stopler's system by providing a mechanism to receive and decode the transmitted information. Market forces would have prompted and rewarded the addition of a

suitable receiver to match Stopler's transmitter, since both devices are needed to reliably transmit data from one location and receive that data at another location.

92. Thus, the combination of Shively, Stopler,and Bremer would have been obvious to a POSITA because it is merely the application of a known technique (designing a receiver to compliment a transmitter) to a similar system in the same way. Alternatively, the combination is merely the application of a known technique to a known system ready for improvement and yielding predictable results.

C. Detailed Analysis

93. The following claim chart describes how Shively in view of Stopler and further in view of Bremer renders obvious each and every element of at least claims 6, 7, 9, 10, 12, 20, 23, 24, and 26 of the '158 patent.

U.S. Patent No. 9,014,158	**Claims 6, 7, 9, 10, 12, 20, 23, 24, and 26 are unpatentable over Shively in view of Stopler, and further in view of Bremer**
Claim 6	
[6.0] The method of claim 1, further comprising, independently deriving the values associated with each carrier using a second pseudo-random number generator in the second transceiver.	As described in [1.1], Shively and Stopler teach a first transceiver in communication with a second transceiver. As described in [1.5] and [1.6], the first transceiver includes a phase scrambler in its transmitter that causes a phase shift in each carrier based on values from a pseudo-random number generator. **First**, since Stopler encodes the transmitted data onto carrier phases, and since Stopler also applies pseudo-random phase shifts to the carrier phases, it would have been obvious to a POSTIA that a device for receiving

and decoding the transmitted signal would have to "compensate" for the pseudo-random phase shifts prior to, or during, the decoding of the signal.

Bremer teaches that when a transmitting device—such as the "first transceiver"—includes components causing a pseudo-random phase modification (or shift) of the transmitted signal, a receiving device requires complementary components to decode the signal:

> The ***modem transmitter circuit includes*** a data scrambler, and QAM signal point mapper, connected in series, ***as well as a pair of mixers having inputs from the pseudorandom signal generator and functioning to modify the gain and phase of portions of the QAM signal point mapper output signal*** before they are pulse amplitude modulated, filtered, converted to analog form, and transmitted over the communications channel. ***Complementary circuit elements in the receiver, which have been synchronized with those of the transmitter by baud rate counters at both locations, demodulate and decode the received encrypted signal.***

Ex. 1017, Abstract.

The pseudorandom signal generator in Bremer "generates [a] pseudorandom number," and is the pseudo-random number generator. Ex. 1017, 2:32.

Bremer further explains that the complementary circuit elements in remote receiver includes a complementary pseudo-random number generator:

> At the end of the transmit training sequence, the generator 8 and associated baud counter are started. ***The remote receiver*** of the

	system, upon detecting the end of receiver training, ***starts its complementary pseudorandom generator*** and baud counter. Thus, both ***the transmitter and the* [remote] *receiver then have identical pseudorandom generating signals*** and baud counts available. Loss of synchronization and/or baud count will cause a loss of receiver demodulation and institute a round robin retraining sequence which will reestablish synchronization. Ex. 1017 4:30-40. A complimentary pseudo-random number generator at a remote receiver (within a remote transceiver) in Bremer constitutes "a second pseudo-random number generator in the second transceiver," as recited in the claim. Bremer explains that this second pseudo-random number generator is necessary for the remote receiver to receive the data transmitted: It is an object of the invention to provide pseudorandom time varying changes to some of the several fixed transmit functions of a typical modem so as to manipulate the data prior to analog transmission and to make ***data reception difficult or impossible unless*** the identical, synchronized, ***complementary changes are provided in the receiver***. Ex. 1017, 1:29-36. It would have been obvious to a POSITA, therefore, that the second transceiver of Shively/Stopler (which receives data from the first transceiver) should include a second pseudo-random number generator, as taught by Bremer. **Second,** it would have been obvious to a POSITA that the second pseudo-random number generator

	independently derives values associated with each carrier. As described in [1.5], Stopler teaches a pseudo-random number generator that, independently of the data being transmitted, produces a "2a+b" value. Further "… the sum (2a+b) is used to select the amount of rotation to be applied to the symbol…." Ex. 1012 12:28-45. Since Stopler's transmitter uses discrete multi-tone (DMT) modulation, each symbol is already associated with the carrier on which it will be transmitted. Accordingly, associating the value 2a+b with a symbol also associates the value 2a+b with the carrier on which the symbol is to be transmitted. Since Bremer teaches that a remote receiver performs changes complementary to those in the transmitter, it would have been obvious to a POSITA that a receiver of the second transceiver in Stopler's system would produce (using the second pseudo-random number generator) the same 2a+b value. Producing the same 2a+b value allows the receiving transceiver to compensate for the carrier signal phase shift produced by Stopler's phase scrambler. It would have also been obvious to a POSITA that the second pseudo-random number generator derives its values independently of the first pseudo-random number generator. Bremer teaches, for example, that the pattern of values produced by the pseudo-random number generators are determined by a seed value: > The pseudorandom pattern generator 8 disclosed in FIG. 1 is implemented for the purpose of time varying certain modulation and demodulation parameters. The ***characteristics of the pseudorandom pattern generator 8 are determined by a T-bits word ("SEED")*** which is programmed into a random access memory (RAM) in generator 8. Ex. 1017, 4:7-13.

	More generally, a POSITA would have known that a pseudo-random number generator produces a deterministic sequence of values based on a seed value. Once the seed value is input to the pseudo-random number generator, it will generate a seemingly random sequence of values. However, if the pseudo-random number generator is re-initialized with the same seed value, it will re-generate the same sequence of values. In other words, the sequence of values depends only on the seed value (and, of course, the particular algorithm used within the pseudo-random number generator.) Thus, if two pseudo-random number generators employing the same algorithm are initialized with the same seed value, both pseudo-random number generators will produce identical sequences of values. Bremer references this concept, noting that after initialization, the pseudo-random number generators in the transmitter (of the first transceiver) and the receiver (of the second transceiver) will produce identical signals: At the end of the transmit training sequence, the generator 8 and associated baud counter are started. The remote receiver of the system, upon detecting the end of receiver training, starts its complementary pseudorandom generator and baud counter. Thus, both the ***transmitter and the receiver then have identical pseudorandom generating signals*** and baud counts available. Loss of synchronization and/or baud count will cause a loss of receiver demodulation and institute a round robin retraining sequence which will reestablish synchronization. Ex. 1017, 4:30-36. Because the pseudo-random number generators in both

	the transmitter and receiver produce identical values based on a shared seed value, it would have been obvious to a POSITA that Bremer's pseudo-random number generator in the remote receiver operates independently of the pseudo-random number generator in the transmitter, and independently of any data transmitted or received. Although Bremer describes a single-carrier QAM communication system, it would have been obvious to a POSITA that Bremer's teaching of a complementary pseudo-random number generator, and performing complementary changes on the received signal, could be applied on a carrier-by-carrier basis to the multicarrier system of Stopler. Because Stopler's multicarrier transmitter determines (as analyzed above in portions [1.5] and [1.6]) a phase shift for each carrier signal based on a value determined by a pseudo-random number generator, it would have been obvious to a person that a complimentary multicarrier receiver would include a second pseudo-random number generator whose output values determine a complementary phase shift for each carrier signal received by the remote receiver. Thus, the prior art renders obvious "independently deriving the values associated with each carrier using a second pseudo-random number generator in the second transceiver" as claimed.
Claim 9	
[9.0] The method of claim 6, wherein the first and second transceivers are cable transceivers.	This limitation is the same as the language of portion [2.0]. Shively, Stopler, and Bremer render this limitation obvious as described in [2.0] and [6.0].
Claim 10	
[10.0] The method of claim 6, wherein the first and second transceivers are DSL	This limitation is substantially similar to the language of portion [4.0]. This portion [10.0] differs only in that it does not recite that the DSL transceivers are "<u>multicarrier</u> DSL transceivers." Because claim 1 (from

transceivers	which this claim 10 depends) recites a "transmission signal having a plurality of carrier signals," I do not believe that this minor difference in language affects the mapping of the prior art onto the claim language. **Thus**, Shively, Stopler, and Bremer render this limitation obvious for the reasons described in [4.0] and [6.0].
[10.1] connected using a pair of twisted wires of a telephone subscriber system.	Shively renders this limitation obvious. As described above, Shively describes modems that are the first and second transceivers. Shively further teaches that the modems that are connected using one or more twisted wire pairs: [Fig. 2] ...shows ***modems in communication over one or more twisted wire pairs*** for purposes of describing an embodiment of the invention. Ex. 1011, 9:42:44. Shively also teaches that the modems are implemented in a telephone subscriber system: The second procedure begins at step S2. An index is set to 1 and a number of bins for spreading (the number of channels over which each block will be spread). This can be done as part of an optimization procedure or selected a priori. To limit the administrative and communication overhead associated with initialization and bit assignment (as well as the computational complexity to explore combinatorics of a large number of options), there is strong motivation to limit the number of grouping options to a single option. That is, either bits are assigned to individual bands as in the prior art, or where spreading is applied, a single sized m-tuple of frequency bands is allowed. (Choosing a larger value of m

	consumes frequency bandwidth more rapidly, choosing a smaller value limits the SNR deficit that can be overcome.) Empirical studies of actual ***telephone loop propagation characteristics*** indicates the payoff is greatest for making the number of bins, m, equal to 4 under this set of conditions." Ex. 1011, 13:35-52. Because the system has telephone loop propagation characteristics, it would have been obvious to a POSITA that the system could be a telephone subscriber system. **Thus,** Shively teaches DSL transceivers that are connected using a pair of twisted wires of a telephone subscriber system.
Claim 12	
[12.0] The method of claim 6, wherein the first and second transceivers are multicarrier DSL transceivers.	This limitation is the same as the language of portion [4.0]. Shively, Stopler, and Bremer render this limitation obvious as described in [4.0] and [6.0].
Claim 20	
[20.0] The system of claim 15, wherein the first transceiver independently derives the values associated with each carrier using a second pseudo-random number generator in the first transceiver.	The additional features recited in claim 20 are similar to those in claim 6, however in claim 20 the second pseudo-random number generator is located in the *first* (transmitting) transceiver. Thus, claim 20 requires two pseudo-random number generators in the first transceiver. This differs from claim 6, where the second pseudo-random number generator is located in the *second* (receiving) transceiver. Claims 20 and 6 also differ in that claim 6 recites "deriving" and claim 20 recites "derives," but this difference does not meaningfully impact my analysis of the prior art. As described above in the interpretation of the word

	"transceiver," a transceiver includes a transmitter and a receiver. And as described in [6.0], Shively, Stopler, and Bremer teach a second pseudo-random number generator in the receiver portion of the second transceiver. It would have been obvious to a POSITA, however, that the receiver portion of the *first* transceiver should also include a pseudo-random number generator to facilitate the reception of data transmitted from the second transceiver to the first transceiver (in other words, data flowing the reverse direction.) A POSITA would have recognized the benefits of enabling bi-directional data communications, and indeed, Stopler describes how "to transmit and/or receive data between" two transceivers. Ex. 1012, 1:15. As analyzed above in portion [6.0], Shively, Stopler, and Bremer render obvious that a transceiver "independently derives the values associated with each carrier" using a pseudo-random number generator. **Thus,** Shively, Stopler, and Bremer teach independently deriving the values associated with each carrier using a second pseudo-random number generator in the first transceiver.
Claim 23	
[23.0] The system of claim 20, wherein the first and second transceivers are cable transceivers.	This claim is unclear, because it refers to "the first and second transceivers" of claim 20, but claim 20 does not recite a second transceiver. The "cable transceivers" language of claim 23 is the same as the language of portion [2.0]. **Thus**, to the extent that claim 23 can be understood, Shively, Stopler, and Bremer render this limitation obvious for the reasons described in [2.0] and [20.0].
Claim 24	
[24.0] The system of	This claim is unclear, because it refers to "the first and

claim 20, wherein the first and second transceivers are DSL transceivers	second transceivers" of claim 20, but claim 20 does not recite a second transceiver. The "DSL transceivers" language of claim 24 is the same as the language of portion [4.0]. To the extent that claim 23 can be understood, Shively, Stopler, and Bremer render this limitation obvious for the reasons described in [4.0] and [20.0].
[24.1] connected using a pair of twisted wires of a telephone subscriber system.	This limitation is the same as that recited in portion [10.1]. Shively, Stopler, and Bremer render this limitation obvious for the reasons described in [10.1], and [20.0].
Claim 26	
[26.0] The system of claim 20, wherein the first and second transceivers are multicarrier DSL transceivers.	This claim is unclear, because it refers to "the first and second transceivers" of claim 20, but claim 20 does not recite a second transceiver. The "DSL transceivers" language of claim 26 is the same as the language of portion [4.0]. To the extent that claim 23 can be understood, Shively, Stopler, and Bremer render this limitation obvious for the reasons described in [4.0] and [20.0].

X. CHALLENGE #4: CLAIMS 8, 11, 13, 22, 25 AND 27 ARE UNPATENTABLE OVER SHIVELY, STOPLER, BREMER, AND GERSZBERG

94. It is my opinion that the Shively, Stopler, Bremer, and Gerszberg references would have rendered obvious to a POSITA the subject matter of claims 8, 11, 13, 22, 25 and 27 of the '158 patent.

A. Reasons to Combine Shively, Stopler, and Bremer with Gerszberg

95. It would have been obvious to combine the teachings of Gerszberg with Shively, Stopler, and Bremer. As I explained above regarding Challenge #2, it would have been obvious to a POSITA to combine the teachings of Shively and Stopler with those of Gerszberg, including by using the multicarrier communication technology of Shively and Stopler to provide internet and video services as described in Gerszberg. And as I explained above in Challenge #3, it would have been obvious to a POSITA to combine the teachings of Shively and Stopler with those of Bremer, including by employing a second pseudo-random number generator in a receiving transceiver.

96. For the same reasons given above in Challenges #2 and #3, it would have been obvious to a POSITA to combine the teachings of all four references, Shively, Stopler, Gerszberg and Bremer.

B. Detailed Analysis

97. The following claim chart describes how Shively in view of Stopler, further in view of Bremer, and further in view of Gerszberg renders obvious each and every element of at least claims 8, 11, 13, 22, 25, and 27 of the '158 patent.

U.S. Patent No. 9,014,158	Shively, Stopler, and Bremer in view of Gerszberg
Claim 8	
[8.0] The method of claim 6, wherein the	Gerszberg renders this limitation obvious.

first and second transceivers are wireless transceivers.	Gerszberg teaches wireless connectivity: An ***intelligent services director (ISD) 22 may be coupled to a central office 34 via*** a twisted-pair wire, hybrid fiber interconnection, ***wireless and/or other customer connection 30***, a connector block 26, and/or a main distribution frame (MDF) 28. The ISD 22 and the central or local office 34 may communicate with each other using, for example, framed, time division, frequency-division, synchronous, asynchronous and/or spread spectrum formats, but in ***exemplary embodiments uses DSL modem technology***. Ex. 1013, 2:67-3:9. **Accordingly,** a POSITA would understand that ISD 22 using a wireless technology to communicate with a central office is a wireless transceiver. **Thus,** Gerszberg's ISD 22 communicating wirelessly with a central office in combination with Shively, Stopler,and Bremer renders obvious "the first and second transceivers are wireless transceivers."
Claim 11	
[11.0] The method of claim 10, wherein the first and second transceivers are VDSL transceivers.	This limitation is the same as that recited in portion [3.0]. Shively, Stopler, Bremer, and Gerszberg render this limitation obvious for the reasons described in [3.0], and [10.0].
Claim 13	
[13.0] The method of claim 6, wherein the first and second transceivers are also used for transport high speed internet access.	This limitation is the same as that recited in portion [5.0]. Shively, Stopler, Bremer, and Gerszberg render this limitation obvious for the reasons described in [5.0], and [6.0].

Claim 22	
[22.0] The system of claim 20, wherein the first and second transceivers are wireless transceivers.	This claim is unclear, because it refers to "the first and second transceivers" of claim 20, but claim 20 does not recite a second transceiver. The "wireless transceivers" language of claim 23 is the same as the language of portion [8.0]. **Thus**, to the extent that claim 22 can be understood, Shively, Stopler, Bremer, and Gerszberg render this limitation obvious for the reasons described in [8.0] and [20.0].
Claim 25	
[25.0] The system of claim 24, wherein the first and second transceivers are VDSL transceivers.	This claim is unclear, because it refers to "the first and second transceivers" of claim 20, but claim 20 does not recite a second transceiver. The "VDSL transceivers" language of claim 24 is the same as the language of portion [3.0]. **Thus**, to the extent that claim 22 can be understood, Shively, Stopler, Bremer, and Gerszberg render this limitation obvious for the reasons described in [3.0] and [24.0].
Claim 27	
[27.0] The system of claim 20, wherein the first and second transceivers are also used for high speed internet access.	This claim is unclear, because it refers to "the first and second transceivers" of claim 20, but claim 20 does not recite a second transceiver. The "high speed internet access" language of claim 27 is the same as the language of portion [5.0]. **Thus**, to the extent that claim 27 can be understood, Shively, Stopler, Bremer, and Gerszberg render this limitation obvious for the reasons described in [5.0] and [20.0].

XI. CHALLENGE #5: CLAIMS 7 AND 21 ARE UNPATENTABLE OVER SHIVELY, STOPLER, BREMER, AND FLAMMER

98. It is my opinion that the Shively, Stopler, Bremer, and Flammer references would have rendered obvious to a POSITA the subject matter of claims 7 and 21 of the '158 patent.

A. Overview of Flammer

99. Flammer is U.S. Patent No. 5,515,369 (Ex. 1019). Flammer, like Shively, Stopler, and Bremer, is a patent in the field of data communications. Ex. 1019, 1:7-8. Flammer relates to data transmission between a source node and a target node, where each node has a transmitter and a receiver. Ex. 1019, Abstract.

100. Like Stopler, Flammer employs pseudo-random number generators in its data communication system. And like Bremer, Flammer teaches the synchronization between the pseudo-random number generators at different ends of the communication channel. Ex. 1019, 3:49-4:10. As part of the synchronization, Flammer teaches transmitting an acquisition/synchronization packet that includes a seed value from the source node to the target node. Ex. 1019, 3:52-58. Once the pseudo-random number generators at both the source node and the target node have the same seed value, they can generate identical pseudo-random number sequences used to select frequency bands. Ex. 1019, 4:42-53.

Thus, Flammer generally describes communication technology that uses pseudo-random number generators, such as the ones taught in Stopler and Bremer.

B. Reasons to Combine Shively, Stopler, and Bremer with Flammer

101. As already discussed above regarding Challenge #3, it would have been obvious to a POSITA to combine the teachings of Shively and Stopler with Bremer. For example, a POSITA would have recognized that since Stopler teaches a pseudo-random number generator that is used to scramble the phases of carrier signals, a receiver for Stopler's system would require a complementary pseudo-random number generator, as explained in detail by Bremer. A POSITA would have further recognized the need to synchronize the two pseudo-random number generators in order for the pseudo-random number generators could properly modulate and demodulate data.

102. Flammer, like Stopler, Shively, and Bremer, also pertains to a field of data communications and facilitates data communication between nodes that "are equipped with transmitters and receivers." Ex. 1019, 1:15-18. Also, like Stopler and Bremer, Flammer employs pseudo-random number generators. Ex. 1019, 3:4. Flammer additionally teaches techniques that synchronize the pseudo-random number generators in a transmitter and a receiver. In one instance, Flammer synchronizes the pseudo-random number generators of a source node that includes a local transmitter and a target node that includes a remote receiver. Ex. 1019,

Abstract. Specifically, Flammer transmits a SEED word from a transmitter to a remote receiver over a communication channel. Ex. 1019, Abstract.

103. Flammer explains that a pseudo-random number generator produces a sequence of numbers that appear to be random, but which are in fact deterministic. Ex. 1019, 4:38-40. The sequence produced by the pseudo-random number generator is determined by the initial "seed" value used to initialize the pseudo-random number generator. Ex. 1019, 4:40-41. "[W]henever an identical seed value is used, the random number generator will produce an identical pseudo-random sequence." Ex. 1019, 4:42-44.

104. To synchronize the pseudo-random number generators of the transmitter at source node and the receiver of the target node, Flammer transmits an acquisition/synchronization packet which includes a seed value from a source node to a target node. Ex. 1019, 3:52-4:9. The transmitted seed value is used to initialize the pseudo-random number generators executing at the respective source and target nodes. Ex. 1019, 3:52-4:9.

105. It would have been obvious to a POSITA to combine the teachings in Flammer with those of Shively, Stopler, and Bremer, to transmit the seed value to synchronize the transmitter of the first transceiver with the receiver of the second transceiver. A POSITA would have recognized that synchronized complimentary pseudo-random generators are necessary in the communication system of Shively,

Stopler, and Bremer in order to modulate and demodulate phase scrambled data. As such, a POSITA would have used the teachings in Flammer to transmit the seed value from a first transceiver to the second transceiver to synchronize the pseudorandom number generators at the first and second transceiver and ensure that the data is properly demodulated. Accordingly, the combination of Shively, Stopler, Bremer, and Flammer would have been obvious to a POSITA, because it is merely an application of a known technique (transmitting a seed value over a network to seed a pseudo-random number generator at the remote receiver) in a similar system in the same way. Additionally, a POSITA would have realized that transmitting a seed value to synchronize a pseudo-random number generator is nothing more than combining prior at elements, according to known methods, to yield predictable results.

C. Detailed Analysis

106. The following claim chart describes how Shively in view of Stopler, in view of Bremer and further in view of Flammer renders obvious each and every element of claims 7 and 21 of the '158 patent.

Claim 7	
[7.0] The method of claim 6, further comprising using in the first and second transceivers a same seed for the first and	As analyzed above in portion [6.0], Shively, Stopler, and Bremer render obvious first and second pseudo-random number generators in the first and second transceivers, respectively. Flammer teaches that it was known for the pseudo-

second pseudo-random number generators	random number generators in a source and target nodes (transmitting and receiving communication devices, respectively) to use the same seed value. In Flammer, the communication devices are the source node and the target node: A network connection is established when a ***target node receives an acquisition/synchronization packet from a source node*** (Step S1). The acquisition/synchronization packet contains information about the node, including a seed value for randomly ordering a channel list and a frequency punch out mask for eliminating channels from the channel list. The ***responding target node*** then constructs a subset of the network channel list by eliminating from the list those frequencies in the punchout mask on which the source node cannot transmit or receive data (Step S2). The ***responding node then uses the seed value from the source node in the acquisition/synchronization packet as a seed value in a pseudo-random number generator*** and generates a channel hopping band plan for the source node by ordering the channels according to the sequence from the pseudo-random number generator (Step S3). Ex. 1019, 3:52-67. More generally, Flammer teaches that when a same seed value is used, two pseudo-random number generators will produce the same sequence of values: A pseudo-random number generator is a well known apparatus for generating a "pseudo-random" sequence of numbers. The random number generator is referred as "pseudo" because the method used to generate the sequence is actually deterministic. It

	typically depends on a seed value used to begin the pseudo-random number generator and ***whenever an identical seed value is used, the random number generator will produce an identical pseudo-random sequence***. In a network according to the invention, each node in the network includes a pseudo-random number generator of identical operation. The generators are designed to accept a seed value and a range value and generate a pseudo-random non-repeating sequence of integers in the given range. According to the invention, each node, therefore, can reproduce an arbitrary length pseudo-random non-repeating integer sequence given the seed value for that sequence and the desired range. Ex. 1019, 4:36-53. A source node and a target node in Flammer are first transceiver and the second transceiver because the source node and the target node include a transmitter and a receiver: ***In a wireless packet communication system having a plurality of nodes, each having a transmitter and a receiver***, the receiver at each node is assigned a seed value and is provided with a channel punchout mask. A node uses its seed value and punchout mask to generate a specific randomly ordered channel hopping band plan on which to receive signals. A node transmits its seed value and punchout mask to target nodes with which it wants to establish communication links, and those target nodes each use the seed value and punchout mask to generate the randomly ordered channel hopping band plan for that node.

	Subsequently, when one of the target nodes wish to transmit to the node, the target node changes frequency to the frequency of the node according to that node's band plan. Ex. 1019, Abstract. A POSITA would have understood that the source node that transmits the packet is the first transceiver and the target node that receives the packet is the second transceiver. As analyzed above in portion [6.0], it would have been obvious to a POSITA that a remote receiver used with Stopler's transmitter would include complementary components to the components of the transmitter, including a complementary pseudo-random number generator. Since Stopler's pseudo-random number generator is employed to scramble the phases of the transmitted multicarrier signal (as analyzed above in portion [1.6]), it would have been obvious to a POSITA that a complementary receiver would need to descramble the phases of the received multicarrier signal. In view of Bremer's teaching that the transmitter and the receiver must be complementary, it would have been obvious to a POSITA to incorporate the use of the same seed value at the remote receiver as taught in Flammer. The same seed value used by the complimentary pseudo-random number generator at a remote receiver would make the identical phase scrambling information available at the remote receiver. In this way, a remote receiver in Stopler's system could reverse the phase scrambling applied by the transmitter. **Thus**, Flammer renders obvious the first transceiver (the source node) and second transceiver (the target node) using "a same seed for the first and second pseudo-random number generators."

[7.1] and the value of the seed is transmitted from the first transceiver to the second transceiver.	Flammer renders obvious this limitation. Flammer teaches transmitting a value of a seed from a source node (e.g., "first transceiver") to a target node (e.g., "second transceiver"): A network connection is established when a ***target node receives an acquisition/synchronization packet*** from a source node (Step S1). The acquisition/synchronization ***packet contains information about the node, including a seed value*** for randomly ordering a channel list and a frequency punch out mask for eliminating channels from the channel list. The responding target node then constructs a subset of the network channel list by eliminating from the list those frequencies in the punchout mask on which the source node cannot transmit or receive data (Step S2). ***The responding node then uses the seed value from the source node in the acquisition/synchronization packet as a seed value in a pseudo-random number generator*** and generates a channel hopping band plan for the source node by ordering the channels according to the sequence from the pseudo-random number generator (Step S3). Once the target node has determined the frequency hopping band plan for the source node, it stores that information in its link list (Step S4). The responding node then switches to the source nodes channel according to the band plan and transmits an acknowledgement/ acquisition/ synchronization packet acknowledging to the source node that it has established a link and giving the source node its own seed value and

	punchout list so that the source node can determine the target node's band plan (Step S5). Ex. 1019, 3:52-4:9. Thus, Flammer renders obvious "the value of the seed is transmitted from the first transceiver to the second transceiver."
Claim 21	
[21.0] The system of claim 20, using in the first and second transceivers a same seed for the first and second pseudo-random number generators.	This claim is unclear, because it refers to "the first and second transceivers" of claim 20, but claim 20 does not recite a second transceiver. In addition, claim 20 recites that a second pseudo-random number generator is included in the first transceiver. Yet, claim 21 cites to the *second* transceiver using the same seed for the first and second pseudo-random number generators. To the extent that claim 21 can be understood, Bremer teaches the limitations of claim 21. As discussed in [6.0] and [7.0], Bremer teaches that the second pseudo-random number generator in the second transceiver uses the same seed as the first pseudo-random number generator in the first transceiver. And as further discussed in [20.0], it would have been obvious to a POSITA to also include a pseudo-random number generator in the receiver of the first transceiver to facilitate the reception of data transmitted in the reverse direction (from the second transceiver to the first transceiver). Bremer teaches that different keys are preferably—but not necessarily—used to protect data transmitted in each direction: Further enhancement of the security of the method of the present invention can be

	obtained by using two privacy keys, one for each direction of communication of the channel. Ex. 1017, 3:4-7. It would have been obvious to a POSITA that the privacy keys are closely related to the seed values used to initialize the pseudo-random number generators. Thus, it would have been obvious to a POSITA that either the same seed value or different seed values could be employ for each direction of communication between the first and second transceivers. When the same seed value is employed for both directions of communication, the same seed value would be employed by both pseudo-random number generators within each transceiver. Thus, Shively, Stopler, and Bremer render obvious this limitation for the reasons described in [6.0], [7.0] and [20.0].
[21.1] and the value of the seed is transmitted from the first transceiver to the second transceiver.	Shively, Stopler, and Bremer render obvious this limitation for the reasons described in [7.1].

XII. CONCLUSION

107. 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: May 8, 2016

Respectfully submitted,

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Dr. Jose Tellado