APPENDIX 3

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TCL INDUSTRIES HOLDINGS CO., HISENSE CO., LTD., and ZYXEL COMMUNICATIONS CORP.
Petitioners,

v.

PARKERVISION, INC.
Patent Owner

Case No. 2021 IPR-00985

DECLARATION OF MATTHEW B. SHOEMAKE, PH.D.

REGARDING U.S. PATENT NO. 7,292,835

I, Matthew B. Shoemake, Ph.D., do hereby declare and state, that all statements are made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. I am over the age of 21 and am competent to make this declaration. These statements were made with the knowledge that willful false statements are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: May 17, 2021

Matthew B. Shoemake, Ph.D.

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I. QUALIFICATIONS

1. I, Matthew B. Shoemake, Ph.D., submit this declaration in support of TCL Industries Holdings Co., Ltd., ZyXEL Communications Corp., and Hisense Co., Ltd. ("Petitioners") Petition for *inter partes* review ("IPR") of claims 1, 12, 13, 14, 15, 17, 18, 19, 20 ("the challenged claims") of USPN 7,292,835 ("the '835 patent") (Ex. 1001). I understand that the '835 patent is currently owned by ParkerVision, Inc., ("Patent Owner").

2. I have been asked to provide my opinion about the state of the art of the technology described in the '835 patent and on the patentability of certain claims of this patent.

3. The statements herein include my opinions and the bases for those opinions, which relate to the following documents:

Exhibit	Description
1001	U.S. Patent No. 7,292,835 ("the '835 patent")
1003	Excerpts of '835 patent File History
1004	U.S. Patent No. 5,734,683 ("Hulkko")
1005	U.S. Patent No. 4,672,117 ("Gibson")

Exhibit	Description
1006	U.S. Patent No. 5,339,459 ("Schiltz")
1007	L. Goldberg, "MCNS/DOCSIS MAC Clears a Path for the Cable-Modem Invasion," *Electronic Design*; Dec. 1, 1997; 45, 27; Materials Science & Engineering Collection pg. 69 ("Goldberg")
1008	USPN 6,011,548 ("Thacker")
1009	ITU-T J.83b Recommendation (April 1997) ("ITU-T J.83b")
1010	Declaration of Brenda Ray
1011	Claim Construction Order, *ParkerVision v. Intel*, 20:cv-00108-ADA (W.D. Tex. January 26, 2021)

4. Although I am being compensated for my time at a rate of $670 per hour in preparing this declaration, the opinions herein are my own. I have no stake in the outcome of this IPR proceeding. My compensation does not depend in any way on the outcome of Petitioner's petition or this IPR proceeding.

5. I graduated *magna cum laude* from Texas A&M University in 1994 upon earning two bachelor's degrees, one in Electrical Engineering and one in Computer Science. While at Texas A&M I took several classes on analog and RF design including the use of switched capacitors. I also took digital signal processing at Texas A&M.

6. I also earned a master's degree and a Ph.D. in Electrical Engineering from Cornell University in 1997 and 1999, where my studies focused on communications systems, communication protocols, and information theory. While at Cornell I also was a teaching assistant for digital signal processing courses.

7. I have almost 30 years of experience in a variety of technologies and industries related to communications systems. From 1991 to 1995, I worked as an intern in the Digital Signal Processing Group at Texas Instruments, Inc. in Stafford, Texas. I worked on both product engineering and applications engineering projects. Our DSP chips were used in a variety of products including wired and wireless communication systems.

8. I was on the founding team of Alantro Communications, Inc. ("Alantro"), a manufacturer of semiconductor products that relate to communication systems. While employed by Alantro, I served as an engineer and engineering manager in the development of an HDSL2 modem, a cable modem, a 2.4 GHz cordless phone, and Wi-Fi technologies. During that time, I was responsible for developing the digital baseband portions of physical layers; the portion of a communication system that is responsible for transmitting information over a physical medium, such as wire, fiber, or air; and successfully decoding the information at the receiver. I also worked on standardized interface technologies such as Ethernet (802.3) and USB. My team at Alantro worked on and pioneered

Wi-Fi technology, which was the foundation of the Wi-Fi product line offered by Texas Instruments. Texas Instruments acquired Alantro in 2000.

9. After Texas Instruments acquired Alantro, I became the director of the Wireless Networking Branch in the Texas Instruments DSP Solutions R&D Center from 2000 to 2003. While manager of this group, I developed technologies for increasing throughput and quality of service in communications networks. I also worked with sister organizations including DSL and cable modem teams to integrate Wi-Fi into products such as home gateways.

10. In 2003, I founded WiQuest Communications, Inc. and was the CEO from 2003 to 2008. At WiQuest, I developed and sold the world's first wireless docking system for notebook computers and the world's first 1 Gbps ultra wideband chipset. Our products contained RF and analog circuitry for modulating and demodulating high-speed signals transmitted wirelessly.

11. From 2008 to 2018 I was the CEO and Founder of Biscotti Inc., which designs high-definition, Wi-Fi-based video calling systems for the home and office. Biscotti was founded in 2008 for the purpose of enabling consumer-based video calling in the home. Biscotti's products were awarded the 2012 CES Innovation award and have been featured on television's *The View* as well as in numerous publications including *The Financial Times*, *The Dallas Morning News*, *Mashable*, *EE Times*, *USA Today*, *PC World* and *Engadget*. Biscotti cameras

provided secure audio/video communication. Biscotti's cameras performed audio and video processing and included interfaces such as HDMI, Wi-Fi, Ethernet and IR. Biscotti products also use interchip communication technologies such as USB, I2C and I2S.

12. Beginning in 2008, companies began calling on me to serve as an expert in patent litigation. I have testified in numerous cases related to communication networks as well as standards. After working as a sole proprietor for many years, I incorporated Peritum LLC in 2016. I continue my expert consulting work via Peritum today.

13. I participated in the IEEE 802.11 standards development process between 1998 and 2004, including, but not limited to, through my participation in the IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, IEEE 802.11e, IEEE 802.11i and IEEE 802.11n standards development processes. I also made numerous presentations to the participants in the groups that developed the IEEE 802.11b, 802.11g and 802.11n amendments. Based on those submissions, technologies of which I am an inventor were ultimately adopted into the IEEE 802.11b and 802.11g amendments.

14. I have personal experience with standard-setting meeting and with rules governing the conduct of meetings at standards-setting bodies. For example, I was a voting member of the IEEE 802.11 Working Group during critical votes

that were taken during the 802.11a, b, g, e, i, and n standards development processes. In September of 1999, I organized and hosted the IEEE 802.11 Working Group meeting in Santa Rosa, California, the meeting at which IEEE 802.11a (now Wi-Fi 1) and IEEE 802.11b (now Wi-Fi 2) were ratified. In January of 2001, I organized and hosted the IEEE 802.11 Working Group meeting in Dallas, Texas. I have continued to actively monitor the 802.11 development process through the years and periodically attend meetings today.

15. I have years of experience with the rules and practices for chairing standard-setting meetings during the standardization process. Having heavily participated in the IEEE 802.11b standardization process, I was elected by the membership of the 802.11 Working Group to chair a Study Group to develop a high-rate extension to the IEEE 802.11b amendment, which ultimately became the IEEE 802.11g amendment (now Wi-Fi 3). This Study Group evolved into a Task Group (known as Task Group G, or TGg), which I also chaired.

16. As Chairperson of Task Group G, I was responsible for leading all of the activities of Task Group G, including, among other things, ensuring compliance with standard-setting rules, processes, and procedures, including patent policies; being knowledgeable in both the standards process and parliamentary procedure; setting goals and deadlines; developing and publishing meeting agendas; calling meetings; entertaining motions; ensuring fairness in discussions,

including mediating discussions and seeking consensus; managing balloting; prioritizing work to best serve the group and its goals; fulfilling financial reporting requirements as appropriate; reporting on TGg status, work, and activities to the full 802.11 Working Group; interfacing with other Task Group chairs as appropriate; and delegating and assigning functions and subtasks of the group. I was the Chair of TGg from inception through ratification of the IEEE 802.11g amendment in 2003.

17. In 2003, I was elected by the IEEE 802.11 Working Group members to be the Chairperson of the 802.11n Task Group (now Wi-Fi 4). In early 2004 I stepped down as chair of IEEE 802.11n to take a CEO position.

18. I am an inventor of technology that was adopted as part of the 802.11 standard (e.g., PBCC), including the 802.11b and 802.11g amendments.

19. My familiarity with digital signal processing, communication systems and analog and RF design began while I was an undergraduate at Texas A&M University in College Station between 1989 and 1994. Further, during my undergraduate studies I was an intern at Texas Instruments' Digital Signal Processor (DSP) group in Stafford, Texas. Texas Instruments' DSP chips were used in multiple applications, including wireless digital communication systems. My study of communication theory continued from 1994 to 1999 while I was a graduate student at Cornell University.

20. I have actively programmed computers for over 40 years, having started programming in BASIC circa 1982. My programming expertise includes BASIC, C, C++, Pascal, Java, Swift, assembly languages, HTML, Matlab, UNIX shell scripts, and hardware description languages (HDL).

21. Based on my study and work experience, I am aware of a wealth of work that relates to communication systems, protocols, standards and interfaces. Examples of previous work I am familiar with include channel access protocols, the OSI and TCP/IP networking models, datagram/frame/packet formatting techniques, automatic repeat request (ARQ) techniques, handshakes, RTS/CTS, detection and estimation theory, capabilities signaling, information theory including theoretical channel capacities and source coding, forward error control (FEC), IEEE 802.1, IEEE 802.3, IEEE 802.11, video communications, audio communications, general purpose and specialized processors, Bluetooth, CAN, USB, wireless USB, I2C, I2S, UARTs, DSL, cable modems, AM radio, FM radio, DVB, NSTC, ATSC, MPEG, MP3, h.264, binary convolutional codes, Reed Solomon codes, trellis codes, low-density parity-check codes, color space conversions, QAM, BPSK, QPSK, SSB, frequency translation, DC offset, carrier offset, LPC-10, G.711, G.722 and AAC. I am also familiar with various file formats including vCards, JSON, XML, and HTML as well as databases.

22. I have authored numerous publications in the field of wireless technology, including "Low Peak-to-Average Ratio Channel Estimation Sequences for MultiBand OFDM Systems" in EE Times, "High Performance Wireless Ethernet" in IEEE Communications Magazine, and various other articles in IEEE publications. I have presented papers at many IEEE and other meetings. I organized and hosted the September 1999 IEEE 802.11 meeting in Santa Rosa, California and the January 2002 meeting in Dallas, Texas. In March 2019 I gave an invited lecture as part of Texas A&M University's Distinguished Speaker Series. The lecture was on the topic of LDPC coding for robust communication networks. I was recognized as a "leader and innovator" and recognized for my "many accomplishments as a researcher leader and scholar."

23. The IEEE 802.11g Task Group that I chaired received the Technology Excellence award in 2003 from PC Magazine for the protocols incorporated in the IEEE 802.11g amendment developed under my leadership.

24. Companies I have founded won CES Innovations Awards in 2008 and 2012 for OFDM-based wireless technology and Wi-Fi connected cameras, respectively.

25. I am a named inventor on at least thirty-four patents.

26. I served on the External Advisory Committee of the Texas A&M University Department of Electrical and Computer Engineering from 2006 to 2020.

27. A full list of my qualifications and experience is contained in my CV, which I attached as an Appendix to this report.

II. MATERIALS REVIEWED

28. My opinions are based on years of education, research and experience, as well as investigation and study of relevant materials. In forming my opinions, I have considered the materials identified in this declaration, including the Exhibits mentioned above.

29. I may rely upon these materials and/or additional materials to respond to arguments raised by the Patent Owner. I may also consider additional documents and information in forming any necessary opinions—including documents that may not yet have been provided to me.

30. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

III. PERSON OF ORDINARY SKILL IN THE ART

31. I have been informed that the '835 patent and its claims, as well as the prior art, are interpreted the way a hypothetical person having ordinary skill in the relevant art would have interpreted these materials at the time of the invention. I

understand that the "time of the invention" in this IPR proceeding is the earliest "priority date" that the applicant for the '835 patent claimed in the United States Patent & Trademark Office ("USPTO"). Here, the face of the patent indicates that the application claims priority to a provisional patent application filed January 28, 2000. As mentioned above, I was conducting research in the relevant technological field at that time.

32. In determining the characteristics of a person of ordinary skill in the art at the time of the claimed invention, I considered several things, including the factors discussed below, as well as (1) the levels of education and experience of the inventor and other persons actively working in the relevant field; (2) the types of problems encountered in the field; (3) prior art solutions to these problems; (4) the rapidity in which innovations are made; and (5) the sophistication of the relevant technology. I also placed myself back in the relevant time period and considered the individuals that I had worked with in the field.

33. It is my opinion that a person having ordinary skill in the relevant art at the time of the invention ("POSITA") would have been someone with at least an undergraduate degree in electrical engineering or a related subject and two or more years of experience in the fields of communication systems, signal processing and/or RF circuit design. Less work experience may be compensated by a higher level of education, such as a master's degree.

34. I understand that a person of ordinary skill in the relevant art is a hypothetical person who is assumed to be aware of all the pertinent information that qualifies as prior art. He or she is a person of ordinary creativity, not an automaton. He or she makes inferences and takes creative steps. In addition, a person of ordinary skill recognizes that prior art items may have obvious uses beyond their primary purposes, and in many cases he or she will be able to fit the teachings of multiple pieces of prior art together like pieces of a puzzle.

35. I am prepared to testify as an expert in this field and also as someone who had at least the knowledge of a person having ordinary skill in the art at the time of the claimed invention, and someone who worked with others that had at least the knowledge of a person having ordinary skill in the art at the time of the alleged invention.

36. Unless otherwise stated, my statements below refer to the knowledge, beliefs and abilities of a person having ordinary skill with respect to the arts relevant to the ’835 patent at the time of the claimed invention.

IV. STANDARDS OF ANTICIPATION AND OBVIOUSNESS

37. I offer no opinions on the law. However, I have developed an understanding of several legal principles regarding invalidity of patent claims, and other relevant legal issues. I have applied this understanding in arriving at my stated opinions and conclusions in this declaration.

38. I understand that the '835 patent contains independent and dependent claims. An independent claim is one that does not refer to other claims in the patent, and it must be read separately from the other claims to determine the scope of such a claim. On the other hand, a dependent claim refers to at least one other claim in the patent. Such a claim incorporates all of the elements of any claim to which the dependent claim refers, as well as the additional elements recited in the dependent claim itself.

39. I understand that, for example in federal district court infringement actions, a claim in an issued patent is presumed to be valid. In such federal court actions, a patent claim can be "invalidated" upon a showing of clear and convincing evidence. This is not such an action.

40. Rather, I understand that in an IPR proceeding like this one, the Petitioner(s) has the burden of proving a proposition of "unpatentability" by a "preponderance of the evidence." I understand that preponderance of the evidence means the greater weight of evidence. In an IPR proceeding, the USPTO may cancel "as unpatentable" one or more claims of a patent on a ground that could be raised under section 102 or 103 of the Patent Act, and only on the basis of prior art consisting of patents or printed publications.

41. I am informed that the patentability of the challenged claims in this proceeding are to be assessed under the pre-America Invents Act ("pre-AIA")

section 102 and 103 of the Patent Act. References to section 102 or 103 herein refer to the pre-AIA versions of those statutes.

42. I understand that section 102 deals with the "novelty" of patent claims. I understand that under section 102(a), a person is not entitled to a patent if, among other things, the invention was patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent. Under section 102(b), a person is not entitled to a patent if, among other things, the invention was patented or described in a printed publication in this or a foreign country, more than one year prior to the date of the application for patent in the United States. Under section 102(e), a person is not entitled to a patent if the invention was described in a published or issued patent application that was filed by another in the United States before the invention by the applicant for patent. Under section 102(g), a person is not entitled to a patent if, before the applicant's invention, the invention was made in the United States by another inventor who had not abandoned, suppressed, or concealed it.

43. I understand that prior art under one or more of these provisions can include, for example but not limited to, one or more of printed publications, patent applications, published patent applications, and domestic, foreign patents, or international patents or publications (e.g., published PCT applications). These are sometimes referred to as prior art "references."

44. I understand that in order for a claim to be unpatentable for lack of novelty, *i.e.,* anticipated, a single prior art reference must disclose each and every claim limitation of that patent claim. It is not considered in a void, rather, one must take into account what a person having ordinary skill in the art would have understood from the reference. I also understand that one should consider not only what is expressly disclosed in the prior art reference, but also what would naturally, inherently have been understood from what is disclosed in the prior art reference. I understand that to prove inherency, the matter that is not expressly described must be necessarily present in the reference, and it would be so recognized by an ordinarily skilled artisan.

45. I understand that in order to cancel as unpatentable a dependent claim, all elements of that dependent claim and the claim (or claims) from which it depends must be disclosed or suggested in the prior art.

46. I understand that determining anticipation of a patent claim requires a comparison of the properly construed claim language to the prior art on an element-by-element basis. As it pertains to an IPR proceeding, a claim is "anticipated" if each and every element of the claim, as properly construed, has been disclosed in a single prior art reference, either expressly or inherently, and the claimed arrangement or combination of those elements must also be disclosed, either expressly or inherently, in that same prior art reference.

47. I also understand that while anticipation cannot be established by combining references, additional references may be used to interpret the anticipating reference by, for example, indicating what the anticipating reference would have meant to one having ordinary skill in the art. Additionally, the description provided in the prior art must be such that a person of ordinary skill could, based on the reference, practice the invention without undue experimentation.

48. I understand that pre-AIA section 103 of the Patent Act deals with "obviousness" of patent claims. In particular I understand that a patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

49. My understanding is that a patent claim is obvious—and therefore can be cancelled as unpatentable in an IPR—if the claimed subject matter as a whole would have been obvious to a person of ordinary skill as of the date of the invention. I understand that this determination is made after weighing the following factors: (1) the level of ordinary skill in the relevant art; (2) the scope and content of the prior art; (3) the differences between the prior art as a whole and

the claim at issue; and (4) when such evidence is made of record, secondary considerations of non-obviousness.

50. I understand that the knowledge and understanding of a person having ordinary skill in the art provides a reference point from which the prior art and claimed invention should be viewed. This reference point prevents one from using his or her own hindsight in deciding whether a claim is obvious, but I understand that if a person of ordinary skill can implement the claimed invention as a predictable variation of a prior art device or method, then the claim may be rendered obvious.

51. As stated earlier, a person having ordinary skill in the art is presumed to have knowledge of the relevant prior art at the time of the claimed invention. I understand that in order for references to be used in an obviousness analysis, the prior art references should be "analogous" to the claimed invention. I understand that a reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention). A reference is "reasonably pertinent" to the problem if it would have logically commended itself to an inventor's attention in considering his or her problem.

52. I understand that an obviousness evaluation can be made using a single prior art reference or a combination of multiple references. I understand that a proper analysis as to the combination of two or more references generally requires a reason that would have motivated a skilled artisan to combine the elements of multiple references in the way the claimed invention does. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine. This suggestion may be found in the art explicitly or implicitly. I further understand that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may be supplied by the direction of the marketplace or other external factors. I understand that advances that would occur in the ordinary course without real innovation are unpatentable.

53. I understand further that "common sense" may, in some circumstances properly be used in an obviousness analysis. First, common sense can be invoked to provide a known motivation to combine references. Second, common sense can be invoked to supply a limitation that is missing from the prior art if the limitation in question is unusually simple and the technology particularly straightforward. In either case, a reference to common sense cannot be used as a wholesale substitute for reasoned analysis and evidentiary support, especially when dealing with a limitation missing from the prior art references specified.

54. Similarly, I understand that statements in a patent's specification such as "it was well known that …" may be used in IPR proceedings when they evidence the "general knowledge" possessed by someone of ordinary skill in the art, and, when used in conjunction with one or more prior art patents or publications, such statements can support an obviousness argument. I further understand that permissible uses of general knowledge including (1) supplying claim limitations, (2) supporting a motivation to combine references in an obviousness analysis, and (3) any other purpose related to patentability.

55. I understand that a particular combination may be proven obvious merely by showing that it was "obvious to try" that combination. For example, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp because the result is likely the product not of innovation but of ordinary skill and common sense.

56. I further understand that a proper obviousness analysis focuses on what was known or obvious to a person having ordinary skill, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of the alleged invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

57. In summary, my understanding is that prior art references or teachings are properly combined where a person having ordinary skill, having the understanding and knowledge reflected in the prior art and motivated by the general problem facing the inventor, would have been led to make the combination of elements recited in the claim. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the claimed invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

58. Further, I understand that at least the following rationales may support a finding of obviousness:

a. Combining prior art elements according to known methods to yield predictable results;

b. Simple substitution of one known element for another to obtain predictable results;

c. Use of a known technique to improve similar devices (methods, products) in the same way;

d. Applying a known technique to a known device (method or product) ready for improvement to yield predictable results;

e. "Obvious to try"—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

f. A predictable variation of work in the same or different field of endeavor if a person having ordinary skill would be able to implement the variation;

g. If, at the time of the alleged invention, there existed a known problem for which there was an obvious solution encompassed by the patent's claims;

h. Known work in one field of endeavor may prompt variations of it for use in either the same or a different field based on design incentives or other market forces if the variations would have been predictable to a person having ordinary skill; and

i. Some teaching, suggestion, or motivation in the prior art that would have led a person having ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

59. I earlier referred to secondary considerations of non-obviousness. I understand that these may include: (1) whether the invention proceeded in a direction contrary to accepted wisdom in the field; (2) whether there was a long felt but unresolved need in the art that was satisfied by the invention; (3) whether others had tried but failed to make the invention; (4) whether others copied the invention; (5) whether the invention achieved unexpected results; (6) whether the invention was praised by others; (7) whether others have taken licenses to the

invention; (8) whether experts or those skilled in the art expressed surprise or disbelief regarding the invention; (9) whether products incorporating the invention have achieved commercial success that is attributable to the invention; and (10) whether or not others having ordinary skill in the field independently made the claimed invention at about the same time the inventor made the invention.

60. I understand that alleged secondary considerations evidence is not relevant unless the patentee can establish a connection or nexus between the secondary consideration and the claimed invention. For example, evidence that allegedly shows commercial success is not relevant unless there is a showing that the success of the product is related to a feature recited in the patent claims. If, however, the commercial success is due to things like advertising, promotion, or salesmanship, or if it is due to features of the product other than the claimed invention, then any commercial success should not be considered an indication of non-obviousness.

61. This declaration discusses certain prior art references including USPN 5,734,683 ("Hulkko") (Ex. 1004), which issued on March 31, 1998 and thus, as informed by counsel, is prior art under 35 U.S.C. §102(b); USPN 4,682,117 ("Gibson") (Ex. 1005), issued on July 21, 1987 and thus, as informed by counsel, is prior art under 35 U.S.C. §102(b); USPN 5,339,459 ("Schiltz") (Ex. 1006), issued on August 16, 1994 and thus, as informed by counsel, is prior art under 35

U.S.C. §102(b); L. Goldberg, "MCNS/DOCSIS MAC Clears a Path for the Cable-Modem Invasion," *Electronic Design*; Dec. 1, 1997; 45, 27; Materials Science & Engineering Collection pg. 69 ("Goldberg") (Ex. 1007), published on December 1, 1997 and thus, as informed by counsel, is prior art under 35 U.S.C. §102(b); USPN 6,011,548 ("Thacker") (Ex. 1008), filed on September 4, 1998 and issued January 4, 2000 and thus, as informed by counsel, is prior art under 35 U.S.C. §§102(a) and 102(e); ITU-T J.83b Recommendation ("ITU-T J.83b") (Ex. 1009), published in April 1997 and thus, as informed by counsel is prior art under 35 U.S.C. §102(b); and Applicant admitted prior art ("AAPA") is set forth in the '835 patent (Ex. 1001) at Column 40, lines 17-35.

V. BRIEF SUMMARY OF OPINIONS

A. The '835 Patent

62. The '835 patent, which claims a priority date of January 28, 2000, is directed to a modem for performing down-conversion, a process for converting a high-frequency signal to a low-frequency signal (called the "baseband signal") that can be processed by a device. Down-conversion was admittedly well-known before the '835 patent, and the structure recited in the challenged claims for performing down-conversion was also well-known. Thus, in my opinion, the challenged clams are unpatentable and should therefore be cancelled.

63. Electronic devices, like computers and cellphones, process data using baseband signals. But baseband signals cannot be transmitted wirelessly from one device to another. Accordingly, a baseband signal must be "modulated" onto a high-frequency radio-frequency ("RF") signal called a "carrier" signal to be transmitted wirelessly. When that high-frequency signal is received by an electronic device, the receiving device must then "down-convert" the signal back to the low-frequency baseband signal, so that the device can process the transmitted data. This process was known for decades before the '835 patent.

64. The challenged claims recite a basic structure for performing down-conversion. Figure 54B (below)[1] shows a modem (5402) that receives an electromagnetic signal 5416, with the received signal 5416 comprising information "modulated with an RF carrier signal" (Ex. 1001 at 42:43-43:57):[2]

[1] All annotations and emphasis have been added unless otherwise noted.

2 The amplifiers and filters shown in Figure 54B are "optional" structures.

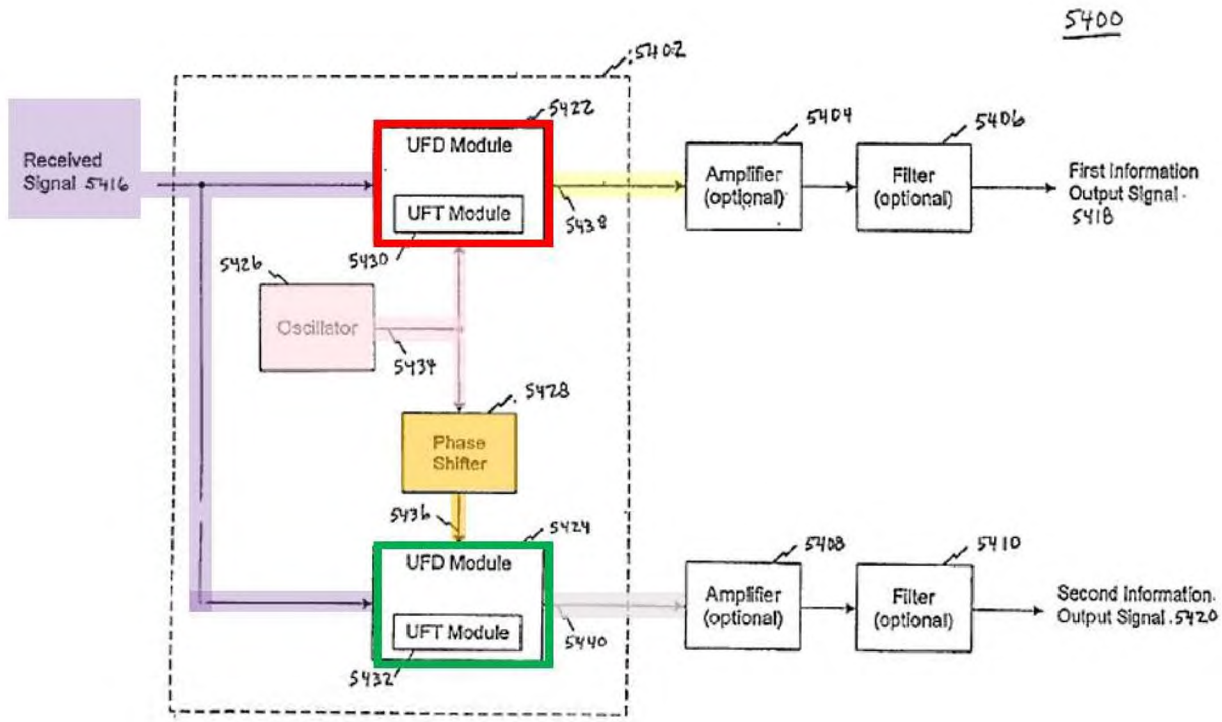


FIG. 54B

Ex. 1001-'835, Fig. 54B

65. This received ***electromagnetic signal*** (purple) is processed by two modules: a ***first frequency down-conversion module*** 5422 (red) and a ***second frequency down-conversion module*** 5424 (green). In addition to the two down-conversion modules, the structure of the challenge claims includes an ***oscillator*** 5426 (pink) that generates in in-phase oscillating signal 5434 (pink), and a ***phase-shifter*** 5428 (orange) that receives the in-phase oscillating signal and outputs a quadrature-phase oscillating signal 5436 (orange). The first frequency down-conversion module 5422 (red) receives the RF signal 5416 and the in-phase oscillating signal

5434, while the second frequency down-conversion module 5424 (green) receives the RF signal 5416 and the quadrature-phase oscillating signal 5436.

66. Each of the two frequency down-conversion modules of Figure 54B above comprises a ***frequency translation module*** (*e.g.*, a switch, blue) and a ***storage module*** (*e.g.*, a capacitor, brown), as shown for example in Figures 20A, 20A-1:

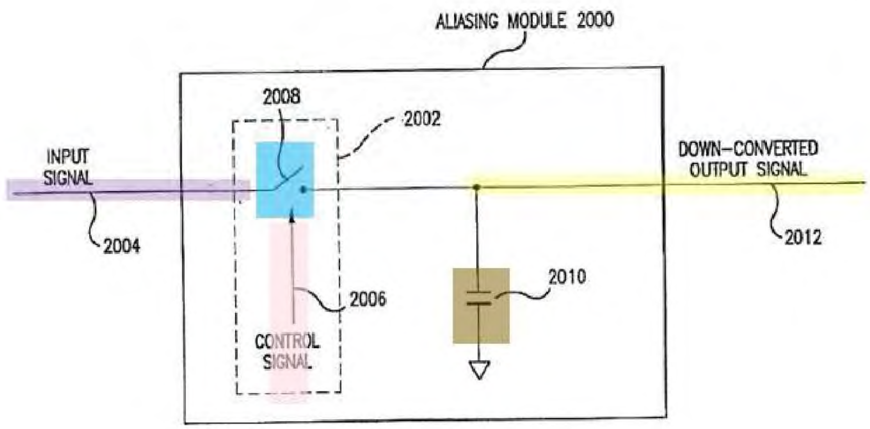


FIG. 20A

Ex. 1000-'835 patent Fig. 20A

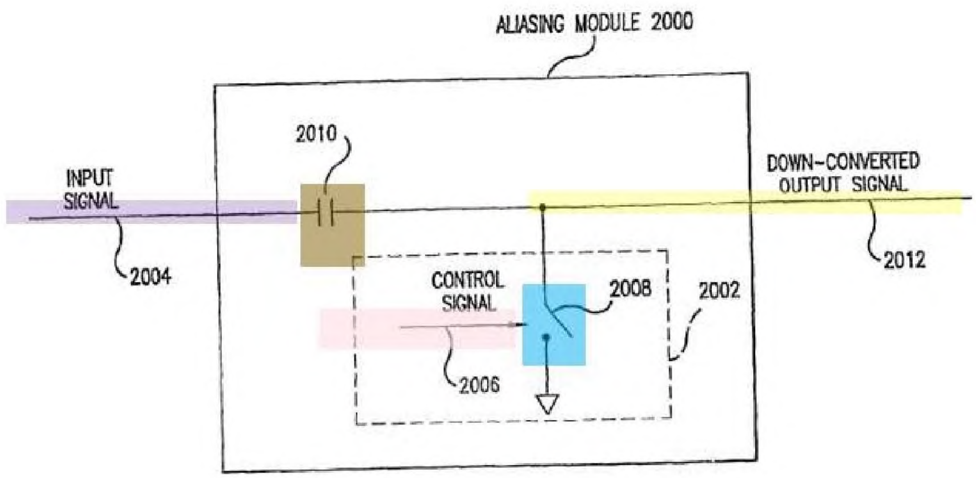


FIG. 20A-1

Ex. 1000-'835 patent Fig. 20A-1

67. In Figure 54B of the '835 patent, shown above, the first-frequency translation module 5422 "samples" the RF signal 5416 at a rate that is a function of the in-phase oscillating signal 5434, creating a down-converted in-phase signal 5438 (yellow). Similarly, the second frequency translation module 5424 samples the RF signal 5416 at a rate that is a function of the quadrature-phase oscillating signal 5436, creating a down-converted quadrature-phase signal 5440 (gray).

B. The Claims are Obvious Over Hulkko in View of Gibson

68. In my opinion, the structure of the challenged claims depicted above was well-known in the prior art—including references that were not cited or discussed during original prosecution.

69. For example, USP 5,734,683 ("Hulkko") (Ex. 1004) discloses and/or renders obvious all the claimed features. Just like Figure 54B of the '835 patent, Figure 2 of Hulkko below shows first and second frequency down-conversion modules (red and green, respectively), a local oscillator (pink) to create an in-phase oscillating signal, and a phase-shifter (orange) to create a quadrature-phase oscillating signal:[3]

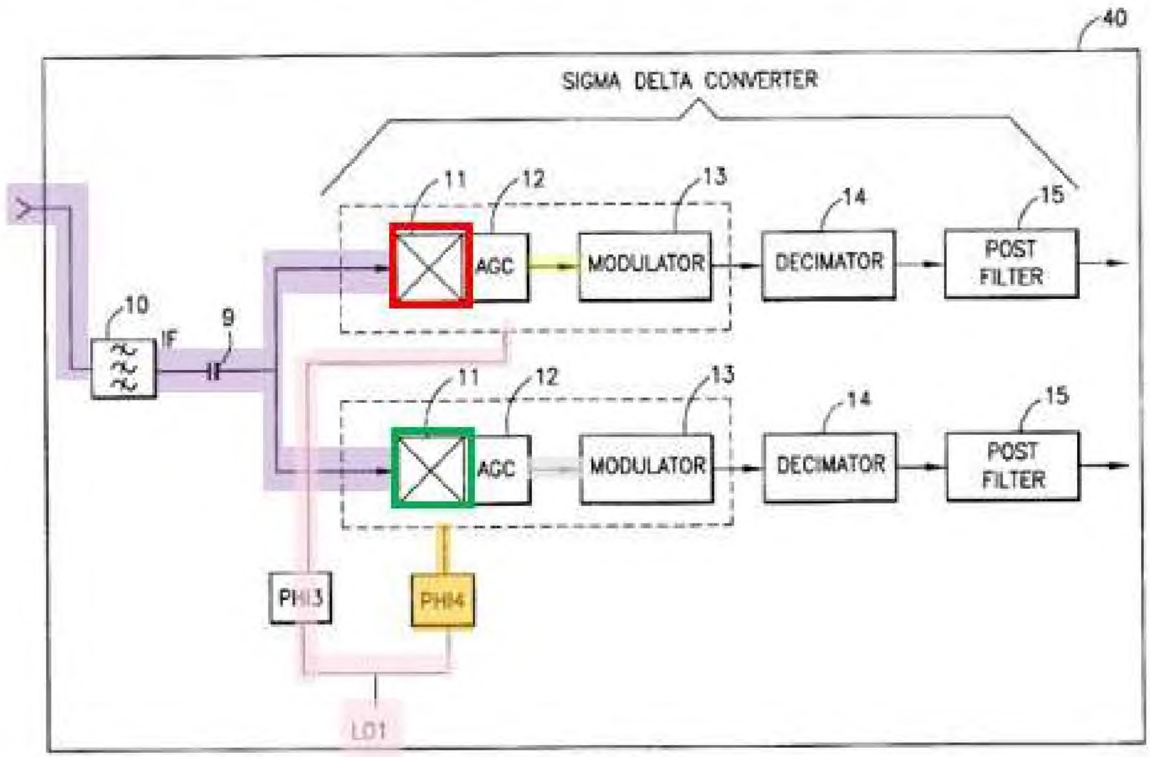


FIG.2

Ex. 1004-Hulkko, Fig. 2.

70. And as recited in the challenged claims (and depicted for example in the '835 patent at Figures 20A and 20A-1, shown above), Hulkko discloses in its

[3] Hulkko discloses that control signals PHI3 and PHI4 are 90 degrees out of phase with each other. (Ex. 1004 at 4:5-9.).

Figure 4 that each of the two frequency down-conversion modules shown in Hulkko's Figure 2 includes a first frequency translation module (switch 31, blue) and a storage module (capacitor 30, brown):

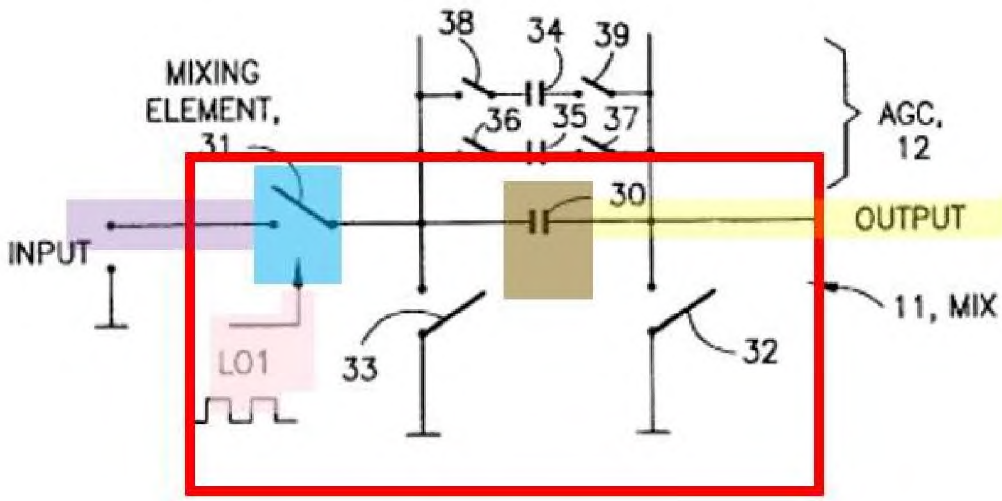


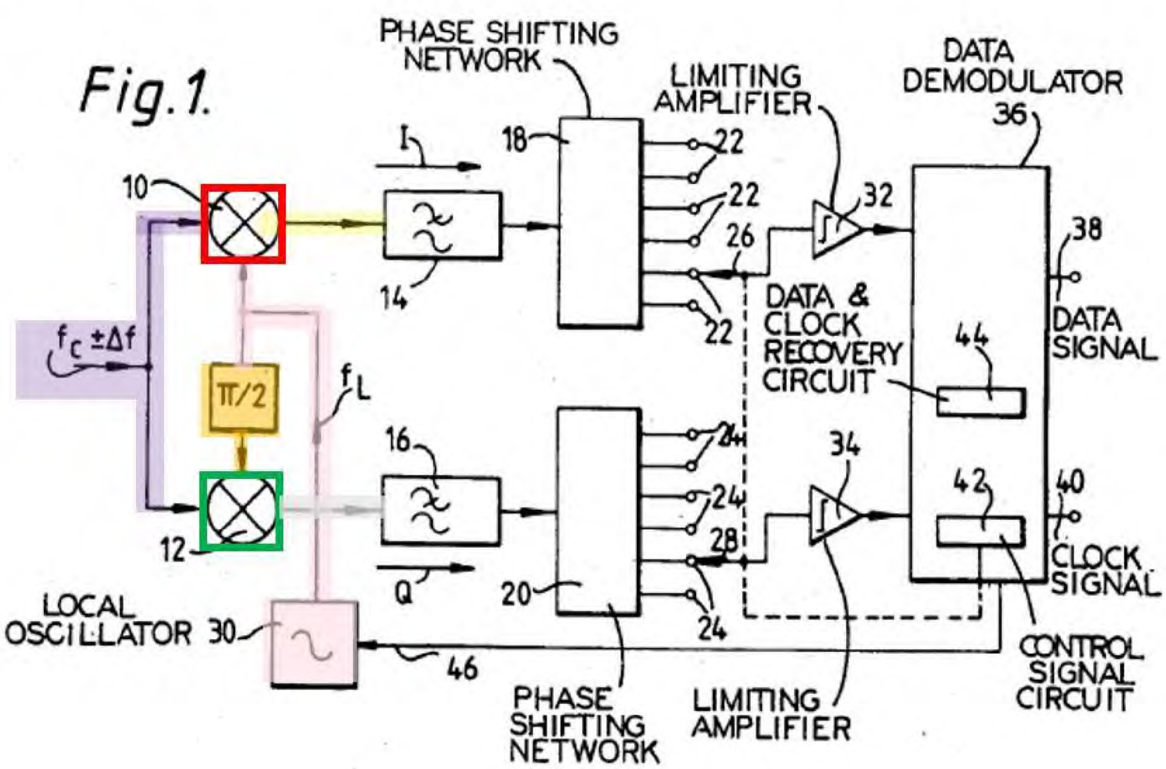
FIG.4

Ex. 1004-Hulko, Fig. 4.

71. Hulkko's frequency translation modules perform down conversion by sampling the input signal using a switched capacitor, just like the alleged invention disclosed and claimed in the '835 patent. In particular, Hulkko discloses that the "mixer 11 can be considered as a sample and a hold circuit that sample the input signal in synchronization with the oscillator and directs the samples to the output as a signal which remains constant for the period of the sampling interval." (Ex. 1004, 5:13-17). A "first capacitor 30 is used to sample and hold the incoming

signal." (*Id*. at 4:61-5:12.). Hulkko discloses that "the inventive idea is realized in the circuit arrangement ... with which switched capacitor switching elements present in the input stage ... are used to implement the mixer 11 which directly demodulates the IF-signal into a base-frequency signal." (*Id*. at Col. 5:39-48).

72. To the extent that Patent Owner alleges that Hulkko does not disclose the in-phase and quadrature-phase oscillating signals as recited in claim 1 of the '835 patent, such arrangement was well-known and is also described, for example, in USPN 4,682,117 ("Gibson") (Ex. 1005). Gibson describes a modem used to down-convert a modulated RF signal into an in-phase sampled signal ("I") and a quadrature-phase sampled signal ("Q"):



Ex. 1005-Gibson, Fig. 1

73. Just as the local oscillator signal of Hulkko is split to provide two control signals 90 degrees out of phase with each other (*see supra* Hulkko Fig. 2 at "PHI3" and "PHI4"; *id*. at 4:5-9 (showing that PHI3 and PHI4 are, respectively, shifted by +45 and -45 degrees)), the local oscillator signal of Gibson (Figure 1, "f_L" pink) is passed through a 90 degree phase-shifter ("π/2" orange) to provide oscillating signals for respective mixers 10 and 12, with the oscillating signals being 90 degrees out of phase with each other. Accordingly, Hulkko in view of Gibson renders the claimed invention obvious.

74. A POSITA would recognize that it is the phase difference of 90 degrees that matters, but to the extent that Patent Owner argues that there is some relevant distinction between having control signals shifted in phase by +45 and –45 degrees, on the one hand, with control signals of shifted by 0 and 90 degrees, on the other, then Gibson expressly discloses the latter, suggesting to alter Hulkko by having PHI3 shifted by 0 degrees and PHI4 shifted by 90 degrees.

75. A received signal can be decomposed into so-called "in-phase" (I) and "quadrature" (Q) components. These components are orthogonal to each other precisely because their phase differs by 90 degrees. This means that the in-phase and quadrature phase components are independent of each other.

76. Two signals are orthogonal if the integral of their products over a period is zero. Consider:

$$\int_0^{2\pi} \sin(x)\sin\left(x + \frac{\pi}{2}\right) dx = 0$$

77. It is also true that if PHI3 = +45 degrees and PHI4 = -45 degrees, then the two control signals input into the mixers of Hulkko are orthogonal:

$$\int_0^{2\pi} \sin\left(x - \frac{\pi}{4}\right)\sin\left(x + \frac{\pi}{4}\right) dx = 0$$

78. In fact, so long as two signals differ in phase by 90 degrees (π/2 radians), the signals are orthogonal:

$$\int_0^{2\pi} \sin(x + y)\sin\left(x + \left(y + \frac{\pi}{2}\right)\right) dx = 0$$

79. But, if the phases do not differ by 90 degrees, the signals are no longer orthogonal. Below I show that with an offset of 63 degrees (63 π / 180 radians), the two signals input to the mixers would no longer be orthogonal to each other:

$$\int_0^{2\pi} \sin(x)\sin\left(x + \frac{63\pi}{180}\right) dx = \pi \sin\left(\frac{3\pi}{20}\right) \approx 1.4263$$

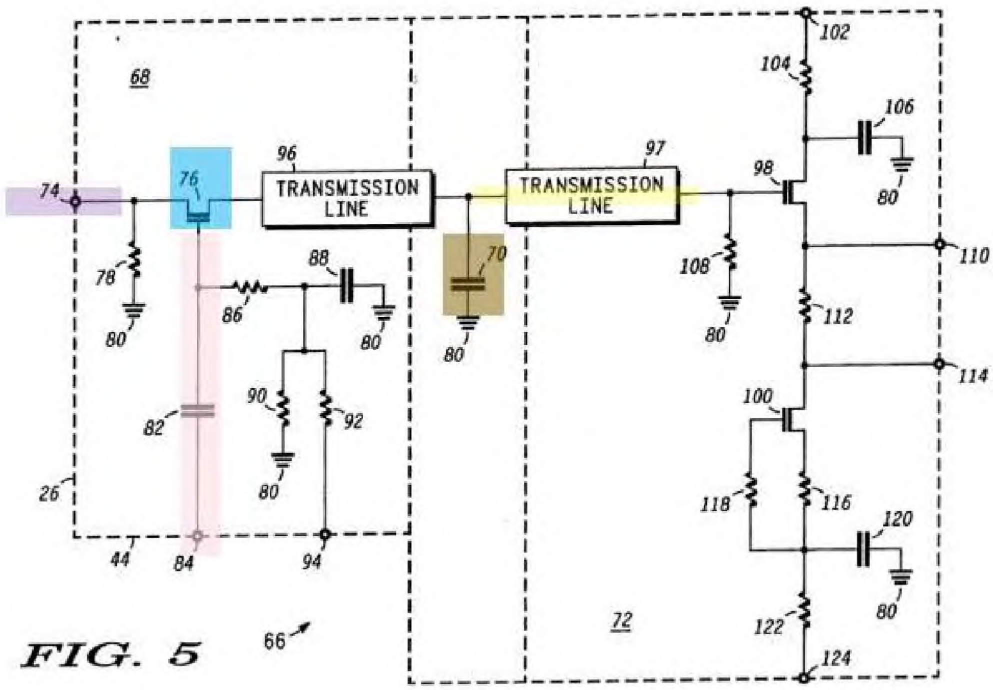
80. Thus, a POSITA would know that it is the 90 degrees phase difference that is material, not that exact values of PHI3 and PHI4.

C. The Claims Are Obvious Over Gibson in View of Schiltz

81. It is also my opinion that other references not cited during original prosecution also render the challenged claims obvious, specifically, Gibson (Ex. 1005) was not cited during the original prosecution of the '835 patent, and it is my opinion that Gibson, when combined with USP 5,339,459 ("Schiltz") (Ex. 1006), renders the challenged claims obvious.

82. Just like Figure 54B of the '835 patent (shown above), Figure 1 of Gibson (shown above) shows two frequency down-conversion modules (red and green), a local oscillator (pink), and a phase-shifter (orange). Gibson does not expressly disclose that its frequency down-conversion modules (mixer 10, red, and mixer 12, green) comprise a switched capacitor arrangement. However, as recited in the challenged claims (and depicted for example in the '835 patent at Fig. 20A and 20A-1, shown above), Schiltz discloses a "high speed sample and hold circuit" comprising a switched capacitor, which circuit is used "as a mixer." (Ex. 1006 at 1:5-10; *see also id*. at 3:45-65, 4:29-32 ("Sample and hold circuit 26 operates as a downconverter in radio 10. Sample and hold circuit 26 converts a high frequency RF signal into an IF signal in a single operation."), 6:3-10 ("Sample and hold circuit 26 … samples the RF signal while the pulses supplied by pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive."), 7:58-60.).

83. The structure of Schiltz's sample and hold circuit (26) is shown in Figure 5 below, which discloses a mixer featuring a sampling switch 68 (comprising a field effect transistor 76, blue) and a "hold capacitor" 70 (brown):



Ex. 1006-Schiltz, Fig. 5

84. Schiltz discloses that the input electromagnetic signal (purple) enters at contact 74, which serves as the sampling input and couples to a source of field effect transistor 76 (blue). (Ex. 1006 at 7:58-8:48.). Contact 84 serves as the input for a control oscillating signal (pink) for the sample and hold circuit 26, and couples to a gate of field effect transistor 76. (*Id.*; *see also id.* at Figure 1 depicting "pulse generator 30."). Field effect transistor 76 operates as a switch and samples

the incoming signal. (*Id*. at 7:58-8:48). A drain of field effect transistor 76 serves as the output of the sample and hold switch 68, which outputs a sampled signal (yellow). (*Id*.). Accordingly, it would have been obvious at the time of the invention to use the sample and hold circuit of Schiltz for the mixers of Gibson. As explained further below, it is my opinion that the combined structure discloses each and every element of all challenged claims.

D. Claim 1 Preamble: "Cable Modem"

85. As discussed above, both Hulkko in view of Gibson, and Gibson in view of Schiltz, each discloses or renders obvious the elements recited in the body of the challenged claims (*e.g.*, two frequency down-conversion modules comprising switched capacitors). The preamble of claim 1 of the '835 patent recites that the modem is a "cable modem," and the specification teaches that cable modems can be wired or wireless. (Ex. 1001 at 36:50-56; *id*. at 37:24-30.). To the extent it is argued or determined that the preamble is not merely a statement of intended use of the structure recited in the body of the challenged claims, using the prior art modems discussed above as "cable modems" would have been obvious.

86. Typical cable modems communicate data at radio frequencies over coaxial cable. The radio frequency spectrum covers frequency from about 30 Hz to 300 GHz. See https://en.wikipedia.org/wiki/Radio_spectrum. VHF and UHF portion of the radio frequency spectrum span 30-300 MHz and 300-3,000 MHz, respectively.

These frequencies were commonly used for over-the-air (wireless) TV at the time of the ’835 patent. See https://en.wikipedia.org/wiki/Radio_spectrum. Cable modems commonly use radio frequencies of 54-860 MHz. Goldberg at 4-5 (“DOCSIS is designed to employ one or more unused video channels within the 54-to-860-MHz cable broadcast spectrum to transmit IP-based data across hybrid fiber coaxial networks.”). Since cable modems use radio frequency transmission, it would have been obvious to a POSITA to use RF demodulation techniques to down-convert signals received over coaxial cable by the cable modem. Likewise, since the ‘835 teaches that signals may be received wirelessly by the cable modem, it also would have been obvious to use down-conversion techniques of the prior art references discussed herein when receiving wireless signals.

87. The ’835 patent correctly admits that cable modems were “well known devices.” (Ex. 1001 at 40:17-35.). Indeed, there existed a number of industry standards for cable data transmission that pre-date the ’835 patent, including the “DOCSIS” (Data Over Cable Service Interface Specification) cable modem standard mentioned in the ’835 specification (Ex. 1001 at 40:8-16), Version 1.0 of which was first released on March 26, 1997, and the ITU-T J.83.b standard released in April 1997. (Ex. 1007; Ex. 1009; Ex. 1008 at 1:30-40.). Version 1.0 of DOCSIS and the J.83 Recommendation each specify use of a QAM demodulation technique (Ex. 1007 at 5; Ex. 1009 at 1, Table 1), and for the reasons discussed

above and below, the receivers of Hulkko and Gibson can each be used to demodulate QAM-modulated signals such as would be received at the customer side of a cable modem. Given that cable modems were admittedly "well known," and utilize standard QAM demodulation, in my opinion it would have been obvious to use the receivers of Hulkko (modified by Gibson) or Gibson (modified by Schiltz) as the operative receiving elements of a "cable modem." Accordingly, it is my opinion that the challenged claims are obvious even if the Board finds that the preamble of claim 1 is limiting.

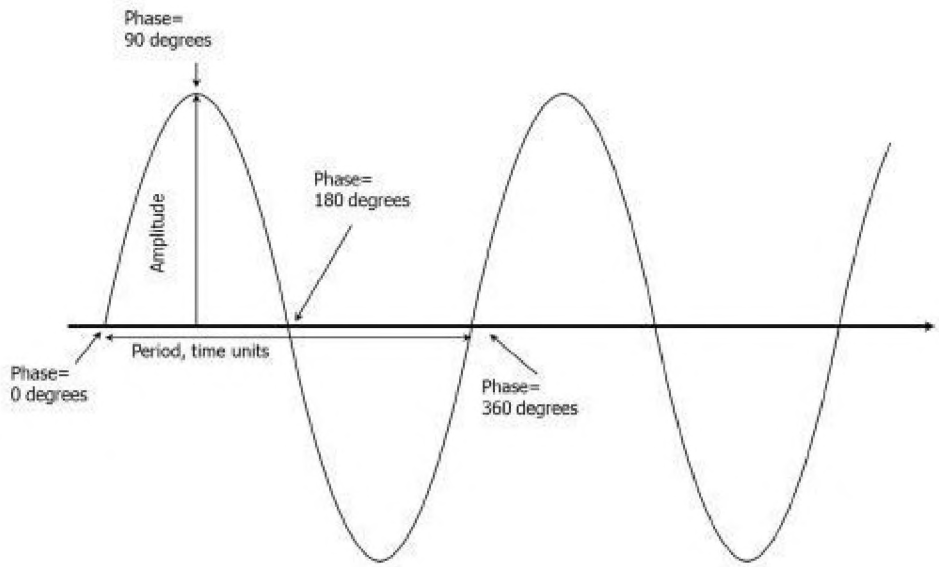
88. I have first-hand experience with the ITU-T J.83b standard and can confirm that Exhibit 1009 was published in 1997. In particular, in 1998 I designed and built an ITU-T J.83b-complaint transmitter and receiver while working at Alantro Communications, Inc. in Santa Rosa, CA. Our implementation was coded in Matlab and in HDL (hardware design language). We sold this design as an IP core to Sarnoff Corporation. Sarnoff integrated our IP into their complete cable modem product. https://en.wikipedia.org/wiki/Sarnoff_Corporation. In 1998 I had the ITU-T J.83b specification in my possession. My advisor for my Ph.D. at Cornell University had contributed to the coding techniques in ITU-T J.83b which resulted in me being aware of its publication in 1997.

VI. BACKGROUND TECHNOLOGY

A. Wireless Communications Signals

89. Wireless devices (*e.g.*, cellular phones) exchange information by transmitting and receiving electromagnetic signals. These signals are communicated from one device's transmitter to another device's receiver. The challenged claims of the '835 patent focus on devices for receiving signals transmitted from another device.

90. Before transmission, information (*e.g.*, voice information of a telephone call) exists as a "baseband signal," which has a relatively low frequency. The baseband signal is often a digital signal, and to transmit the baseband signal wirelessly, the digital signal sometimes is converted into an analog signal. As shown below, an analog signal is a continuous waveform that oscillates at a particular frequency between maximum and minimum values:

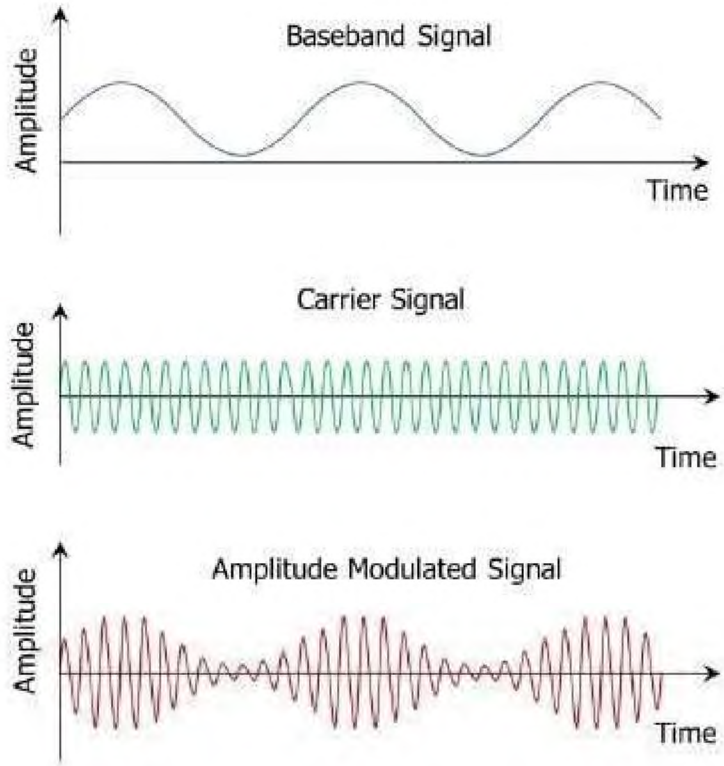


B. "Modulating" Signals for Wireless Communications

91. Because baseband signals have relatively low frequencies, they cannot be effectively transmitted through the air between wireless devices. Instead, a baseband signal must be "imprinted" onto a higher frequency signal—called a "carrier" signal—that can be transmitted more easily. This carrier signal "carries" the baseband signal through the air from one device to another device.

92. This process of "imprinting" a lower frequency baseband signal onto a higher frequency carrier signal is called "modulation." Modulation is achieved by modifying the frequency, phase, and/or amplitude of the carrier signal based on the frequency, phase, and/or amplitude of the baseband signal. The following describes well-known modulation techniques.

1. Amplitude Modulation

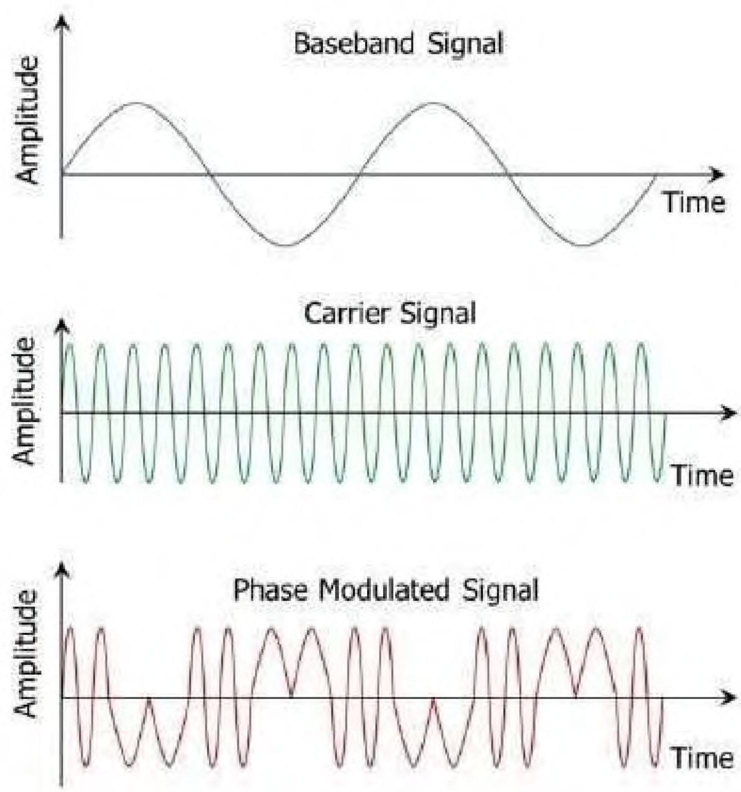


93. As shown below, modifying the carrier signal's amplitude based on the amplitude of the baseband signal is called "amplitude modulation." In this case, the modified carrier signal is called an "amplitude modulated signal," which can be transmitted wirelessly over the air.

94. The receiver "knows" the frequency of the unmodulated carrier signal ahead of time. Thus, when it receives the amplitude modulated signal, it can recover the original baseband signal from the modulated signal by from the amplitude of the received signal at that carrier frequency.

2. Phase Modulation

95. A baseband signal can also be transmitted wirelessly to another device using phase modulation. In this case, the carrier signal's phase is modified based on the phase of the baseband signal, as shown below.

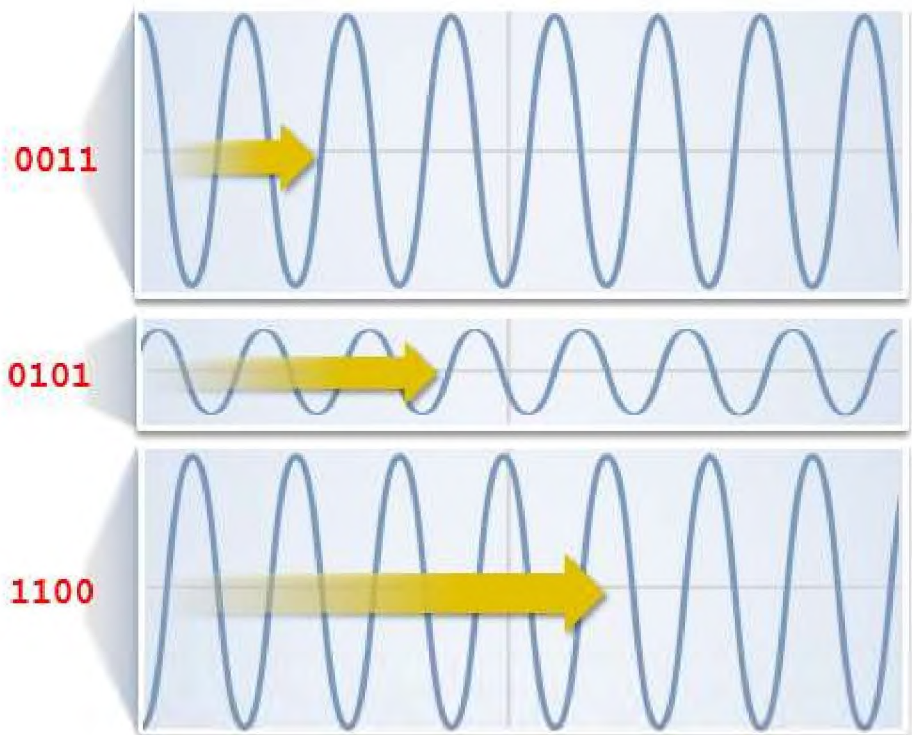


96. This modified carrier signal is called a "phase modulated signal," which can be wirelessly transmitted. As with amplitude modulation, the receiver knows the frequency of the carrier signal beforehand and can recover the baseband signal by extracting the phase of the carrier signal.

3. Quadrature Amplitude Modulation ("QAM")

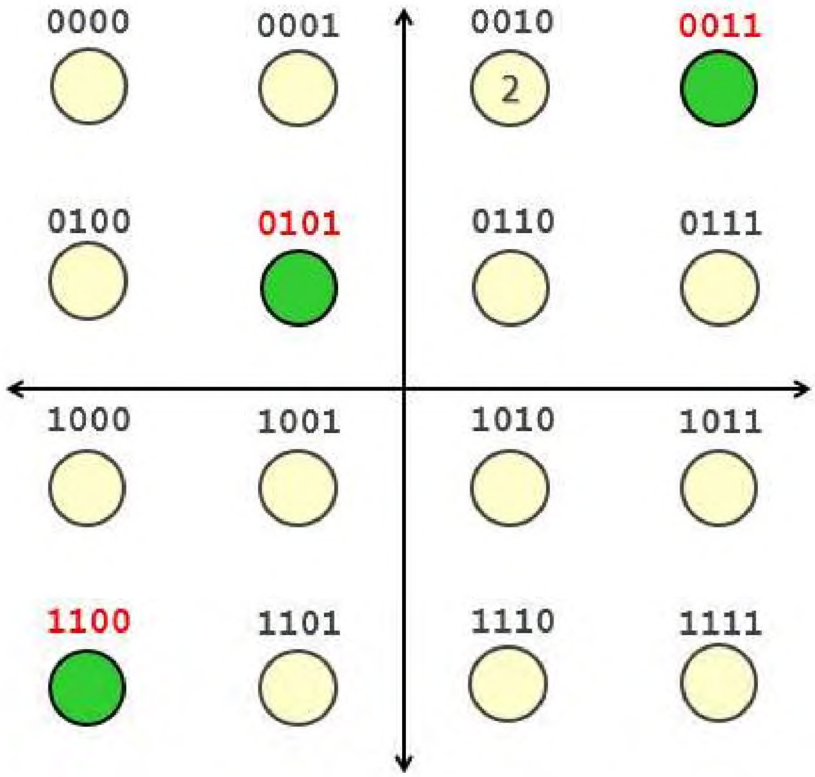
97. QAM modulation involves ***two*** carrier waves of the same frequency that are out of phase with each other by 90 degrees, a condition known as "quadrature." The amplitude of each of the two carrier waves are independently modified in amplitude to convey information. Often one signal is called the in-phase or "I" signal, and the other is called the quadrature-phase or "Q" signal. (*Id.*). After modulation of these two carriers waves, the signals are combined and transmitted. (*Id.*; *see* Ex. 1001 at 40:35-51.). The combined transmitted wave thus has variations in amplitude and phase, depending on the information that it conveys.

98. For example, if the baseband signal contains the bit string "0011" the QAM-modulated wave may have a first amplitude and a first phase as shown on the top of the figure below. When the baseband signal contains the bit string "0101" the QAM-modulated wave may have a second amplitude and a second phase as shown in the middle of the figure below. And when the baseband signal contains the bit string "1100" the QAM-modulated wave may have a third amplitude and a third phase, as shown in the bottom of the below figure:



99. A QAM receiver receives the overall signal, which again is a combination of both the amplitude-modulated I and Q carriers. The QAM receiver separates the in-phase modulated signal from the quadrature-phase modulated signal. Because the receiver "knows" the frequency of the unmodulated I and Q carrier signals ahead of time, it can recover the original baseband signals.

100. Recovery of the transmitted data is illustrated below with the aid of a "constellation" diagram, which plots the recovered I signal on the x-axis and the recovered Q signal on the y-axis:



101. This example is known as "16-QAM" because the modulated wave transmits 16 symbols (with 4 bits per symbol). As seen in the above constellation diagram, when the receiver detects a symbol having an amplitude and phase corresponding to the green circle on the top right of the diagram, it interprets this as the bit string "0011." When the receiver detects the green symbol in the upper left quadrant, it interprets it as the bit string "0101," and when it detects the green symbol in the lower left quadrant," it interprets it as "1100," and so on. In this

way, the receiver can demodulate the QAM-modulated signal and recover the transmitted information (*e.g.*, a transmitted bit string). (*Id.*).

102. QAM modulation transmits by varying the phase ***and*** amplitude of a wave and thus can transmit data faster than modulations that vary phase or amplitude alone. For example, 16-QAM transmits 4 bits per symbol. 64-QAM is faster still, as it can transmit 6 bits per symbol, and otherwise operates according to the same principles as 16-QAM. (Ex. 1001 at 47:6-14).

VII. OVERVIEW OF THE '835 PATENT

A. Alleged Problem

103. The '835 patent discloses purportedly inventive receivers for use in "cable modem applications." (Ex. 1001, Abstract).

B. Alleged Invention

104. The '835 patent purportedly teaches a wireless "QAM modulation mode receiver" used to down-convert and demodulate an input signal that is modulated according to QAM. (Ex. 1001-'835, 42:43-43:57, Fig. 54B.) The patent admits that QAM "is a well known technique for modulating digital signals using both amplitude and phase coding" (Ex. 1001 at 40:37-51) and states that the receivers of the invention "may be implemented in cable modems." (*Id.* at 40:52-61). But the patent admits that "cable modem receivers … of the present invention

may be implemented using a variety of well known devices." (*Id.* at 40:17-35) (listing prior art cable modem devices "manufactured by Broadcom").

105. As I discussed above, the challenged claims and the specification recite a basic structure for performing down-conversion, with nothing that is unique to "cable modems." Figure 54B (shown again below) shows a modem (5402) that receives a signal 5416, with the received signal 5416 comprising "two information signals modulated with an RF carrier signal according to" the QAM modulation technique. (Ex. 1001 at 42:43-43:57):

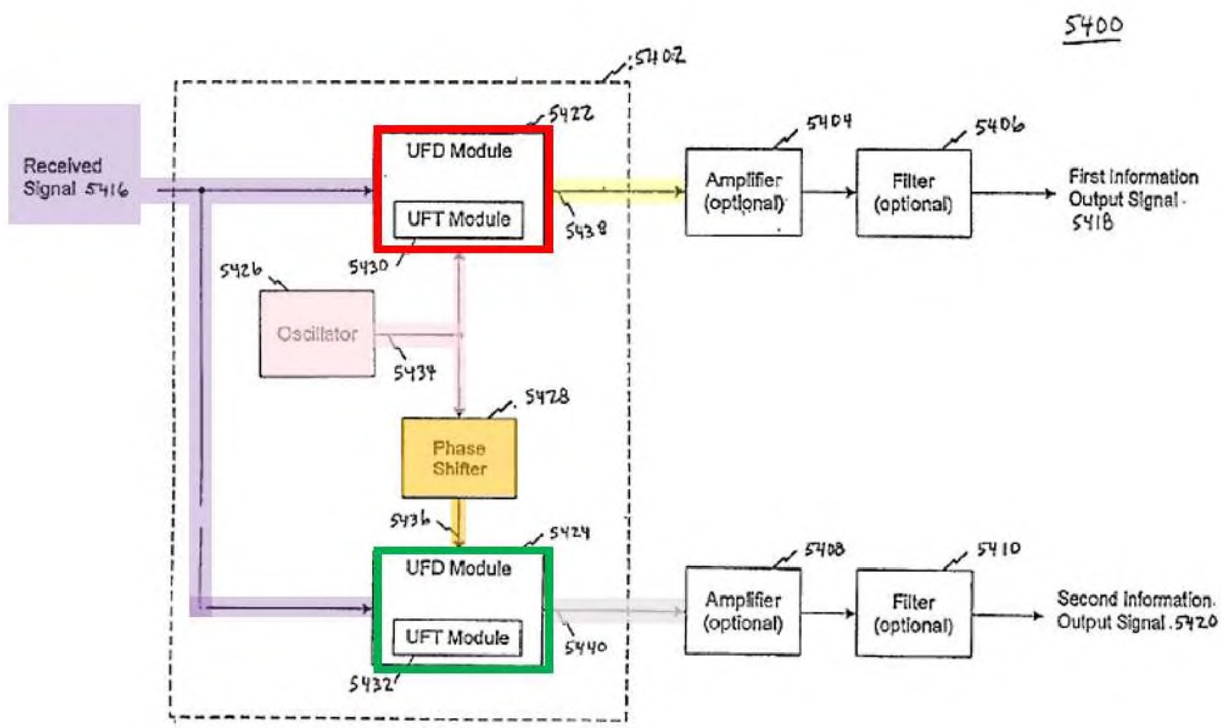


FIG. 54B

Ex. 1001-'835, Fig. 54B

106. This received RF ***electromagnetic signal*** is processed by two modules: a ***first frequency down-conversion module*** 5422 and a ***second frequency down-conversion module*** 5424. In addition, the challenged claims include an ***oscillator*** 5426 that generates in in-phase oscillating signal 5434, and a ***phase-shifter*** 5428 that receives the in-phase oscillating signal and outputs a quadrature-phase oscillating signal 5436. Each down-conversion module comprises a ***frequency translation module*** (*e.g.*, a switch, blue) and a ***storage module*** (*e.g.*, a capacitor, brown), as shown for example in Figs. 20A, 20A-1:

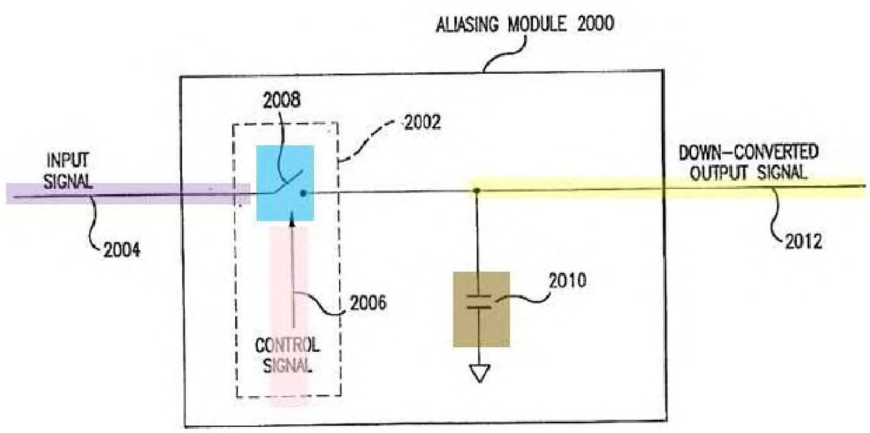


FIG. 20A

Ex. 1000, '835 patent Fig. 20A

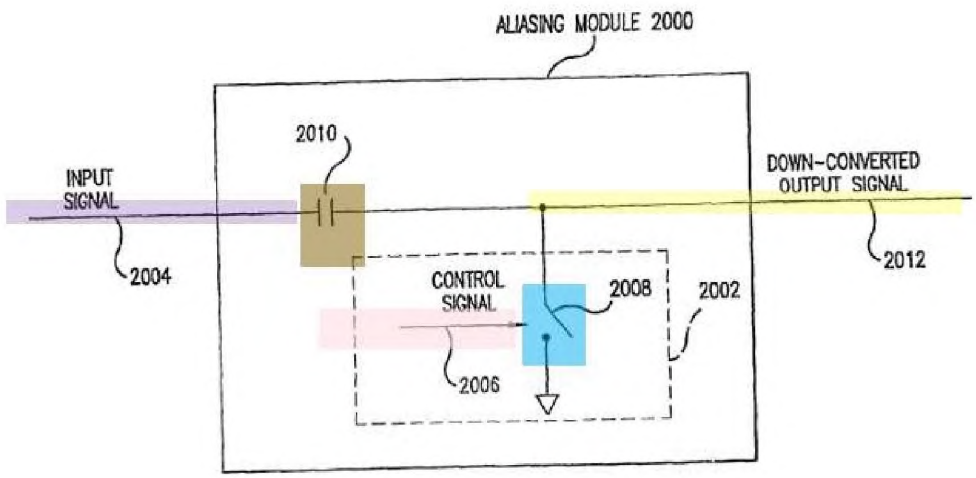


FIG. 20A-1

Ex. 1000, '835 patent Fig. 20A-1

107. In Figure 54B of the '835 patent, the first-frequency translation module 5422 "samples" the RF signal 5416 at a rate that is a function of the in-phase oscillating signal 5434, creating a down-converted in-phase signal 5438 (yellow). Similarly, the second frequency translation module 5424 samples the RF signal 5416 at a rate that is a function of the quadrature-phase oscillating signal 5436, creating a down-converted quadrature-phase signal 5440 (gray). The down-converted "I" and "Q" signals may be "information" signals with "more than two possible states or voltage levels" according to the QAM modulation technique. (Ex. 1001 at 43:17-20, 43:32-34.).

108. Representative claim 1 is directed to the receiver of Figure 54B:

A cable modem for down-converting an ***electromagnetic signal having complex modulations,*** comprising:

an ***oscillator*** to generate an in-phase oscillating signal;

a ***phase shifter*** to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal;

a ***first frequency down-conversion module*** to receive the electromagnetic signal and said in-phase oscillating signal;

a ***second frequency down-conversion module*** to receive the electromagnetic signal and said quadrature-phase oscillating signal; wherein

said first frequency down-conversion module further comprises ***a first frequency translation module*** and a ***first storage module***, wherein said first frequency translation module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating a first sampled signal; and

said second frequency down-conversion module further comprises a ***second frequency translation module*** and a ***second storage module***, wherein said second frequency translation module sample the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating a second sampled signal.

(Ex. 1001, claim 1) (emphasis added).

C. The Examiner Did Not Consider or Analyze the Primary Prior Art References Presented in the Petition During Original Prosecution

109. The application was filed on January 29, 2001. (Ex. 1003 at 1-8.). On August 30, 2001, the applicant filed a preliminary amendment, amending the preamble of claim 1 by deleting "system" in favor of "cable modem," and amending the body of claim 1 by replacing "universal frequency transfer module" with "universal frequency translation module." (*Id.* at 9-20.). The applicant did not provide a reason for either of these amendments. (*See id.*).

110. Along with a response to a restriction requirement, on December 28, 2004, the applicant amended claim 1 by deleting "universal" in the phrase "universal frequency down-conversion module." (Ex. 1003 at 31-47.). Shortly thereafter, the examiner allowed the claims, without having issued any rejections. (*Id.* at 48-53 (Feb. 10, 2005 Notice of Allowance)). The stated reason for allowance was that "the prior arts of record, in combination or individual, fail to show or make … obvious" the invention recited in independent claim 1. (*Id.* at 52.). Then, on several occasions, the applicant requested continued prosecution to

cite additional references. (*Id.* at 54-85.). Each time, the examiner repeated his previously-stated reason for allowance. (*Id.*).

111. It is my opinion that the two primary references forming the grounds of this Petition (Hulkko and Gibson) disclose and render obvious all challenged claims, but neither of these references seems to have been considered during prosecution.

VIII. CLAIM CONSTRUCTION

112. Petitioner proposes construing certain terms in this IPR and submits that no other terms currently need to be construed. Depending on the issues raised by Patent Owner in co-pending litigation or in this proceeding, Petitioner reserves the right to construe other claim terms.

A. "cable modem" (Claim 1, Preamble)

113. The preamble of claim 1 recites "A cable modem for down-converting an electromagnetic signal having complex modulations." A cable modem is used to communicate with a cable TV network and, in the limited context of the '835 patent, allegedly can be wired or wireless. (Ex. 1001 at Col. 36:19-25, 36:50-56 ("wired cable modem"), 37:24-30 ("wireless cable modem"), Fig. 45B (wireless cable modem 4522.). Further, the invention "is not limited to" the DOCSIS (Data Over Cable Service Interface Specification) standard, as it can be used with "additional standards" (*e.g.*, ITU-T J.83b) and can also be used in "non-standard

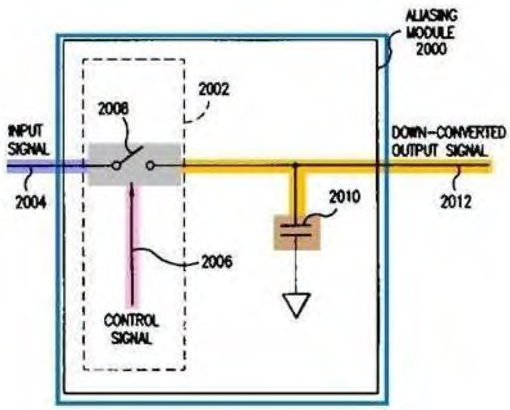
configurations." (*Id*. at 38:28-34.). Accordingly, if the preamble is limiting and if the Board finds it necessary to construe "cable modem" to resolve this IPR, the Board should find that any modem that can be used to down-convert modulated signals from a TV network is a "cable modem," regardless of whether the modem is wired or wireless, and regardless of whether it complies with any cable data standard. As discussed further herein, it is my opinion that it would have been obvious to use the modems of the prior art (e.g., Hulkko, Gibson) as "cable modems" within the context of the '835 patent.

B. "frequency translation module" (Claims 1, 18)

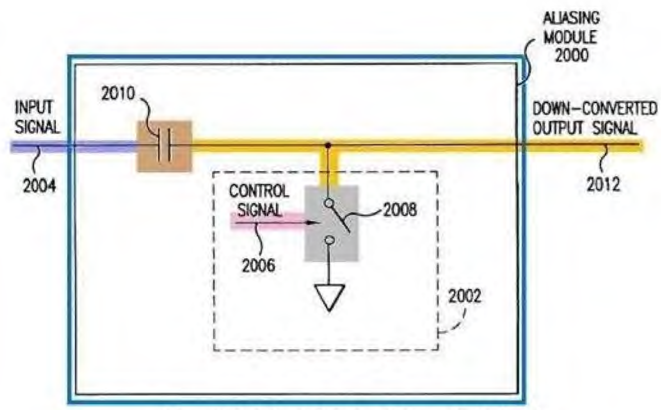
114. Claim 1 recites a (1) "a first frequency translation module" that "samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal" and (2) a "a second frequency translation module" that "samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal."

115. To the extent it is argued or determined that 35 U.S.C. § 112(6) applies to the first and second "translation module," the claimed function is to "sample[] the electromagnetic signal at a rate that is a function of" the in-phase oscillating signal and the quadrature-phase oscillating signal, respectively. (Ex. 1001, claim 1.) And the corresponding structure disclosed in the '835 patent for a "translation module" is the switch (gray) that is one part of the "aliasing module

2000" (blue), which aliasing module has two alternative configurations shown below in Figures 20A and 20A-1:



Ex. 1001-'835, Fig. 20A



Ex.1001-'835, Fig. 20A-1

116. In Figure 20A "switch 2008 is in series with input signal 2004" and in Figure 20A-1 "switch 2008 "is shunted to ground (although it may be other than ground in configurations such as differential mode)." (Ex. 1001 at 7:3-8; *see also id.* at Fig. 1B (disclosing switch 106 controlled by control signal 108).). The patent explains that when switch 2008 "is closed, input signal 2004 is coupled to capacitor 2010, and charge is transferred from input signal 2004 to capacitor 2010. The charge stored during successive pulses forms a down-converted output signal 2012." (Ex. 1001 at 7:37-41.).

117. The dependent claims confirm that a "frequency translation module" simply may be a switch. Dependent claim 18 recites that the "first translation module comprises a first switch coupled to said first storage module" and the

"second frequency translation module comprises a second switch coupled to said second storage module." Dependent claim 19 recites that each of the first and second switches comprises "a first port; a second port; and a third port," while dependent claim 20 recites that the first ports of the switches are for receiving the electromagnetic signal, the second ports are for receiving a control signal, and the third ports are coupled to a storage device (*e.g.*, a capacitor).

C. "storage module" (Claims 1, 18)

118. Claim 1 recites a (1) "a first storage module" and (2) a "a second storage module." To the extent it is argued or determined that 35 U.S.C. § 112(6) applies to the first and second "storage module," the claimed function is to store electromagnetic charge. (Ex. 1001, claim 1.) And the corresponding structure disclosed in the '835 patent for a "storage module" is a capacitor (brown) that is one part of the "aliasing module 2000" (blue), which aliasing module has two alternative configurations shown in Figures 20A and 20A-1 and discussed previously. Claim 3 expressly requires a "storage module" to be a "capacitor," and the specification discloses "an inductor" as an alternative structure. (*Id.* at claim 3, 11:8-25.). Accordingly a "storage module" can be a capacitor or an inductor.

119. I understand that in a pending litigation against Intel, ParkerVision attempted to read in functional language, *i.e.*, "for driving a low impedance load," into similar claim terms from other of ParkerVision's patents. (Ex. 1011: *compare*

"Plaintiff's Proposed Construction" *with* "Court's Final Construction," for each of claim terms: "energy storage element," "energy storage device," "energy storage module," "storage element," and "storage module."). I understand that the Court rejected ParkerVision's attempt to read this function into the claims, *see id*., and, in my opinion, the PTAB should do the same if ParkerVision argues that a "storage module" in the challenged claims is "for driving a low impedance load."

IX. OVERVIEW OF THE PRIOR ART REFERENCES

A. Hulkko (Ex. 1004)

120. Just like as shown in Figure 54B of the '835 patent and recited in the challenged claims, Figure 2 of Hulkko shows a modem for down-converting an electromagnetic signal (purple), with the modem comprising first and second frequency down-conversion modules (red and green, respectively), a local oscillator (pink) to create an in-phase oscillating signal, and a phase-shifter (orange) to create a quadrature-phase oscillating signal:[4]

[4] Hulkko discloses that control signals PHI3 and PHI4 are 90 degrees out of phase with each other. (Ex. 1004 at 4:5-9.).

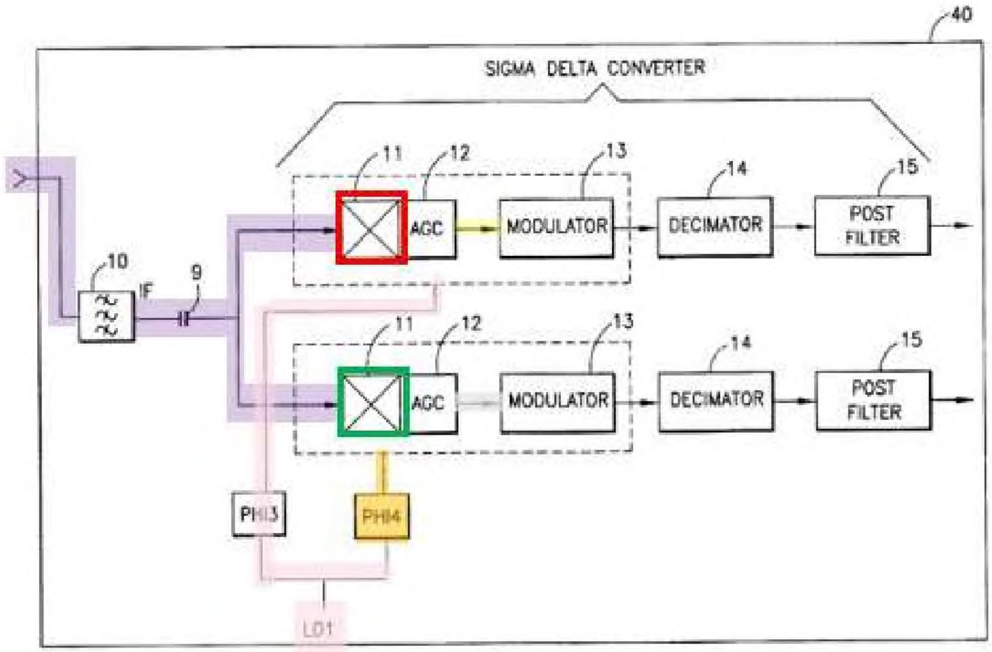


FIG.2

Ex. 1004-Hulkko, Fig. 2.

121. As shown above, Hulkko discloses that the first frequency down-conversion module (mixer 11, red) receives the electromagnetic signal (purple) and the in-phase oscillating signal (pink); while the second frequency down-conversion module (mixer 12, green) receives the electromagnetic signal (purple) and the quadrature-phase oscillating signal (orange).

122. Hulkko Figure 4 discloses that each of the two frequency down-conversion modules shown in Hulkko's Figure 2 includes a first frequency translation module (switch 31, blue) and a storage module (capacitor 30, brown):

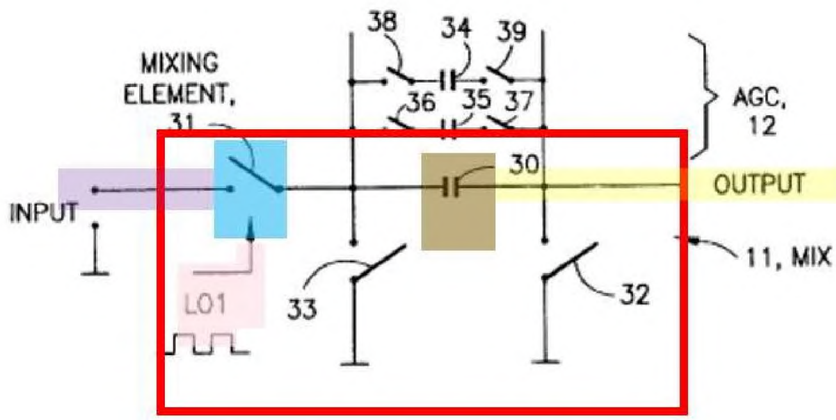


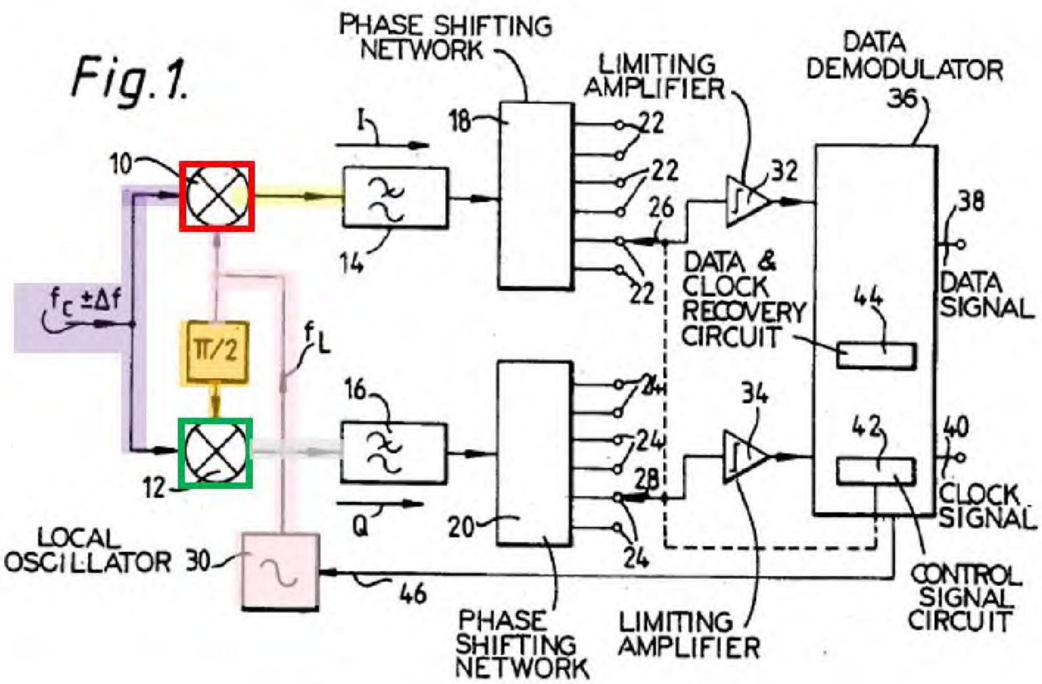
FIG.4

Ex. 1004-Hulko, Fig. 4.

123. Hulkko's frequency translation modules perform down conversion by sampling the input signal using a switched capacitor, just like the alleged invention disclosed and claimed in the '835 patent. In particular, Hulkko discloses that the "mixer 11 can be considered as a sample and a hold circuit that sample the input signal in synchronization with the oscillator and directs the samples to the output as a signal which remains constant for the period of the sampling interval." (Ex. 1004, Col. 5:13-17). A "first capacitor 30 is used to sample and hold the incoming signal." (*Id.* at 4:61-5:12). Hulkko discloses that "the inventive idea is realized in the circuit arrangement … with which switched capacitor switching elements present in the input stage … are used to implement the mixer 11 which directly demodulates the IF-signal into a base-frequency signal." (*Id.* at Col. 5:39-48).

B. Gibson (Ex. 1005)

124. Similar to Figure 54B of the '835 patent and Hulkko, Gibson Figure 1 discloses a modem used to down-convert a modulated RF signal into an in-phase sampled signal ("I") and a quadrature-phase sampled signal ("Q"):



Ex. 1005-Gibson, Fig. 1

125. The modem receives an input electromagnetic signal (purple) and has first and second frequency down-conversion modules (red and green, respectively), a local oscillator to generate an in-phase oscillating signal (pink), and a phase-shifter to generate a quadrature-phase oscillating signal (orange). Gibson's first frequency down-conversion module (mixer 10, red) receives the electromagnetic signal (purple) and the in-phase oscillating signal (pink); while Gibson's second

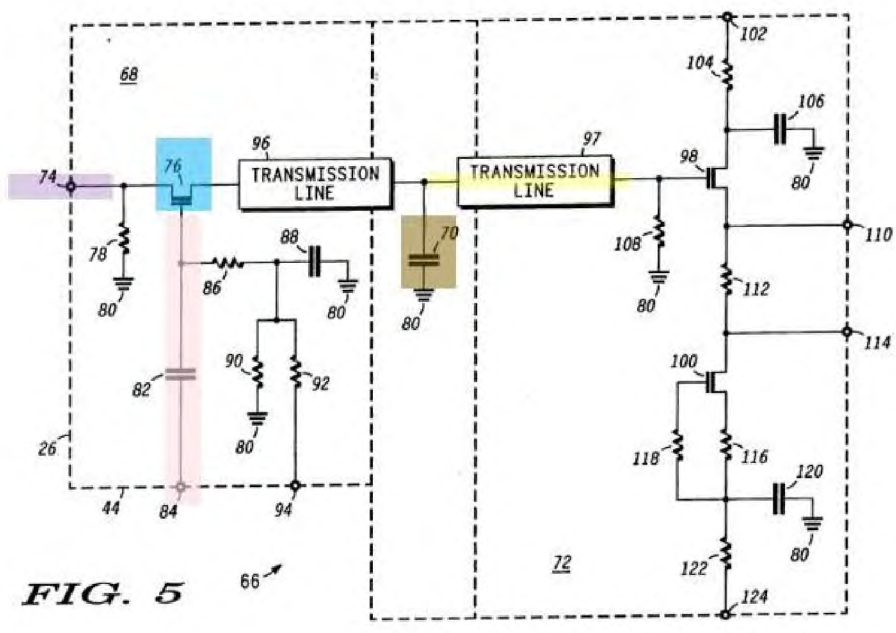
frequency down-conversion module (mixer 12, green) receives the electromagnetic signal (purple) and the quadrature-phase oscillating signal (orange).

126. Gibson discloses that the local oscillator frequency "f_L" is "substantially equal to carrier frequency f_C." (Ex. 1005 at 2:55-60.). While the frequency of the in-phase and quadrature-phase oscillating signals (pink and orange above, respectively) are both equal to f_L, the oscillating signals are 90 degrees out of phase. (*Id.*). The first frequency down-conversion module (mixer 10, red) down-converts a modulated carrier signal (purple, f_c +/- Δf) to form an in-phase signal ("I," of frequency Δf). (Ex. 1005 at 2:55-3:2.) Similarly, the second frequency down-conversion module (mixer 12, green) down-converts the modulated carrier signal (purple, having frequency f_c +/- Δf) to form a quadrature-phase signal ("Q," of frequency Δf, shifted in phase by 90 degrees relative to "I"). (*See id.*).

C. Schiltz (Ex. 1006)

127. Schiltz discloses a "high speed sample and hold circuit" comprising a switched capacitor, which circuit is used "as a mixer." (Ex. 1006 at 1:5-10); *see also id*. at 3:45-65, 4:29-32 ("Sample and hold circuit 26 operates as a downconverter in radio 10. Sample and hold circuit 26 converts a high frequency RF signal into an IF signal in a single operation."), 6:3-10 ("Sample and hold circuit 26 … samples the RF signal while the pulses supplied by pulse generator 30

(see FIG. 1) are active and holds the samples while the pulses are inactive."), 7:58-60, 10:15-17 ("[T]he present invention provides an improved radio which uses a sample and hold circuit in various mixing applications, such as down conversion."), 10:29-31 ("[A] high bandwidth results when the sample and hold circuit is used as a mixer.", 10:40-45 ("[T]hose skilled in the art will appreciate that radio and other architectures other than those described herein may utilize a sample and hold circuit as a mixer."). The structure of Schiltz's sample and hold circuit (26) is shown in Figure 5 below, which discloses a mixer featuring a sampling switch 68 (comprising a field effect transistor 76, blue) and a "hold capacitor" 70 (brown):



Ex. 1006-Schiltz, Fig. 5.

128. The input electromagnetic signal (purple) enters at contact 74, which serves as the sampling input and couples to a source of field effect transistor 76 (blue). (Ex. 1006 at 7:58-8:48.). Contact 84 serves as the input for a control oscillating signal (pink) for the sample and hold circuit 26, and couples to a gate of field effect transistor 76. (*Id.*; *see also id.* at Figure 1 depicting "pulse generator 30."). Field effect transistor 76 operates as a switch and samples the incoming signal. (*Id.* at 7:58-8:48). The drain of field effect transistor 76 is coupled to "hold capacitor 70" and serves as the output of the sample and hold switch 68, which outputs a sampled signal (yellow). (*Id.*).

D. DOCSIS References (Goldberg (Ex. 1007), Thacker (Ex. 1008))

129. As the '835 patent acknowledges, "DOCSIS is a Cable Modem Standard that stands for Data Over Cable Service Interface Specification (DOCSIS), and defines the interface requirements for cable modems involved in high-speed data transmission over cable television networks." (Ex. 1001 at 40:8-12; *id.* at 40:17-35 (listing "well known devices" including DOCSIS-compliant cable modems.). DOCSIS was first released on March 26, 1997, and was described in patents and printed publications. (Ex. 1008 (Thacker) at 1:30-40 ("MCNS released its … DOCSIS … to vendors in March 1997. Many vendors have announced plans to build products based on MCNS DOCSIS standard."); Ex. 1007 (Goldberg) at 4-8). DOCSIS mandated the QAM modulation format. (Ex.

1008 (Thacker) at 1:50-62; Ex. 1007 (Goldberg) at 5 ("[T]he shared downstream channel uses either 64- or 256- point quadrature-amplitude modulation (QAM)."). Indeed, Figures 2 and 3 of Goldberg discloses some of the same Broadcom cable modem products, including the BCM3116 QAM receiver and the BCM3037 QPSK/16-QAM modulator (Ex. 1007, Figs. 2, 3), that the '835 patent admits were "well known devices." (Ex. 1001 at 40:17-35).[5]

E. ITU-T J.83b (Ex. 1009)

130. Another international cable data standard that was well established prior to the filing of the '835 patent was the ITU-T J.83b standard that was used for QAM television. (Ex. 1009.) As mentioned previously, I can personally confirm that Ex. 1009 was published in 1997. In particular, in 1998 I built and designed and built an ITU-T J.83b-complaint transmitter and receiver while working at Alantro Communications, Inc. in Santa Rosa, CA. Our implementation was coded in Matlab and in HDL (hardware design language). We sold this design as an IP core to Sarnoff Corporation. Sarnoff integrated our IP into their complete cable modem product. https://en.wikipedia.org/wiki/Sarnoff_Corporation. In 1998 I had the ITU-T J.83b specification in my possession. My advisor for my Ph.D. at

[5] Other patents corroborate that DOCSIS was well-known before the '835 patent. *See* USPN 6,088,569 at 1:9-22 ("[O]ne such system is being proposed by the Multimedia Cable Network System (MCNS) consortium for data over cable television communication in … DOCSIS"); USPN 6,181,716 at 1:5-17 (" DOCSIS 1.0 was ratified by the … ITU … in March of 1998.").

Cornell University had contributed to the coding techniques in ITU-T J.83b which resulted in me being aware of its publication in 1997.

F. Applicant Admitted Prior Art ("AAPA")

131. The '835 patent contains the following applicant admitted prior art:

> The cable modem receivers, transmitters, and transceivers of the present invention may be implemented using a variety of ***well known devices***. In embodiments, these receivers, transmitters, and/or transceivers may be implemented by a BCM3415 CMOS Digital Cable Tuner, a BCM3125 QAMLink™ Universal Set-Top Box Transmission Solution, a BCM3120-Set-Top Box Transceiver, a BCM3116-QAMLink™ 64/256-QAM ITU-B Receiver, a BCM3118B-QAMLink™ 64/256-QAM DVB/DAVIC Receiver, a BCM3115-QAMLink™ 64/256-QAM Dual-Channel Receiver, a BCM3037-QAMLink™ QPSK/16-QAM Burst Modulator, a BCM3033-QAMLink™ Universal Modulator, a BCM3137-QAMLink™ QPSK/16-QAM Burst Demodulator, a BCM3360 QAMLink™ Single-Chip MCNS/DOCSIS Cable Modem, a BCM93310 DOCSIS External Cable Modem, a BCM93310i DOCSIS Internal PCI Cable Modem, and/or a BCM3300-QAMLink™ Single-Chip MCNS/DOCSIS Cable Modem, manufactured by Broadcom™ Corporation.

(Ex. 1001 at Col. 40:17-35) (emphasis added) ("AAPA").

132. It is my understanding that statements in a challenged patent like these may be used in IPR proceedings when they evidence the general knowledge possessed by someone of ordinary skill in the art, and, at least when used in conjunction with one or more prior art patents or publications, such statements can support an obviousness argument. Here, it is my opinion that the AAPA is evidence of certain general knowledge at the time of the invention: (1) cable

modems were known; (2) cable modems could demodulate QAM signals; and (3) standard-compliant cable modems were known.

G. Motivation to Combine

1. Ground 1: Hulkko in View of Gibson

133. In my opinion, a POSITA would have been motivated to combine the teachings of Hulkko with Gibson. In particular, a POSITA would have been motivated to use Gibson's phase shifter (Ex. 1005, Fig. 1 "π/2") to provide a quadrature-phase oscillating signals to branch "PHI4" of the receiver in Hulkko's Figure 2.

134. First, Hulkko itself discloses that the oscillating signal supplied to first mixer 11 (through "PHI3") is 90 degrees out of phase with the oscillating signal supplied to second mixer 12 (through "PHI4"). (Ex. 1004, Hulkko at Fig. 2; 4:5-9 ("PHI3 = +45º PHI4 = -45º "). However, while Hulkko is silent as to the mechanism for making these signals be 90 degrees out of phase, Gibson shows expressly that at it was conventional to use a phase shifter to supply a quadrature-phase oscillating signal. Specifically, Gibson Figure 2 discloses phase shifter "π/2," which takes as input the in-phase oscillating signal "f_L" from local oscillator 30, and outputs a quadrature-phase oscillating signal to mixer 12. (Ex. 1005 at Fig. 2, 2:56-3:2.).

135. Second, both references show that a POSITA would have recognized the benefits of using a phase shifter as taught by Gibson, in that the receiver could be used to demodulate an I/Q modulated signal such as a QAM modulated signal. Hulkko expressly teaches that "[w]hen the input signal (in) is branched into two different branches, it is possible to arrange the receive circuit arrangements of embodiments of this invention in each of the branches. The demodulation of an I/Q modulated signal (I=in the phase, Q=in the phase shift of 90 degrees) may be implemented simply this way using principles known per se and described by way of example in" a textbook. (Ex. 1004 at 6:35-45.) Similarly, Gibson Figure 1 shows that first mixer 10 outputs an "I" signal and second mixer 12 outputs a "Q" signal. (Ex. 1005 at Fig. 1, 2:56-3:2.).

136. Moreover, in my opinion, combining Hulkko with Gibson would have yielded only expected, predictable results. Just as Hulkko teaches forming two control signals that are 90 degrees out of phase with each other by shifting a local oscillator signal by +45 degrees (Ex. 1004 at Fig. 2 "PHI3") and – 45 degrees (Fig. 2 "PHI4"), respectively (*see id*. at 4:5-9), Gibson teaches forming two control signal that are 90 degrees out of phase with each other by using a simpler structure—*i.e.*, a single, 90 degree phase shifter (Ex. 1005 at Fig. 1 "π/2"). Each combination would have been (1) a combination of prior art elements according to known methods to yield predictable results, since a POSITA would have

understood how to implement a phase shifter (as taught by Gibson) in the context of Hulkko; and (2) obvious to try—a choice of one type of phase shifting device from a finite number of identified, predictable solutions, with a reasonable expectation of success.

2. Ground 2: Gibson in View of Schiltz

137. It is also my opinion that a POSITA would have been motivated to combine the teachings of Gibson with Schiltz. In particular, a POSITA would have been motivated to use Schiltz's sample and hold circuit (Ex. 1006, Figs. 1 and 5 at circuit 26) to use as a respective mixer in each of the two branches of Gibson's receiver (Ex. 1005, Fig. 2 at mixers 10 and 12).

138. First, Gibson itself expressly discloses using a first mixer (Fig. 2 at 10) to down-convert an electromagnetic signal ("f_C +/-Δf") by mixing the symbol with an in-phase oscillating signal ("f_L"), and using a second mixer (Fig. 1 at 12) to down-convert the electromagnetic signal by mixing it with a quadrature-phase oscillating signal (frequency "f_L" shifted by 90 degrees in phase). (Ex. 1005 at Fig. 1; 2:55-3:2 ("… input signal … is applied to quadrature mixers 10, 12 …")). However, Gibson does not expressly disclose the precise inner workings of its mixers. Schiltz shows that it was conventional to use a "sample and hold circuit ***as a mixer***" for down-conversion. (Ex. 1006 at 1:5-10 (emphasis added), 10:15-22 ("an improved radio which uses sample and hold circuit ***in various mixing***

applications, such as down conversion … Due to the use of a sample and hold circuit ***as a mixer***, only a single stage is required to down convert a high frequency RF signal[.]") (emphasis added)). Schiltz therefore expressly teaches POSITA to use a sample and hold mixer for down-conversion, just as Gibson teaches POSITA to use mixers for down-conversion.

139. Second, a POSITA would have recognized the benefits of using the sample and hold circuit, as taught in Schiltz for each of the mixers disclosed by Gibson. For example, Schiltz encourages the use of a sample and hold circuit because "the sample and hold circuit may be accurately operated at high frequencies" and "may be applied to virtually any frequency RF and IF signals." (Ex. 1006 at 10:15-48.).

140. Further, in my opinion, combining Gibson with Schiltz would have yielded only expected, predictable results. Each combination would have been (1) a combination of prior art elements according to known methods to yield predictable results, since a POSITA would have understood how to implement a sample and hold mixer (as taught by Schiltz) in the context of Gibson; and (2) obvious to try—a choice of one type of mixer from a finite number of identified, predictable solutions, with a reasonable expectation of success.

3. "Cable Modem"

141. If the Board finds that the preamble of claim 1 is limiting and requires a "cable modem," it is my opinion that a POSITA would have been motivated to use the modems of Hulkko modified with Gibson (as in Ground 1 of the Petition), and Gibson modified with Schiltz (Ground 2), as "cable modems," in view of the DOCSIS References (Thacker and Goldberg), ITU-T J.83b, and AAPA.

142. First, as discussed above the modems of Hulkko modified with Gibson (Ground 1) and Gibson modified with Schiltz (Ground 2) are useful for down-converting an I/Q modulated electromagnetic signal. Thacker, Goldberg, and ITU-T J.83b show cable data standards were released long before the priority date of the '835 patent, and mandated use of I/Q modulation (*e.g.*, QAM) in cable modems. (Ex. 1008 (Thacker) at 1:30-40, 1:50-62; Ex. 1007 (Goldberg) at 4; Ex. 1009 (ITU-T J.83b) at 10, Table 1). After DOCIS 1.0 and J.83b were each released in 1997, cable modems rapidly gained popularity, providing an incentive to use I/Q modems like those disclosed in primary references Hulkko and Gibson as cable modems. (Ex. 1008 (Thacker) at 1:30-40, 1:50-62; Ex. 1007 (Goldberg) at 4 ("MCN/DOCSIS MAC Clears a Path for the Cable-Modem Invasion")).

143. Second, AAPA shows that QAM modems (such as disclosed in Hulkko and Gibson) had been implemented in a "variety of well known devices," including various QAM and QPSK cable modems manufactured by Broadcom.

(Ex. 1001 at 40:17-35.). This demonstrates that making and using such devices—for use as "cable modems"—was within the general knowledge and level of skill in the art, supplying further motivation to use the modems of Hulkko/Gibson and Gibson/Schiltz as cable modems. Notably, some of the same Broadcom devices that the '835 patent admits were "well known" are disclosed in Goldberg. (Ex. 1007 at Figs. 2, 3).

144. Third, in my opinion, neither the Patent Owner nor the examiner placed any criticality on the use of the structure recited in the body of claim 1 as a "cable modem" during prosecution, and the body of the claim recites a structurally-complete invention capable of being used as a "cable modem" (as that term is used in the '835 patent). Moreover, as discussed above, the specification of the '835 patent states that a "cable modem" can be wired *or wireless*, and can be compliant with DOCSIS *or not compliant* with any standard. Thus, within the context of the '835 patent, a modem is a "cable modem" so long as it includes communication at RF frequencies over cables and this includes the communication of data for television. Again, as discussed previously, this communication can even be performed wirelessly within the context of the '835 patent. To the extent that the preamble of claim 1 is accorded any patentable weight, it is my opinion that the modems of Hulkko modified with Gibson (Ground 1), and Gibson modified with Schiltz (Ground 2), have the structure recited in claim 1, and a POSITA would

have been motivated to use them as cable modems in view of Thacker, Goldberg, ITU-T J.83b, and AAPA.

145. Finally, using the modems of Grounds 1 and 2 as "cable modems" would have yielded only expected, predictable results. Especially in view of Thacker, Goldberg, and AAPA discussed above, each combination would have been (1) a combination of prior elements according to known methods to yield predictable results; and (2) obvious to try, with a reasonable expectation of success.

X. SPECIFIC GROUNDS FOR PETITION

A. Ground I: Claims 1, 12, 15, and 17 are Obvious Over Hulkko in View of Gibson

146. For the reasons shown below, it is my opinion that claims 1, 12, 15, and 17 are obvious over Hulkko in view of Gibson. If the Board finds that the preamble of claim 1 is limiting and requires a "cable modem," then it is my opinion that these claims are obvious over Hulkko in view of Gibson, and further in view of the Thacker, Goldberg, ITU-T J.83b, and/or AAPA.

1. Claim 1

(a) Element [1 preamble]: "A cable modem for down-converting *an electromagnetic signal having complex modulations,* comprising"

147. Hulkko discloses a modem for down-converting an electromagnetic signal having complex modulations. (Ex. 1004 at Fig. 2):

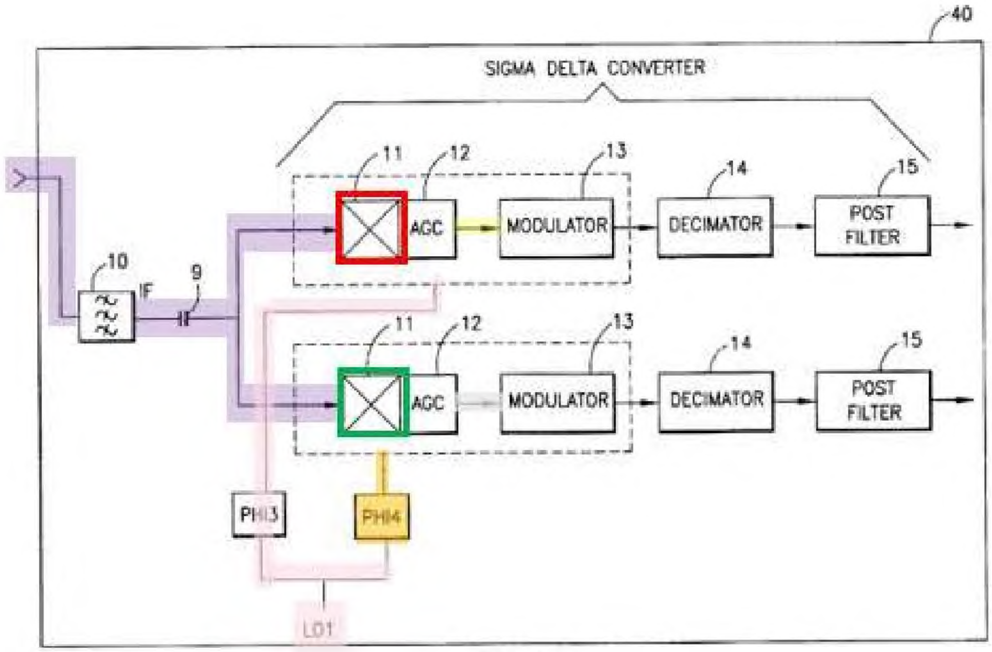


FIG.2

(Ex. 1004 at 2:38-40 ("… down converting the carrier frequency signal using a time discrete sampling means ...")).

148. To the extent that the preamble is limiting and the electromagnetic signal must have "complex modulations," Hulkko discloses complex modulations because the invention works with "QAM" modulation and "an I/Q modulated signal," all of which were complex modulation formats within the general knowledge of a POSITA at the time. (Ex. 1001 at 2:1-3, 6:35-45.).

149. QAM modulation is viewed as a "complex modulation" because QAM can be viewed as $Re\{(x(t) + j\ y(t))\ exp(2\pi f_c t)\} = Re\{(x(t) + j*y(t))(cos(2\pi f_c t) + j\ sin(2\pi f_c t))\} = x(t)cos(2\pi f_c t) - y(t)sin(2\pi f_c t)$. Here, "Re" means to take the real part of the complex expression in brackets; "j" is the square root of

negative one, "f_c" is a carrier frequency, and the term "exp($2\pi f_c t$)" means to raise Euler's number ("e," approximately 2.71828) to the power "$2\pi f_c t$." The term x(t) + j y(t) represents the QAM signal used to modulate the carrier wave, and it is complex (because y(t) is multiplied by j). The x(t) represents the in-phase portion (I), and the y(t) represents the quadrature portion (Q), both of which are functions of time. Indeed, Goldberg explicitly refers to QAM modulation as "[c]omplex phase/amplitude modulation." (Ex. 1007 at 5.).

150. And to the extent that "cable modem" is limiting, as I discussed above, it would have been obvious to use the modem of Hulkko (as modified by Gibson, discussed below) as a cable modem, in view of the DOCSIS References (Thacker, Goldberg), ITU-T J.83b, and/or AAPA.

(b) Element [1A]: "an *oscillator* to generate an in-phase oscillating signal"

151. Hulkko discloses as oscillator (Fig. 2, "LO1") to generate an in-phase signal. (Ex. 1004 at Fig. 2, 3:54-57 ("The switched capacitor switching elements providing the mixing function of the mixer 11 are driven by a square wave local oscillator signal (LO1")). The in-phase oscillating signal is the output of "PHI3" (pink) and has a phase that is 90 degrees offset from the quadrature-phase oscillating signal travelling through "PHI4" (orange):

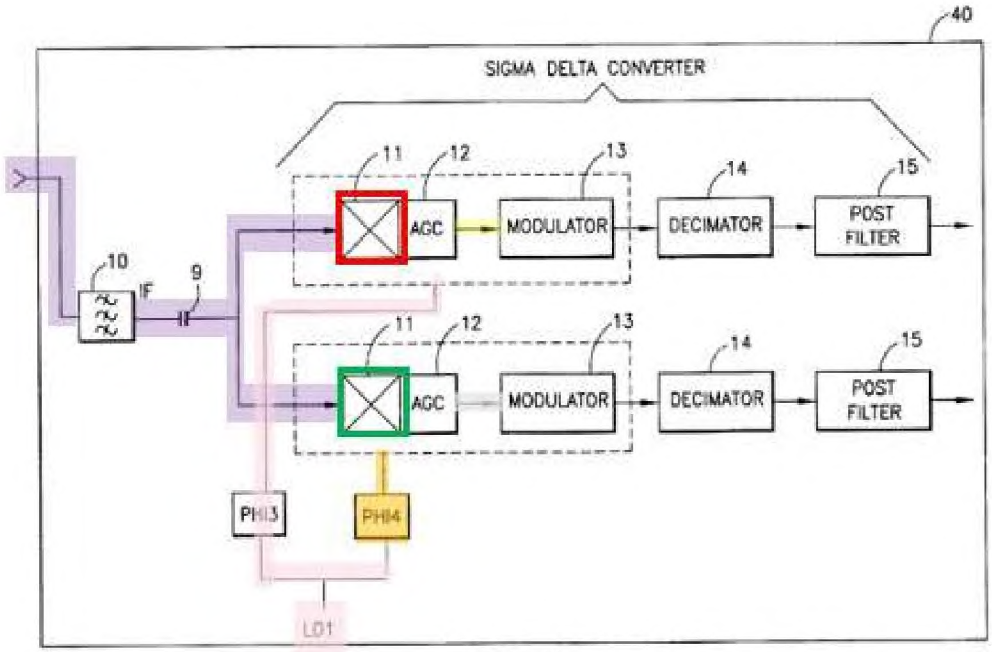


FIG.2

(c) Element [1B]: "a *phase shifter* to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal"

152. Hulkko Figure 2 discloses a phase shifter ("PHI4") to receive said in-phase oscillating signal (pink) and to create a quadrature-phase oscillating signal (orange signal output from "PHI4"):

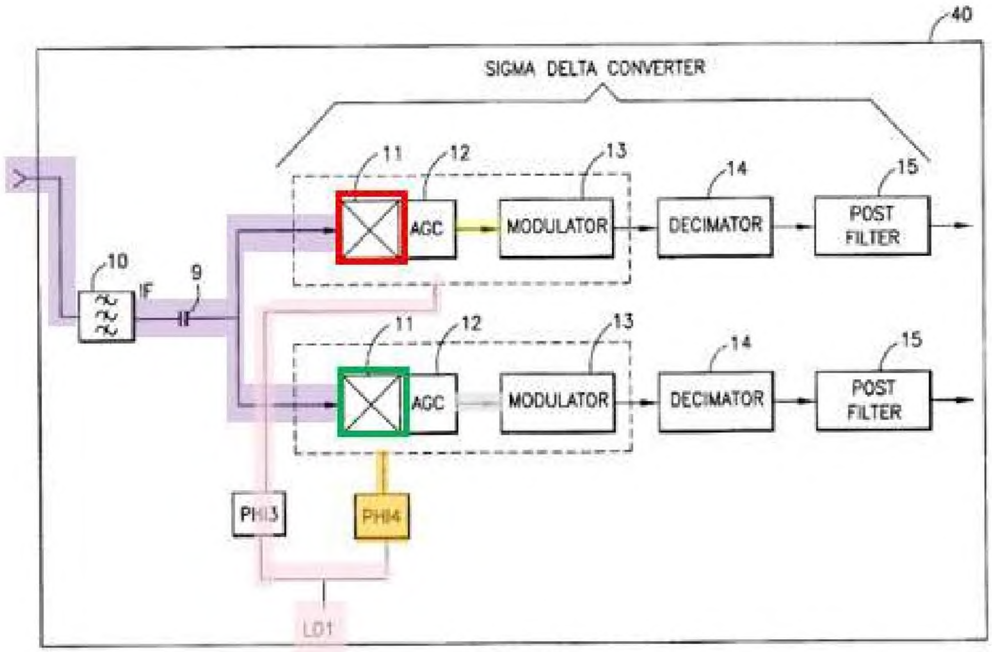
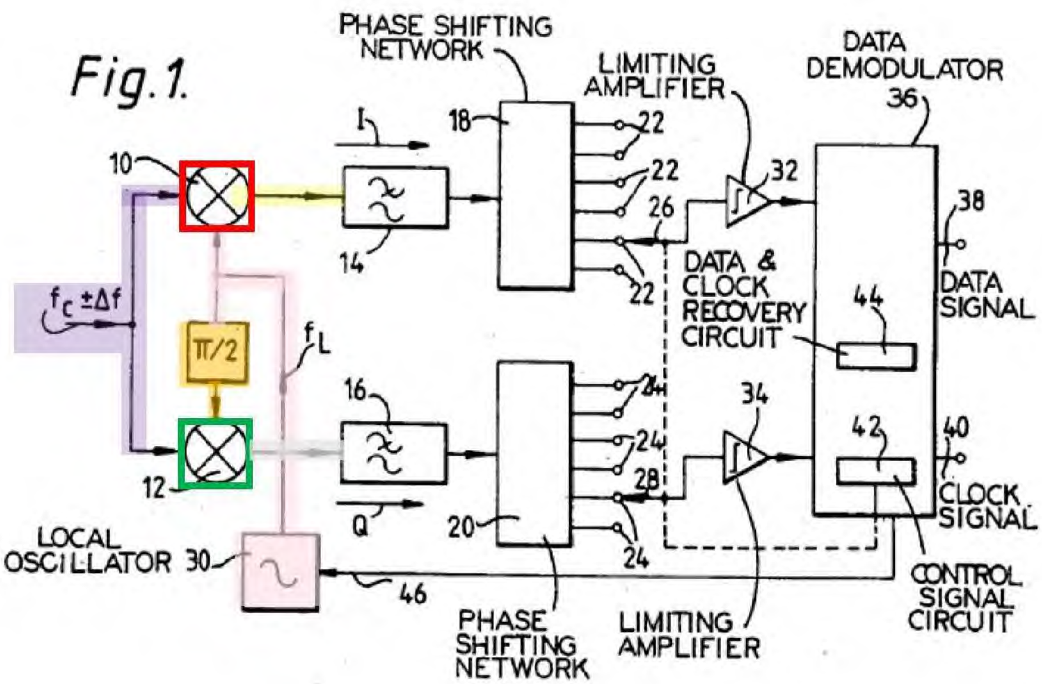


FIG.2

153. The quadrature-phase oscillating signal is 90 degrees out of phase with the in-phase oscillating signal. (Ex. 1004 at 3:48-4:9 ("PHI3 = + 45º," "PHI4 = - 45º")). Moreover, the in-phase signal (through PHI3) and the quadrature-phase signal (through PHI4) can be used for demodulating an I/Q modulated signal. (Ex. 1004 at 6:35-45 ("When the input signal (in) is branched into two different branches, it is possible to arrange the receive circuit arrangement of embodiments of this invention in each of the branches. The demodulation of an I/Q-modulated signal (I=in the phase, Q=in the phase shift of 90 degrees) may be implemented simply in this way using principles known per se and described by way of example in Digital Communication, Edward A. Lee, David G. Messershmitt, Kluwer Academic Publishers, Boston, 1990 incorporated herein by reference.").

154. To the extent it is argued or determined that Hulkko fails to disclose Element [1B], it is my opinion that it would have been obvious to modify the arrangement of Hulkko's PHI3 and PHI4 by eliminating PHI3 and replacing PHI4 with a 90 degree phase-shifter, such that the first mixer 11 (red) uses the signal from the local oscillator directly as the in-phase oscillating signal, and the 90 degree phase-shifter outputs a quadrature-phase oscillating signal to the second mixer 11 (green) as taught by Gibson:



155. Gibson (Ex. 1005) Figure 1 above shows a local oscillator (30) to create an in-phase oscillating signal (pink) and a phase shifter (orange "π/2 ") to receive said in-phase oscillating signal and to create a quadrature-phase oscillating

signal (orange signal from phase shifter "π/2 " output to green mixer 12). I discussed certain motivations for combining these references above.

(d) Element [1C]: "a *first frequency down-conversion module* to receive the electromagnetic signal and said in-phase oscillating signal"

156. Hulkko discloses a first frequency down-conversion module (red mixer 11) to receive the electromagnetic signal (purple) and said in-phase oscillating signal (pink):

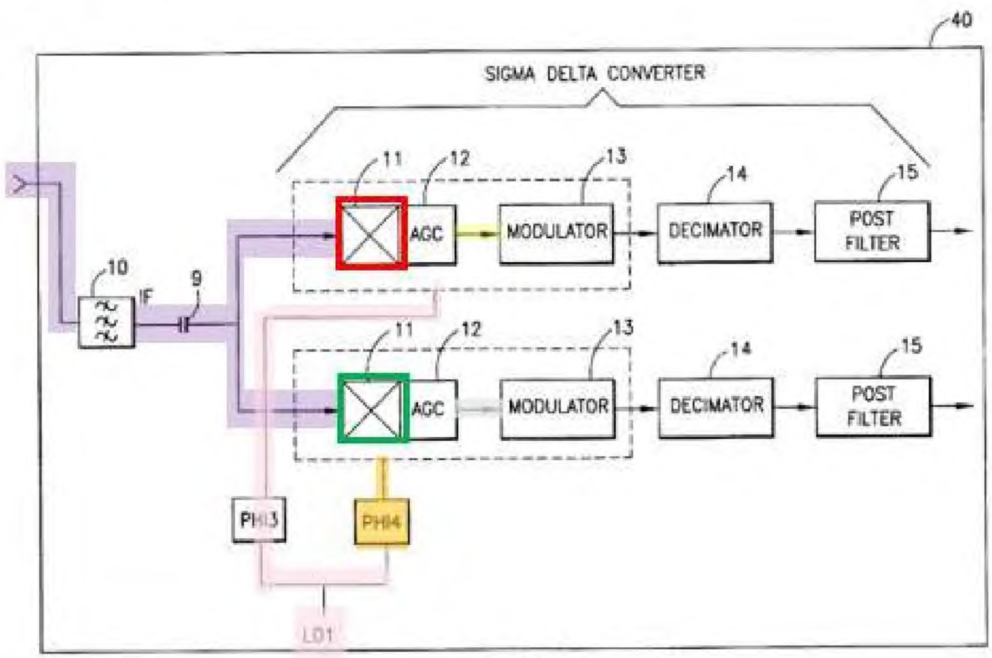


FIG.2

157. Mixer 11 down-converts the received electromagnetic signal to baseband or an intermediate frequency. (Ex. 1004 at 5:12-6:34; *id.* at 5:34-37 ("The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band or a frequency approaching the

base band."); *id* at claim 1 ("A receiver for receiving a modulated carrier signal comprising … a time discrete sampling means … controlled by a square wave local oscillator for down converting the received modulated carrier signal to a base-band signal ….").

(e) Element [1D]: "a *second frequency down-conversion module* to receive the electromagnetic signal and said quadrature-phase oscillating signal"

158. Hulkko discloses a second frequency down-conversion module (green mixer 11) to receive the electromagnetic signal (purple) and said quadrature-phase oscillating signal (orange):

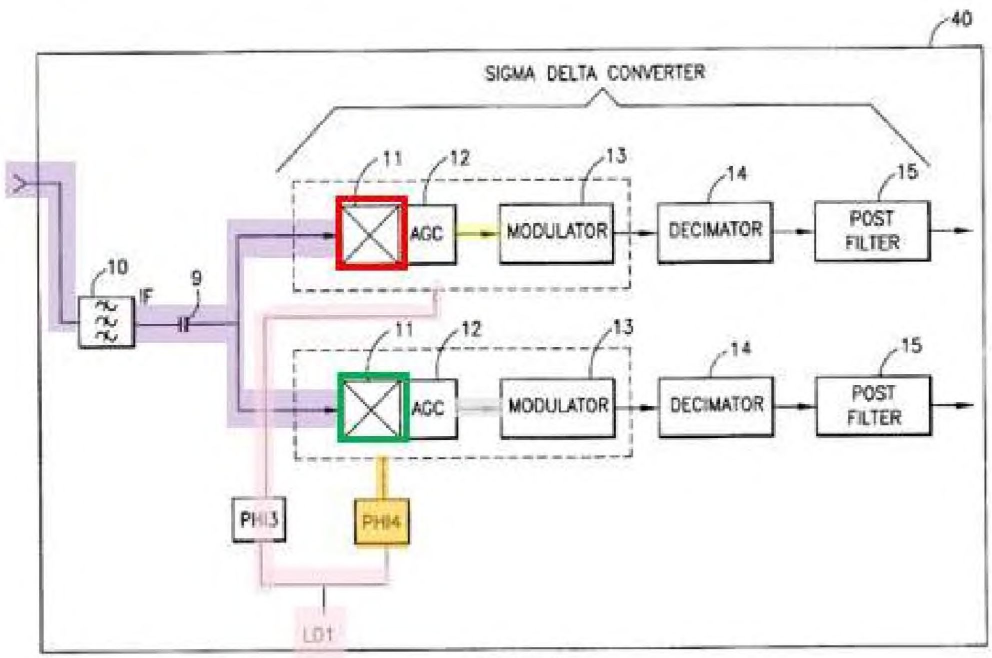


FIG.2

159. The second frequency down-conversion module of Hulkko (green mixer 11) is structurally identical to its first frequency down-conversion module

(red mixer 11) discussed above with respect to Element [1C], the only difference being that the first down-conversion module receives the in-phase oscillating signal (pink) while the second down-conversion module receives the quadrature-phase oscillating signal (orange). Like the first down-conversion module, the second down-conversion module (green mixer 11) down-converts the received electromagnetic signal to baseband or an intermediate frequency. (Ex. 1004 at 5:12-6:34; *id.* at 5:34-37 ("The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band[.]"); *id* at claim 1.).

(f) Element [1E]: "wherein said first frequency down-conversion module further comprises a *first frequency translation module*"

160. Hulkko discloses that the first frequency down-conversion module (red mixer 11) comprises a first frequency translation module (blue switch 31):

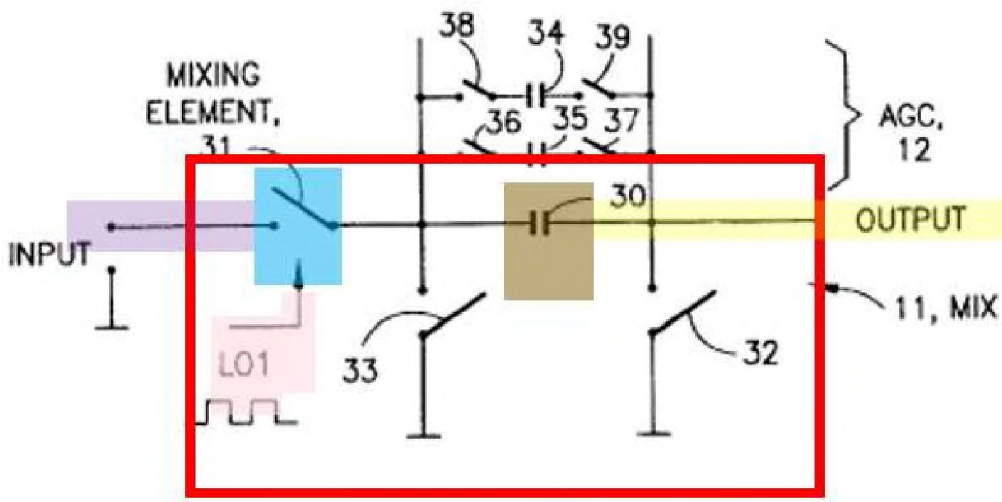


FIG.4

161. "It is preferable to use the first switch 31 of the switched capacitor switching element as the mixing element. In this case, signal bands around the multiples of the frequency of the local oscillator signal LO1 are folded onto the base frequency. The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band or a frequency approaching the base-band." (Ex. 1004 at 5:30-37; *see id.* at 4:61-6:34; claim 2 ("the time discrete sampling means comprises a switching member having an input node coupled to said received modulated carrier signal, and wherein said square wave local oscillator signal is coupled to said switching member for controlling the opening and closing of said switching member"); claim 3 ("the time discrete sampling means comprises switched capacitor switching elements")).

(g) Element [1F]: "and a *first storage module*"

162. As I discussed above, the '835 patent at Figs. 20A and 20A-1 provide two examples of frequency down-conversion modules wherein a capacitor is used as the constituent storage module. In Figure 4 and its accompanying description, Hulkko likewise uses a capacitor (brown capacitor 30) as the storage module of the claimed frequency down-conversion module:

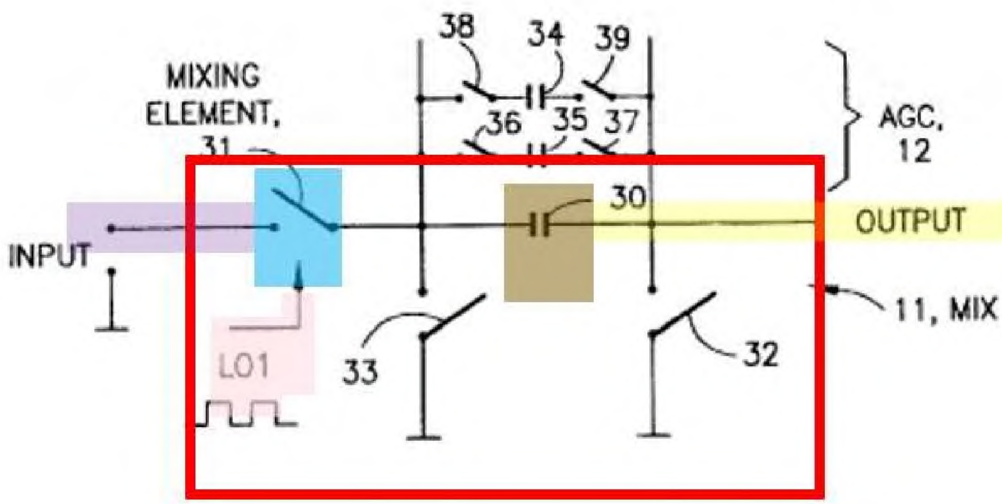


FIG.4

163. (*See* Ex. 1004 at 4:64-65 ("A first capacitor 30 is used to sample end [sic] hold the incoming signal."); claim 3 ("the time discrete sampling means comprises switched capacitor switching elements").).

(h) Element [1G]: "wherein said first frequency down-conversion module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating *a first sampled signal*"

164. As discussed above, Hulkko discloses that the first frequency down-conversion module (red mixer 11 in Figure 2, comprising blue switch 31 and brown capacitor 30 as shown in Figure 4) samples the electromagnetic signal (purple) at a rate that is a function of said in-phase oscillating signal (pink), thereby creating a first sampled signal (yellow, labelled "output" in Figure 4):

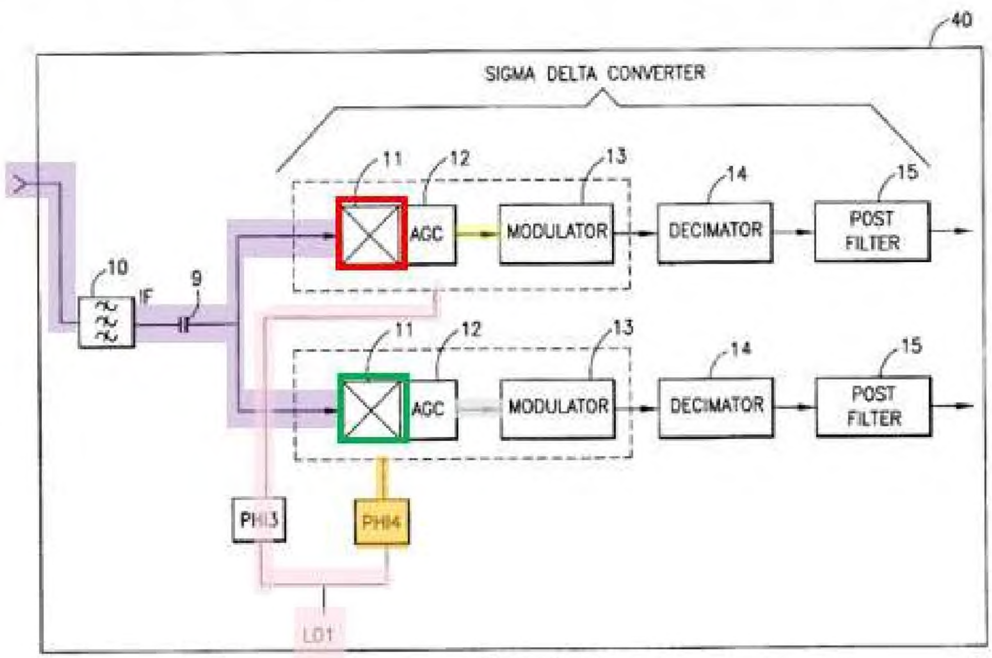


FIG.2

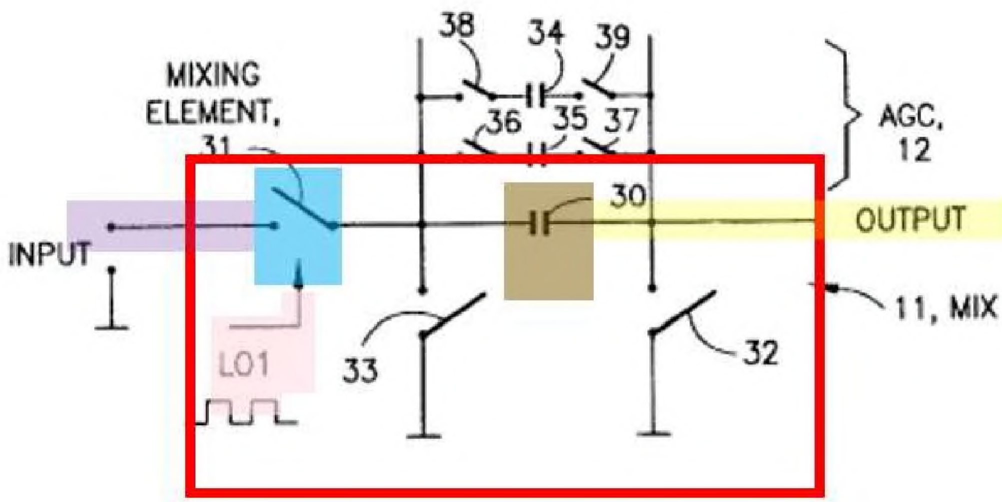


FIG.4

165. "It is preferable to use the first switch 31 of the switched capacitor switching element as the mixing element. In this case, signal bands around the multiples of the frequency of the local oscillator signal LO1 are folded onto the base frequency. The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band or a frequency approaching the base-band." (Ex. 1004 at 5:30-37; *see id.* at 4:61-6:34; claim 2 ("the time discrete sampling means comprises a switching member having an input node coupled to said received modulated carrier signal, and wherein said square wave local oscillator signal is coupled to said switching member for controlling the opening and closing of said switching member"); claim 3 ("the time discrete sampling means comprises switched capacitor switching elements").).

(i) Element [1H]: "said second frequency down-conversion module further comprises a *second frequency translation module*"

166. As discussed above with respect to Element [1E], Hullko discloses using a first frequency translation module comprising a switch 31 that is controlled by a control signal. The second frequency down-conversion module is in lower mixer 11 (green) in Hulkko's Figure 2 and is structurally identical to the first frequency down-conversion module (shown in Figure 4) discussed above.

167. As discussed above, the control signal that controls switch 31 in the second-frequency down conversion module (lower mixer 11, green in Figure 2) is the quadrature-phase oscillating signal coming from PHI4 in Figure 2 (orange).

(j) Element [1I]: "and a *second storage module*"

168. The second storage module (in lower mixer 11 in Figure 2) is the same as the first storage module (in upper mixer 11) discussed above with respect to Element [1F], each comprising a respective capacitor 30, as shown in Figure 4.

(k) Element [1J]: "wherein said second frequency down-conversion module samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating *a second sampled signal*"

169. As discussed above, Hulkko discloses that the second frequency down-conversion module (green mixer 11 in Figure 2, comprising switch 31 and capacitor 30 as shown in Figure 4) samples the electromagnetic signal (purple) at a

rate that is a function of said quadrature-phase oscillating signal (orange signal from "PHI4"), thereby creating a second sampled signal (gray in Figure 2 below, and labelled "output" in Figure 4):

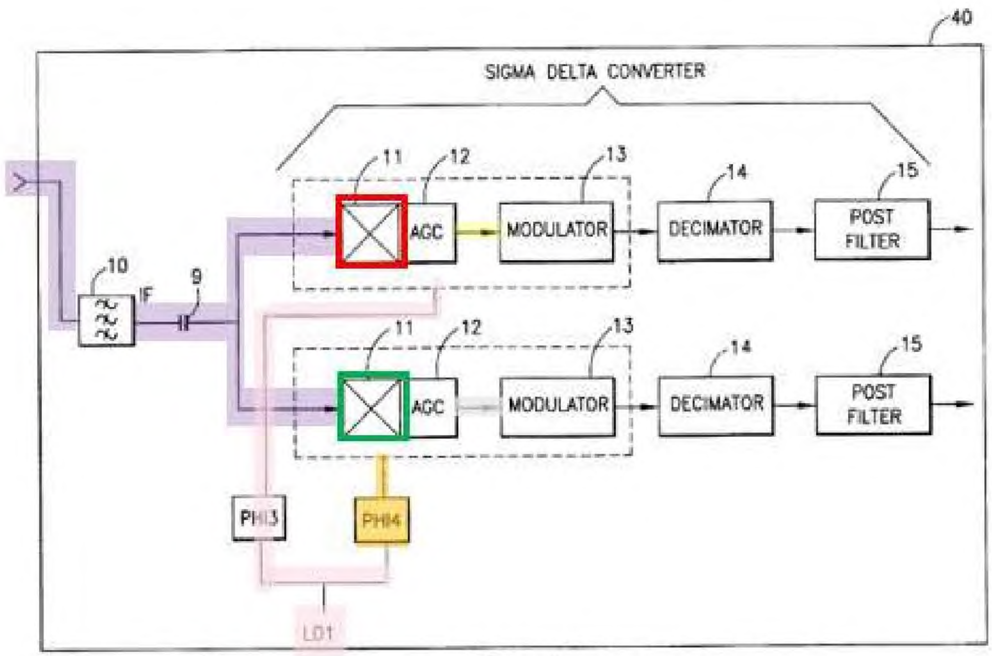


FIG.2

170. (*See* Ex. 1004 at 5:30-37, 4:61-6:34, claims 2 and 3.).

2. Claim 12: "The cable modem of claim 1, wherein said sampled signal is a first information output signal, and said second sampled signal is a second information output signal."

171. Hulkko in view *of* Gibson renders obvious claim 1 as discussed above.

172. Hulkko *discloses* or renders obvious a "first sampled signal" and a "second sampled signal." *See*, respectively, Element [1G] and Element [1J], *supra*. Each such output signal carries the baseband information signal that was previously modulated onto the carrier. (Ex. 1004 at 5:10-37 ("The mixer 11 can be

considered as a sample and hold circuit that samples the input signal in synchronization with the oscillator ***and directs the samples to the output as a signal*** . . . The local oscillator base frequency or its subharmonics can therefore be used to down convert the carrier signal to the base-band or a frequency approaching the base-band.") (emphasis added); *also* 2:30-37 ("there is provided a receiver for receiving a modulated carrier signal"); 6:35-45 (disclosing that input signal can comprise "an I/Q modulated signal" and be "branched into two different branches").).

3. Claim 15: "The cable modem of claim 1, further comprising a first filter receiving said first sampled signal and outputting a first filtered signal, and a second filter receiving said second sampled signal and outputting a second filtered signal."

173. Hulkko in view of Gibson renders obvious claim 1 as discussed above. Gibson Figure 1 discloses optionally using low pass filters 14 and 16 to receive the output of mixers 10 and 12, and each outputting a filtered signal. (Ex. 1005 at 2:60-65.). It would have been obvious to a POSITA to use such conventional low pass filters at the outputs of Hulkko's mixers in order to eliminate unwanted high frequency signals. In fact, this is a teaching of Gibson as well. Gibson teaches that filters may be applied after the mixer to eliminate unwanted high frequency signals. (Gibson, Ex. 1005 at 2:60-65 ("The outputs of

the mixers 10, 12 are filtered in low pass filters 14, 16 which will pass the modulation frequency Δf.”)).

4. Claim 17: “The cable modem of claim 1, wherein the electromagnetic signal has been transmitted by a wireless method to the cable modem.”

174. Hulkko in view of Gibson renders obvious claim 1 as discussed above.

175. As an initial matter, electromagnetic signals may propagate in only two ways: guided and unguided. A POSITA would know of both. The propagation of unguided EM waves is commonly called “wireless.” The propagation of a guided EM commonly occurs on conductors like a co-axial cable. A device that acts as an interface between guided and unguided EM signals is called an antenna. Further, a POSITA would know that cable modems operate at RF frequencies. For example, the Goldberg (Ex. 1007) discloses using frequencies from 54 to 860 MHz. By comparison, a POSITA knew that FM radio in the U.S. operates from 88 to 108 MHz. Thus, the carrier frequencies used even in wired cable modems are at such RF frequencies that could easily be transmitted and received wirelessly using an antenna.

176. Hulkko expressly discloses using its receiver on an electromagnetic signal that has been transmitted by a wireless method. (Ex. 1004 at *e.g.*, 4:22-26 (“The modulated reception signal (in), for instance a ***bandpass-filtered input-***

signal from the RF-part of the radio telephone 40, is directed to the mixer 11 (mix) to which the local oscillator (LO1) signal is also applied.") (emphasis added)). Further, it was well known at the time of the inventions that "modulated carrier signals" as disclosed in Hulkko could be (and most often were) "transmitted by a wireless method." Further, Hulkko's Figure 2 contains a triangular symbol known to a POSITA to indicate an antenna for receiving electromagnetic signals that have been transmitted wirelessly:

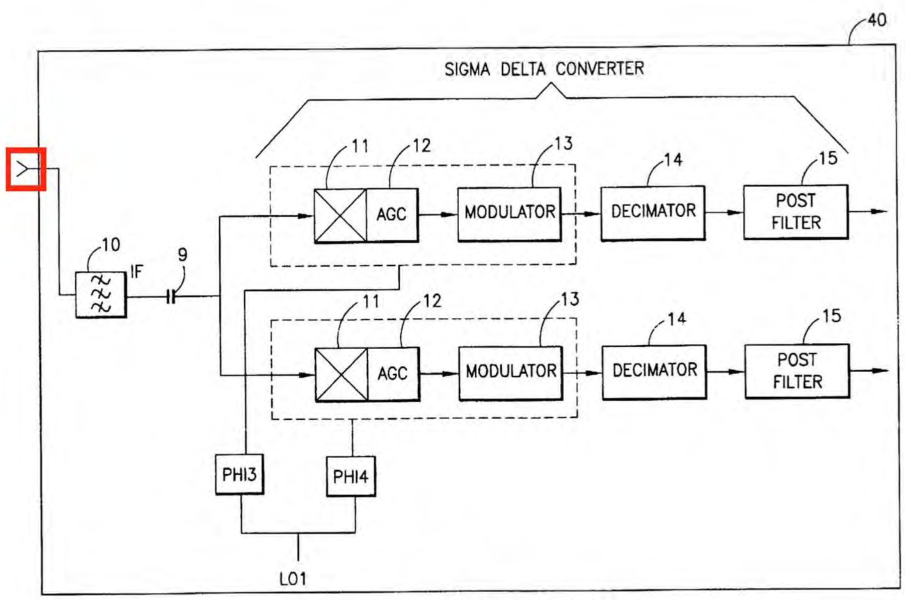


FIG.2

177. As discussed previously, a POSITA knows that an antenna is a device that acts as an interface between guided and unguided EM signals.

B. Ground II: Claims 1, 12-15, and 18-20 are Obvious Over Gibson in View of Schiltz

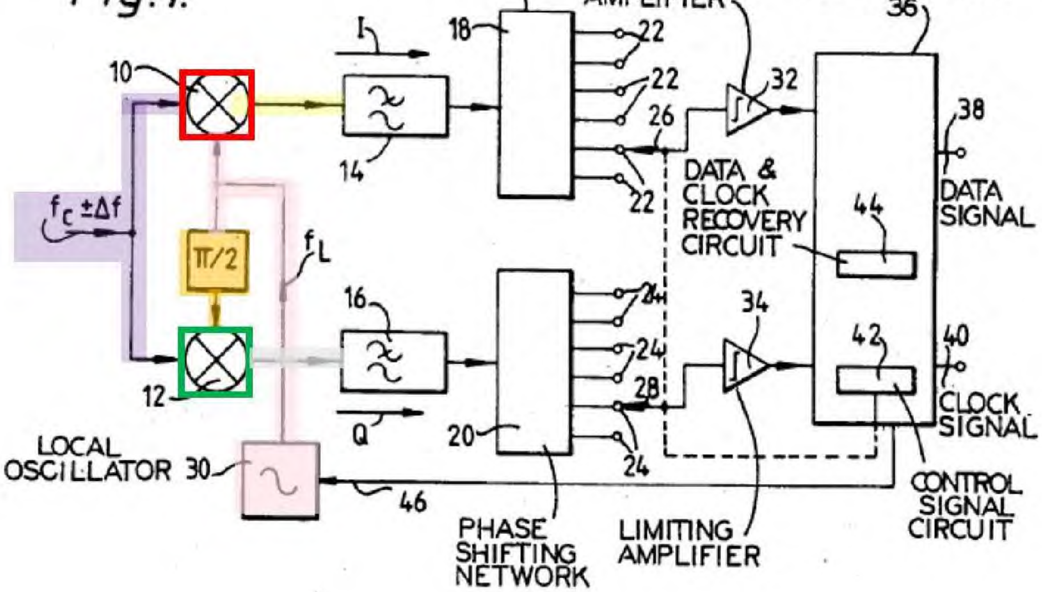
178. As shown below, it is my opinion that claims 1, 12-15, and 18-20 are obvious over Gibson in view of Schiltz. If the preamble of claim 1 is limiting, and therefore requires a "cable modem," then in my opinion these claims are obvious over Gibson in view of Schiltz, and further in view of Thacker, Goldberg, ITU-T J.83b, and/or AAPA.

1. Claim 1

(a) Element [1 preamble]: "A cable modem for down-converting *an electromagnetic signal having complex modulations,* comprising"

179. Gibson discloses a modem for down-converting an electromagnetic signal having complex modulations. (Ex. 1005, Fig 1):

Fig.1.



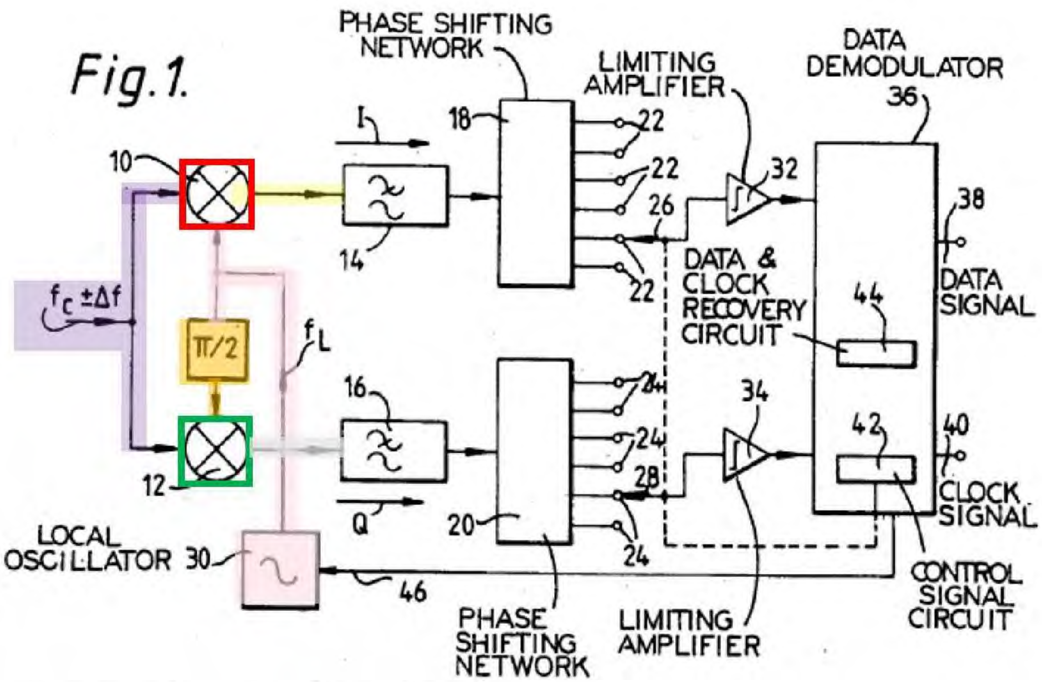
180. The modem down-converts the modulated carrier signal, for example from a 900 MHz signal to a 4 kHz signal. (Ex. 1005 at 2:55-3:21.).

181. To the extent that the preamble is limiting and the electromagnetic signal must have "complex modulations," Gibson discloses that it discloses that the invention works with I/Q modulation, which were complex modulation formats within the general knowledge of a POSITA at the time. (Ex. 1001 at Fig. 1, 2:55-3:21.). The I component is associated with the real part of a complex value and the Q component is associated with the imaginary part, *e.g.*, x(t) + j * y(t) is the complex value that is used to modulate the carrier, and x(t) is the I portion and y(t) is the Q portion.

182. And to the extent that the preamble is limiting and requires a "cable modem," as discussed above, it would have been obvious to use the modem of Gibson (as modified by Schiltz, discussed below) as a cable modem, in view of Thacker, Goldberg, ITU-T J.83b, and/or AAPA.

(b) Element [1A]: "an *oscillator* to generate an in-phase oscillating signal"

183. Gibson discloses an oscillator (30) to generate an in-phase oscillating signal (f_L):

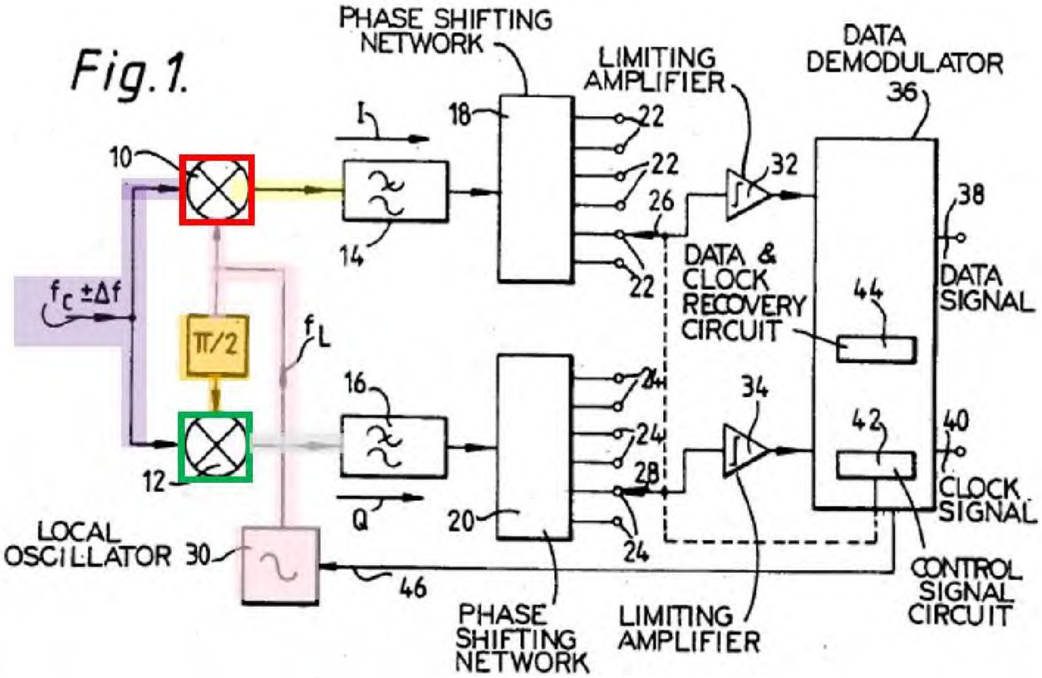


184. (Ex. 1005 at 2:56-3:2.)

(c) Element [1B]: "a *phase shifter* to receive said in-phase oscillating signal and to create a quadrature-phase oscillating signal"

185. Gibson discloses a phase shifter (π/2) to receive said in phase oscillating signal (pink, f_L) and to create a quadrature-phase oscillating signal (orange signal output from "π/2" to green mixer 12):

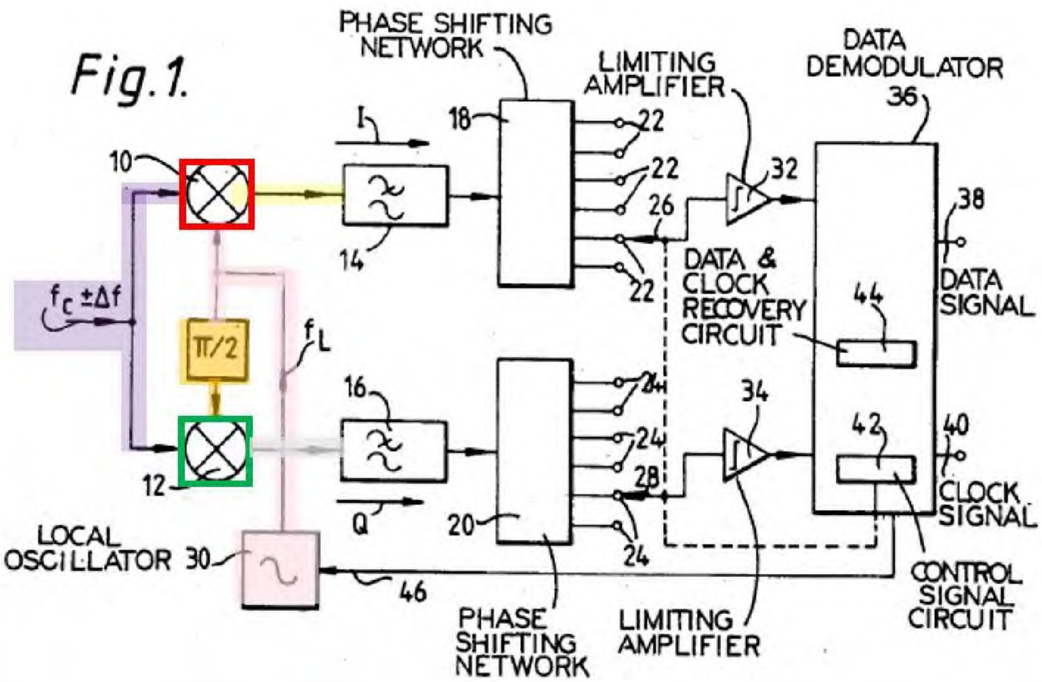
Fig.1.



186. (Ex. 1005 at 2:56-3:2.)

(d) Element [1C]: "a *first frequency down-conversion module* to receive the electromagnetic signal and said in-phase oscillating signal"

187. Gibson discloses a first frequency down-conversion module (mixer 10, red) to receive the electromagnetic signal (purple "f_C +/- Δf") and said in-phase oscillating signal (pink, f_L):



188. To the extent it is argued or determined that Gibson does not disclose Element [1C], Schiltz discloses a frequency down-conversion module, specifically, a "high speed sample and hold circuit" used "as a mixer." (Ex. 1006 at 1:5-10; *id.* at 3:45-65, 4:29-32 ("Sample and hold circuit 26 operates as a downconverter in radio 10. Sample and hold circuit 26 converts a high frequency RF signal into an IF signal in a single operation."), 6:3-10 ("Sample and hold circuit 26 … samples the RF signal while the pulses supplied by pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive."), 7:58-60.).

189. The structure of Schiltz's sample and hold circuit (26) shown in Figure 5 (and includes the "impulse generator" of Figure 1[6]) discloses a mixer

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[6] Ex. 1006 at 5:63-6:6 ("Sample and hold circuit 26 (see FIG. 1) samples the RF signal while the pulses supplied by the pulse generator (see FIG. 1) are active and

having a sampling switch 68 (comprising a field effect transistor 76, blue) and a "hold capacitor" 70 (brown):

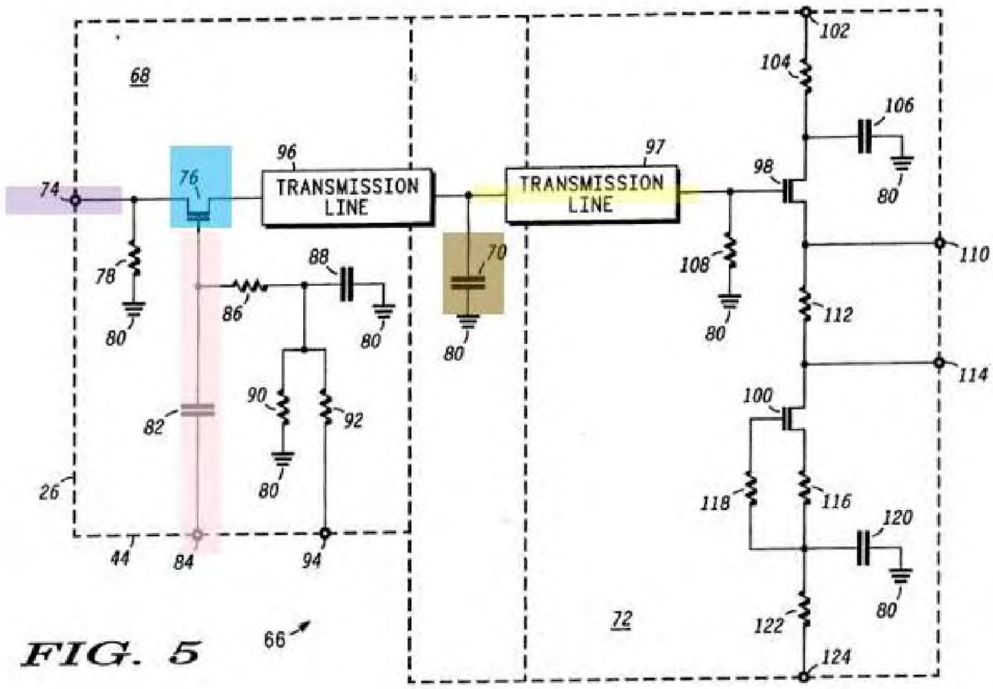


FIG. 5

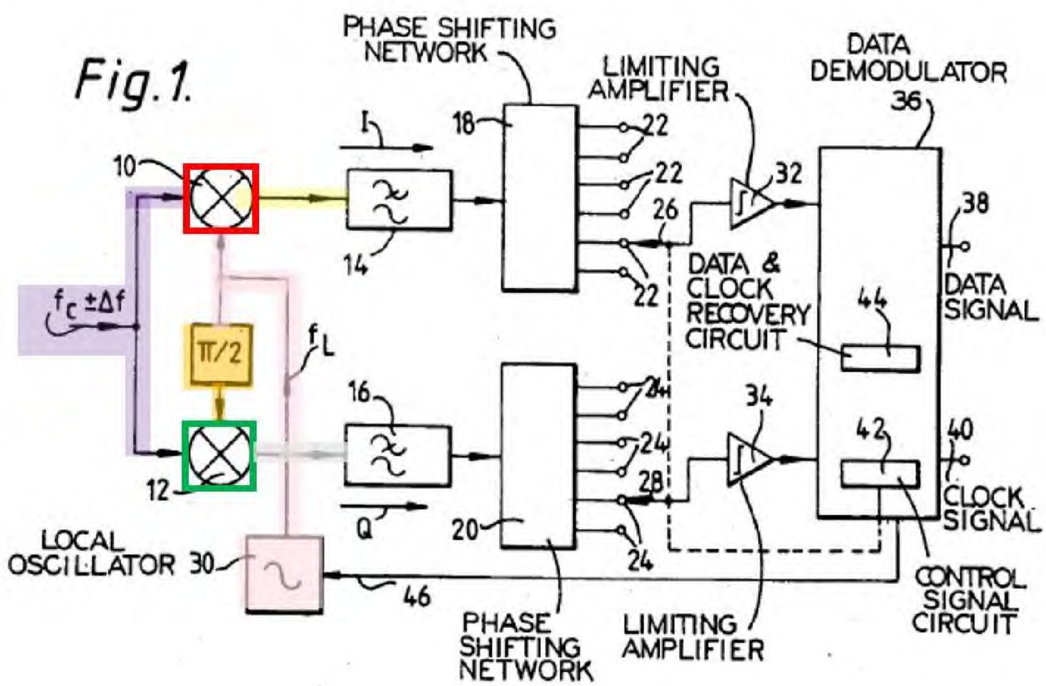
190. The input electromagnetic signal (purple) enters at contact 74, which serves as the sampling input and couples to a source of field effect transistor 76 (blue). (Ex. 1006 at 7:58-8:48.). Contact 84 serves as the input for a control oscillating signal (pink) for the sample and hold circuit 26, and couples to a gate of field effect transistor 76. (*Id.*; *see also id.* at Figure 1 depicting "impulse generator 30"; 4:8-13 ("Oscillator 32 couples to an input of an impulse generator 34 … A

holds the samples while the pulses are inactive."); 7:43-45 ("[T]he discussion of Figure 5 is presented from the perspective of sample and hold circuit 26.").

stream of sampling pulses at a pulse rate of f_s results.")). Field effect transistor 76 operates as a switch and samples the incoming signal. (*Id.* at 7:58-8:48). A drain of FET 76 is coupled to "a first node of hold capacitor 70" and serves as the output of the sample and hold switch 68, which outputs a sampled signal (yellow). (*Id.*). Above, I discussed certain motivations to combine these references.

(e) Element [1D]: "a *second frequency down-conversion module* to receive the electromagnetic signal and said quadrature-phase oscillating signal"

191. Gibson discloses a second frequency down-conversion module (mixer 12, green) to receive the electromagnetic signal (purple) and said quadrature-phase oscillating signal (orange):



192. To the extent it is argued or determined that Gibson does not disclose Element [1D], it would have been obvious to use the frequency down-conversion module of Schiltz in place of each of the second mixer of Gibson in the same manner and for the same reasons as discussed previously for Gibson's first mixer with respect to Element [1C].

(f) Element [1E]: "wherein said first frequency down-conversion module further comprises a *first frequency translation module*"

193. As shown above, Gibson discloses a first mixer 10 but does not expressly disclose that it has a switch (if a "frequency translation module" requires one). As discussed above with respect to Elements [1C] and [1D], Schiltz discloses a mixer comprising a switch (FET 76, blue) coupled to a storage module (capacitor 70, brown):

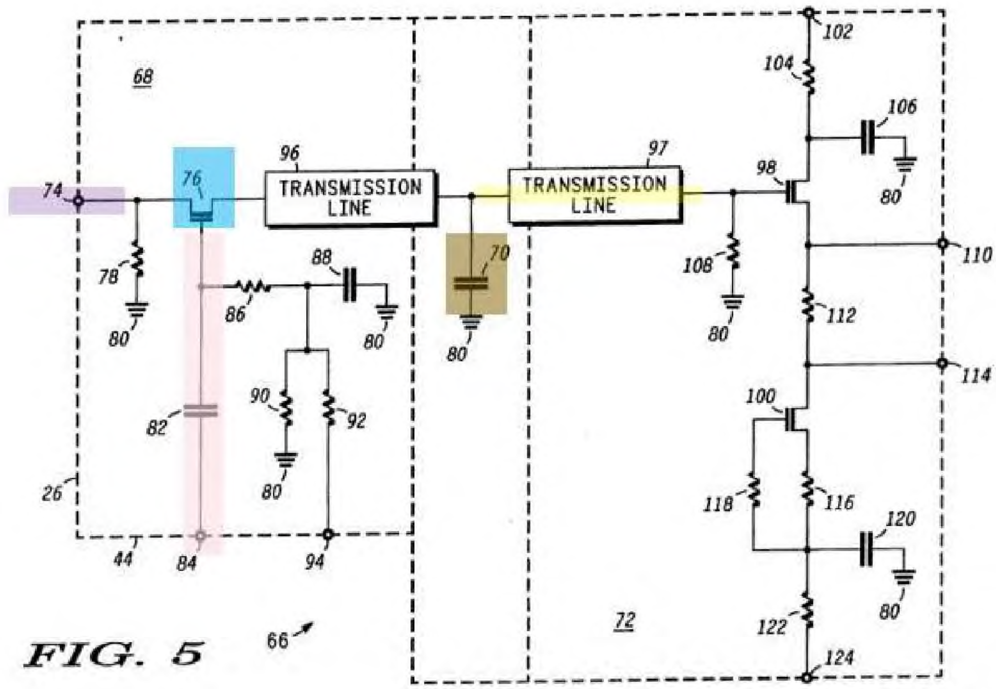


FIG. 5

194. It would have been obvious to use the mixer of Schiltz for each of the mixers (10, 12) in Gibson for the reasons discussed above with respect to Elements [1C] and [1D].

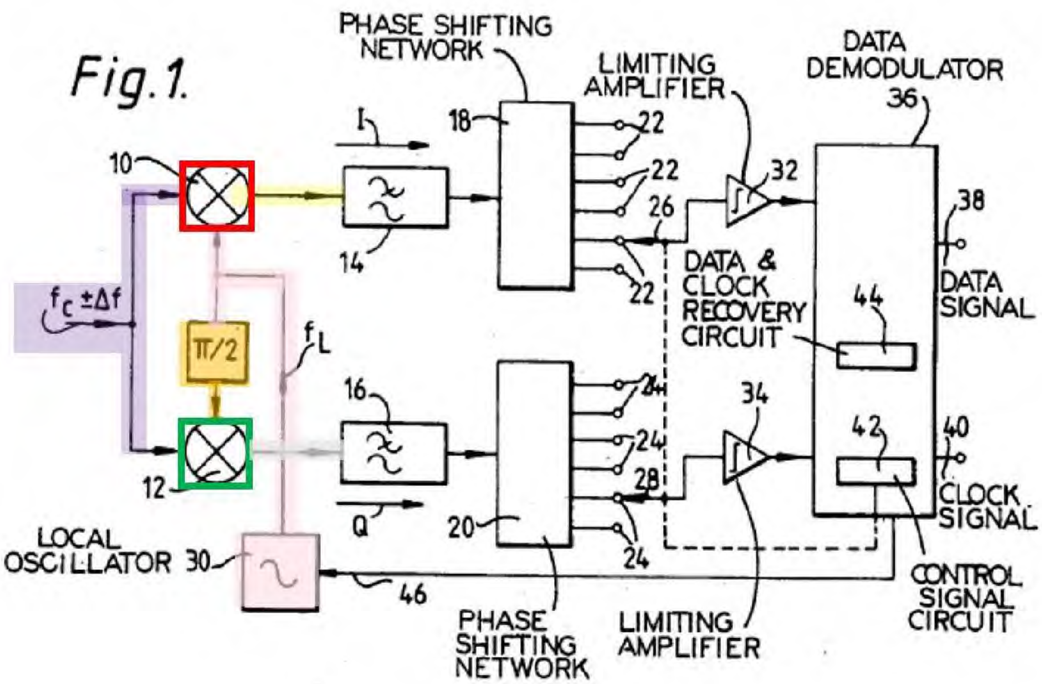
(g) Element [1F]: "and a *first storage module*"

195. Gibson does not expressly disclose that first mixer 10 has a storage module (*e.g.*, capacitor). As discussed above with respect to Elements [1C], [1D], and [1E], Schiltz discloses a mixer comprising a switched capacitor, and it would have been obvious to use such a mixer in the modem of Gibson for the reasons discussed above with respect to Elements [1C] and [1D].

(h) Element [1G]: "wherein said first frequency down-conversion module samples the electromagnetic signal at a rate that is a function of said in-phase oscillating signal, thereby creating *a first sampled signal*"

196. Gibson discloses that the first frequency down-conversion module (mixer 10) mixes the electromagnetic signal (purple) with the in-phase oscillating signal (pink):

Fig.1.



197. Gibson does not expressly disclose sampling. As discussed above with respect to Elements [1C], [1D], [1E], and [1F], Schiltz discloses a mixer module comprising a pulse generator and a switched capacitor acting as a "sample and hold circuit." As seen in Figures 1 and 5 of Schiltz, that mixer module uses an input oscillating signal (pink, such as the one shown as an input to mixer 10 in

Figure 1 of Gibson) in order to generate a stream of oscillating sampling pulses[7] in order to control FET switch 76 which, in conjunction with "hold capacitor 70," down-converts the incoming RF signal (purple) to create a first sampled signal (yellow):

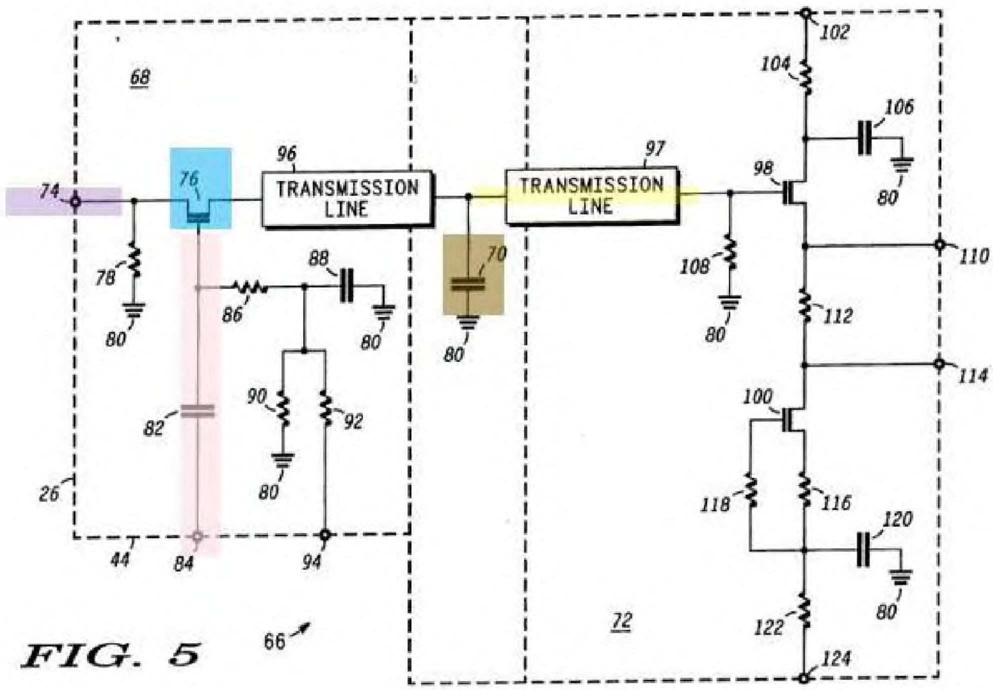


FIG. 5

198. It would have been obvious to use the sampling mixer of Schiltz in place of the mixers (10, 12) in Gibson, for the reasons discussed above.

[7] Ex. 1006 at 4:8-13 ("Oscillator 32 [of FIG. 1] couples to an input of an impulse generator 34 … A stream of sampling pulses at a pulse rate of f_s results"); *see also* 7:43-45 ("[T]he discussion of Figure 5 is presented from the perspective of sample and hold circuit 26 [of FIG. 1].").

(i) Element [1H]: "said second frequency down-conversion module further comprises a *second frequency translation module*"

199. The first and second mixers of Gibson (10, 12) are structurally identical, and it would have been obvious to use the sample and hold mixer of Schiltz as a mixer in Gibson for the reasons discussed above with respect to element [1E]. Specifically, the mixer of Schiltz has a frequency translation module, *i.e.*, a switch (FET 76, blue), that is in turn coupled to a capacitor (70, brown), which down-converts the incoming RF signal (purple) to create a second sampled signal (gray):

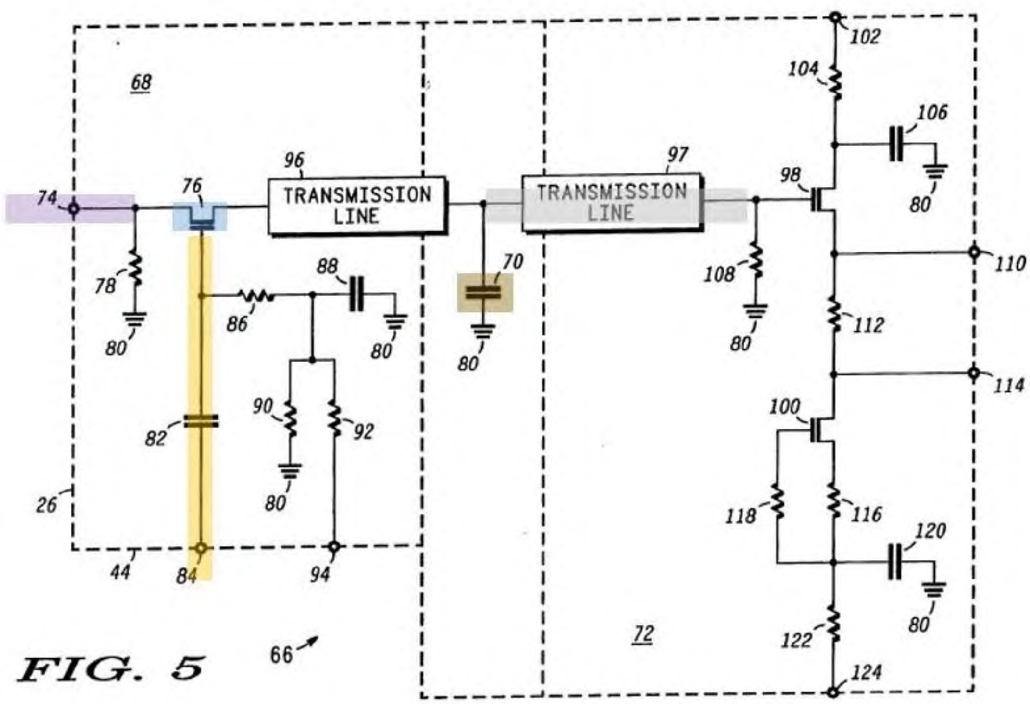


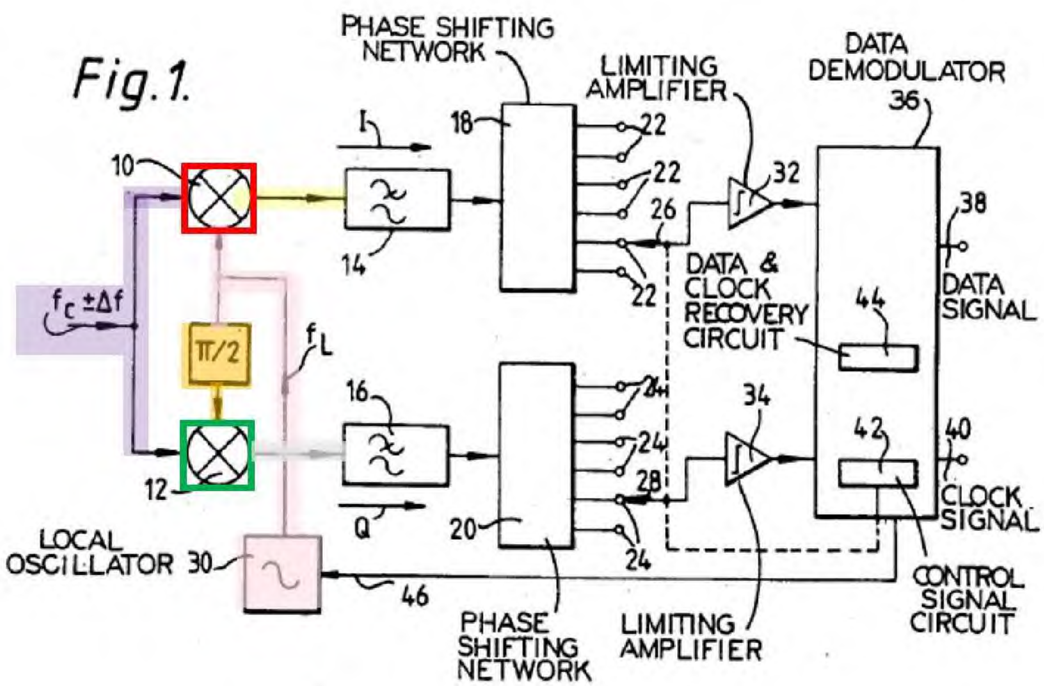
FIG. 5

(j) Element [1I]: "and a *second storage module*"

200. As discussed above, the mixer of Schiltz includes a storage module (capacitor 70).

(k) Element [1J]: "wherein said second frequency down-conversion module samples the electromagnetic signal at a rate that is a function of said quadrature-phase oscillating signal, thereby creating *a second sampled signal*"

201. Gibson discloses that the second frequency down-conversion module (mixer 12) samples the electromagnetic signal (purple) at a rate that is a function of the quadrature-phase oscillating signal (orange):



202. As discussed with respect to Element [1G], Schiltz discloses a mixer comprising a switched capacitor acting as a "sample and hold circuit." As seen in

Figure 5 of Schiltz, that mixer uses an oscillating signal (orange, such as the quadrature-phase oscillating signal shown as an input to mixer 12 in Figure 1 of Gibson) in order to control FET switch 76 which, in conjunction with "hold capacitor 70," samples the incoming RF signal (purple) to create a second sampled signal (gray):

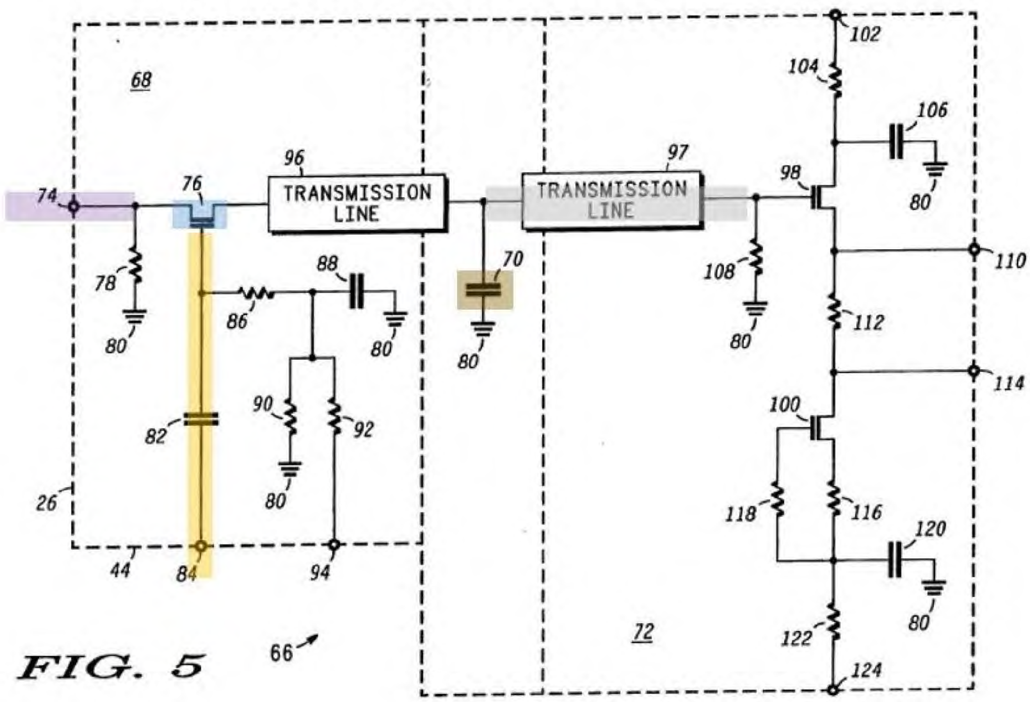


FIG. 5

203. It would have been obvious to use the sampling mixer of Schiltz in place of the mixers (10, 12) in Gibson, for the reasons discussed previously.

2. Claim 12: "The cable modem of claim 1, wherein said sampled signal is a first information output signal, and said second sampled signal is a second information output signal."

204. Gibson in view of Schiltz renders claim 1 obvious as shown above. Schiltz discloses or renders obvious a "first sampled signal" and a "second sampled signal." *See*, respectively, Elements [1G] and [1J] *supra*. In particular, each such sampled signal is the output of Schiltz's switched-capacitor mixer / sample and hold circuit (element 26 in Schiltz Figs. 1 and 5). Each such sampled signal is an "information output signal" as recited in claim 12. These output signals contain "information" because the input signal is an RF signal modulated by an information signal, *e.g.*, a baseband signal. (Ex. 1006 at *e.g.*, 3:4-14, 7:58-62.).

205. Indeed, the whole point of the systems of Gibson and Schiltz is to communicate information. Other uses of EM signals that do not convey information are the transmission of power, but these systems are not power transmission systems. They are communication systems specifically designed to communicate information.

3. Claim 13: "The cable modem of claim 1, further comprising a first amplifier receiving said first sampled signal and outputting a first amplified signal, and a second amplifier receiving said second sampled signal and outputting a second amplified signal."

206. Gibson in view of Schiltz renders claim 1 obvious as shown above. The Schiltz mixer discloses a first amplifier (Fig. 5, 72) receiving the first sampled signal (*i.e.*, output of the sample and hold circuit) and outputting a first amplified signal. (Ex. 1006 at Abstract ("The circuit includes a sampling switch, a hold capacitor, and a buffer amplifier."), 8:21-28 ("A drain of FET 76 serves as the output of sample switch 68. The schematic diagram of FIG. 5 shows a transmission line 96, which couples sample switch 68 to a first node of hold capacitor 70. The schematic diagram of FIG. 5 also shows a transmission line 97, which couples the first node of hold capacitor 70 and sample switch 68 to an input of buffer amplifier 72. A second node of hold capacitor 70 couples to ground terminal 80.")). The amplifier outputs an amplified signal. (*Id.* at 9:58-64 ("… buffer amplifier 72 provides two diverse outputs at contacts 110 and 114. These two outputs are suited for diverse outputs, such as mixing ….")).

207. As discussed above, the second frequency down conversion module is structurally identical to the first frequency down conversion module, and therefore the second mixer of Gibson, as modified in view of Schiltz, has a second amplifier

receiving said second sampled signal and outputting a second amplified signal. (Ex. 1006 at 8:21-28, 9:58-64.).

4. Claim 14: "The cable modem of claim 13, further comprising a first filter receiving said first amplified signal and outputting a first filtered signal, and a second filter receiving said second amplified signal and outputting a second filtered signal."

208. Gibson in view of Schiltz renders claim 13 obvious as shown above. Gibson Figure 1 discloses band pass filters 14 and 16 receiving the output signals of mixers 10 and 12 (which are amplified as shown above with respect to claim 13), and each outputting a filtered signal.

5. Claim 15: "The cable modem of claim 1, further comprising a first filter receiving said first sampled signal and outputting a first filtered signal, and a second filter receiving said second sampled signal and outputting a second filtered signal."

209. Gibson in view of Schiltz renders claim 1 obvious as shown above. Gibson Figure 1 discloses band pass filters 14 and 16 receiving the output of mixers 10 and 12, and each outputting a filtered signal. (Ex. 1004 at 2:60-62.).

6. Claim 17: "The cable modem of claim 1, wherein the electromagnetic signal has been transmitted by a wireless method to the cable modem."

210. Gibson in view of Schiltz renders claim 1 obvious as shown above. Further, Gibson does not limit the mode of transmission of the electromagnetic signal that serves as the input to its quadrature modulation data receiver. Schiltz

discloses that its mixer is especially designed for use with wireless electromagnetic signals. (Ex. 1006 at Abstract, 1:7-10 ("[T]he present invention relates to a high speed sample and hold circuit and to *radios* which use such a circuit as a mixer.") (emphasis added). Therefore, it would have been obvious to one of ordinary skill in art to use the combined Gibson/Schiltz modem to down-convert electromagnetic signals transmitted wirelessly.

7. Claim 18

(a) Element [18A]: "The cable modem of claim 1, wherein said first frequency translation module comprises a first switch coupled to said first storage module, and said second frequency translation module comprises a second switch coupled to said second storage module"

211. As to the first modules, *see* Elements [1C], [1E], [1F], and [1G], *supra*. As to the second modules, *see* Elements [1D], [1H], [1I], and [1J], *supra*.

(b) Element [18B]: "and wherein said first frequency down-conversion module further comprises a first control signal generator coupled to said first switch and coupled to receive said in-phase oscillating signal"

(c) Element [18C]: "and said second frequency down-conversion module further comprises a second control signal generator coupled to said second switch and coupled to receive said quadrature-phase oscillating signal."

212. As discussed above, the first and second frequency down-conversion modules disclosed by Gibson are structurally identical, the only difference being

that the in-phase oscillating signal is used to generate the sampling pulses that control the switch in the first module, while the quadrature-phase oscillating signal is used to generate the sampling pulses that control the second switch in the second module. (Ex. 1004 at Figure 1, 2:56-67.). Schiltz discloses that a control signal generator (Fig. 1, "impulse generator" 34 coupled through node 84 in Fig. 5)[8] that is coupled to the respective switch (FET 76) and coupled to receive the respective control oscillating signal. *See* Element [1C], *supra*.; Ex. 1006 at 4:8-13 ("Oscillator 32 [of FIG. 1] couples to an input of an impulse generator 34 … A stream of sampling pulses at a pulse rate of f_s results.").

8. Claim 19: "The cable modem of claim 18, wherein each of said first and second switches comprises: a first port; a second port; and a third port."

213. *See* Element [1C], *supra* (showing how FET 76 of Schiltz Figure 5 has three ports); *see also* Schiltz claim 1 ("… a sampling switch having a first port serving as said sample input, a second port serving as said control input, and a third port; a hold capacitor coupled to said third port of said sampling switch …").

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[8] *See also* Ex. 1006 at 5:63-6:6 ("Sample and hold circuit 26 (see FIG. 1) samples the RF signal while the pulses supplied by the pulse generator 30 (see FIG. 1) are active and holds the samples while the pulses are inactive."); 7:43-45 ("[T]he discussion of Figure 5 is presented from the perspective of sample and hold circuit 26.").

9. Claim 20: "The cable modem of claim 19, wherein said first port of said first switch receives the electromagnetic signal, said second port of said first switch receives a first control signal generated by said first control signal generator, and said third port of said first switch is coupled to said first storage device, and wherein said first port of said second switch receives the electromagnetic signal, said second port of said second switch receives a second control signal generated by said second control signal generator, and said third port of said second switch is coupled to said second storage device."

214. *See* claim 19, *supra*.

XI. CONCLUSION

215. For the reasons give above, it is my opinion that claims 1, 12, 13, 14, 15, 17, 18, 19, 20 of the '835 patent are not patentable, and should be cancelled.

APPENDIX

Matthew B. Shoemake

Curriculum Vitae

Last updated May 16, 2021

Personal Information

Born **February 1971 in Pauls Valley, Oklahoma, USA**
Citizenship **United States of America**
Marital Status **Married to Bobbie Jo DeKay Shoemake since August 1998**
Children **One daughter, age 19, and one son, age 15**

Education

1999 **Ph.D. in Electrical Engineering**, *Cornell University*, Ithaca, New York.
1997 **M.S. in Electrical Engineering**, *Cornell University*, Ithaca, New York.
1994 **B.S. in Computer Science**, *Texas A&M University*, College Station, Texas, *with honors*.
1994 **B.S. in Electrical Engineering**, *Texas A&M University*, College Station, Texas, *with honors*.
1989 **Valedicatorian**, *Mexia High School*, Mexia, Texas.

Work Experience

2016–Present **Owner & President**, PERITUM LLC, Fairview, Texas.
- Peritum provides expert consulting services.
- Providing services since 2008. Incorporated in 2016.

2008–2018 **President & CEO**, BISCOTTI INC., Allen, Texas.
- Biscotti develops high-definition, video calling systems for the home and office.

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2003–2008 **President & CEO**, WiQuest Communications, Inc., Allen, Texas.
- Developed world's first 1 Gbps ultrawideband chipset
- Developed world's first wireless VGA/DVI system for notebook computers
- Customers put into product: Dell, Toshiba, Lenovo, Belkin, D-Link and Kensington
- Built company from inception to 120 employees with offices and personnel in Texas, India, California, Taiwan and Japan.

2000–2003 **Director Advanced Technology, Wireless Networking Business Unit**, Texas Instruments, Inc., Dallas, Texas.
- Lead development of Bluetooth and Wi-Fi coexistence technology
- Lead TI efforts to enhance the IEEE 802.11 standards with quality of service extensions
- Lead development of very low power Wi-Fi technology for mobile phones
- Designed Wi-Fi into Nokia Communicator

1998–2000 **Manager, Baseband Systems Team**, Alantro Communications, Inc., Dallas, Texas.
- Developed 802.11b compliant physical layer
- Shipped over 100M units in 2nd generation of IntelâĂŹs Centrino technology
- Company backed by Cisco and Vantage Point Venture Partners
- Acquired by Texas Instruments for $300MM

1991–1995 **Intern and Engineer, Digital Signal Processing Group**, Texas Instruments, Inc., Stafford, Texas.
- Product engineering for TMS320C2X Digital Signal Processors
- Applications engineering for TMS320C3X Digital Signal Processors

Ph.D. Dissertation

Title *Turbo Codes: Bounds and Applications, Ph.D., August 1999.*

Supervisor Professor Chris D. Heegard

Committee Members Professors Toby Berger, Chris D. Heegard, Dexter Kozen, Venugopal V. Veeravalli and Stephen Wicker

Masters Thesis

Title *Topics in Turbo Coding, M.S., May 1997.*

Supervisor Professor Chris D. Heegard

Fundraising

2010-2016 **$10M Series A**, Palomar Ventures, Biscotti Inc.

2009, 2016 **$1.35M Seed Investment**, Texas Emerging Technology Fund, Wham! Inc.

2008 **$50k Grant**, Allen Economic Development Center, Wham! Inc.

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2008 **$420k Seed Round**, Private Individual Investors, Wham! Inc.

2007 **$5M Debt Line**, Triple Point Capital, for WiQuest Communications, Inc.

2007 **$23M Series C**, Lead by Adams Street Capital, WiQuest Communications, Inc.

2006 **$18M Series B**, Lead by Sequoia Capital, WiQuest Communications, Inc.

2005 **$50k Grant**, Allen Economic Development Center, WiQuest Communications, Inc.

2004 **$15M Series A**, Menlo Ventures, Palomar Ventures and iD Ventures America, WiQuest Communications, Inc.

2003 **$827k Seed Round**, Private Individual Investors, WiQuest Communications, Inc.

Computer Skills

Languages C, C++, Fortran, Python, Pascal, Java, Verilog, VHDL, BASIC, MATLAB, LaTeX, Spice, Perl, shell scripting, various assembly languages, Lisp, Swift.

Standards and Protocols IEEE 802.3, IEEE 802.11, ADSL, HDSL, DOCSIS, Bluetooth, I^2C, I^2S, USB, CAN bus, HDMI, 3GPP, LTE, IS-95, EDGE, LTO, RS-232, HTTP, FTP, Telnet, Internet Protocol (IP), TCP, UDP, RTP, RTCP, SIP, STUN, TURN, ICE, CSMA/CD, CSMA/CA, ITU-T G.8031/8032, ITU, ITU-T J83B, MQTT, IEEE 802.15, IEEE 802.16, SSL, TLS, WEP, WPA, WPA2.

Professional Activities

2006-2020 **External Advisory Committee, Texas A&M University, Department of Electrical and Computer Engineering**

2008-2010 **Board Member, TeXchange, Dallas Chapter** TeXchange is a non-for-profit organization dedicated to helping entrepreneurs succeed.

2003-2004 **Chairperson, IEEE 802.11n Task Group** Lead committee of over 300 engineers through initial stages of standardization of data rate enhancements in excess of 100 Mbps

Jan. 2002 **IEEE 802.11 Meeting Organizer and Host, Wyndham Anatole, Dallas, Texas**

2000-2003 **Chairperson, IEEE 802.11g Task Group** Lead committee of over 200 engineers to set standard for 54 Mbps data rates in the 2.4 GHz band in a fashion that is backward compatible with IEEE 802.11b. Standard become the basis for the most widely used version of Wi-Fi.

Sept. 1999 **IEEE 802.11 Meeting Organizer and Host, Hilton Sonoma County, Santa Rosa, California.**

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1999 **Chairperson, IEEE 802.11g Study Group**Lead committee of 20 engineers to set project requirements for IEEE 802.11g.

1991-Present **IEEE Member**

Awards

2012 **CES Innovation Award for the Biscotti TV Phone**

2008 **CES Innovation Award for Wireless Digital Video Technology** This high-speed digital video technology shipped in notebook computers from Toshiba.

2006 **Intel Technology Innovation Award** Awarded to WiQuest for innovations in Wireless USB technology.

2003 **PC Magazine Technology Excellence Award for IEEE 802.11g** This award was bestowed on the IEEE 802.11 Working Group and the Wi-Fi Alliance for the protocols incorporated in the IEEE 802.11g standard under my leadership.

2002 **Texas Instruments Senior Member Technical Staff**

1997-1998 **Intel Foundation Graduate Fellowship Award**

Consulting & Litigation Services

2021–Present ***Parker Vision v. Hisense and TCL***, Retained by Hisense and TCL via their counsel Kilpatrick Townsend & Stockton LLP.

2021–Present ***In the Matter of Certain LTE-Compliant Cellular Communication Devices*, ITC Inv.No. 337-TA-1253**, Retained by Samsung via their counsel Quinn Emmanuel Urquhart & Sullivan, LLP.

2021–Present **OnePlus Technology (Shenzhen) Co., Ltd. matter**, Retained via their counsel Morgan Lewis & Bockius LLP. Technologies relate to random access channels, power adjustment, qualify feedback, battery charge estimation, link adaptation, and buffer reporting.

2021–Present **Wi-Fi Matter**, Retained for Wi-Fi patent owner via their counsel Hiem, Payne & Chorush, L.L.P. Matter relates to IEEE 802.11 and Wi-Fi patents.

2021–Present **Intelligent Agency v. NeighborFavor, Inc.**, Relating mobile applications. Retained via NeighborFavor's counsel, Baker Botts LLP.

2021–Present **FK Ironworks, et al.**, Related wireless power charging systems.

2020-Present ***TrickStar v. American Conservation Group***, Related to efficient power distribution technology.

2020–Present **MediaTek Inc.**, Related to Wi-Fi.

2020–Present ***Intelligent Agency v. 7-Eleven Inc.***, Relating mobile applications. Retained via 7-Eleven's counsel, Baker Botts LLP.

2020–Present **Caltech**, Related to intellectual property.

2020-2021 ***Quartz Auto Technologies LLC v. Uber Technologies, Inc.*, Case No. 1:20-cv-00720 (W.D. Tex.)**, Retained by Uber via their counsel Gibson Dunn & Crutcher LLP.

2020–Present ***Blitzsafe Texas, LLC v. Fiat Chrysler Automobiles, N.V. et al.*, E.D. Tex.**, Retained by FCA US LLC and Maserati North America, Inc. via their counsel Venable LLP. Matter relates to use of USB and Bluetooth in automobiles.

2020–2021 ***Blitzsafe Texas, LLC v. Navistar, Inc. and Navistar International Corp.*, Case No. 2:19-cv-00403-JRG (E.D. Tex.)**, Retained by Navistar via their counsel DLA Piper. Matter relates to use of USB and Bluetooth in automobiles.

2020–2021 ***Blitzsafe Texas, LLC v. General Motors, LLC*, Case No. 2:19-cv-00377-JRG (E.D. Tex.)**, Retained by GM via their counsel Quinn Emanuel. Matter relates to use of USB and Bluetooth in automobiles.

2020–Present **Grill manufacturer**, Relating to Wi-Fi features.

2020–Present **Cornell University**, Relating to communication networks.

2020 ***Castlemorton Wireless, LLC v. Juniper Networks, Inc.*, Civil Action No. 6-20-cv-00026 (W.D. Tex.)**, Retained for Juniper via their counsel Covington & Burling LLP. Matter relates to IEEE 802.11 products.

2020–Present ***Essential WiFi v. MediaTek, et al.*, Civil Case No. 6:20-cv-225 (W.D. Tex.)**, Retained for by MediaTek via their counsel Quinn Emanuel.

2020–Present ***DeCurtis LLC v. Carnival Corp.*, Case No. 6:20-cv-00607 (M.D. Fla) and *Carnival Corp. v. DeCurtis Corp., et al.*, Case No. 1:20-cv-21547 (S.D. Fla)**, Retained for DeCurtis LLC via their counsel Quinn Emanuel.

2020–Present **Samsung Electronics Co., Ltd**, Retained for Samsung via their counsel Quinn Emanuel.

2020–Present ***KAIFI LLC v. AT&T Corp. et al.*, Civil Case No. 2:19-cv-138 (E.D. Tex.)**, Retained for AT&T via their counsel Gibson, Dunn & Crutcher LLP.

2020 ***Castlemorton Wireless, LLC v. T-Mobile US, Inc. et al* Civil Action No. 6:20-cv-00027-ADA (W.D. Tex.)**, Retained for T-mobile via their counsel McGuireWoods LLP.

2020–Present ***Sonos v. Google***, Retained for Google via their counsel Quinn Emanuel. Deposition and ITC trial testimony.

2020–Present ***Sisvel International S.A. and 3G Licensing S.A. v. Cradlepoint, Inc.*, Civil Case No. 1:19- CV-1142-MN (D. Del.)**, Retained for Cradlepoint, Inc. and Sierra Wireless, Inc. via their counsel Perkins Coie LLP.

2020–2021 ***LG Electronics, Inc. v. Hisense Electronics Manufacturing Company America*, Civil Case No. 2:19-cv-9474 (C.D. Cal.)**, Retained for Hisense via their counsel Covington & Burling LLP.

2020 ***Blitzsafe Texas, LLC v. PACCAR Inc.***, Retained for PACCAR via their counsel Baker Botts LLP.

2020 ***Castlemorton Wireless, LLC v. Sprint Corporation, et al.* (W.D. Tex.)**, Retained for Sprint via their counsel McGuireWoods LLP. Patent at issue is US 7,835,421. The accused products are alleged "to practice IEEE 802.11b and/or IEEE 802.11g" standards.

2019–Present ***Wapp Tech Ltd., et al. v. Seattle SpinCo, Inc., Micro Focus LLC, et al. ("Micro Focus")* (E.D. Tex., D. Del.)**, Retained for Micro Focus by Gibson Dunn and Shelton Coburn. Patents at issue in case are US 9,971,678, 9,298,864, and 8,924,192 . Patents relate to emulation of mobile devices and application development. Deposition and trial testimony.

2019 ***Blitzsafe v. Bosch* (N. D. Tex.)**, Retained by Bosch via their counsel DLA Piper. Patents asserted against the use of USB and Bluetooth in vehicles.

2019–2021 ***Linksmart Wireless Technology LLC v. Panasonic Avionics Corp.* (C. D. Cal.)**, Retained by Panasonic Avionics via their counsel Haynes & Boone LLP. Case related to Wi-Fi, Internet access on airplanes, satellite communications, DHCP, IEEE 802.3, gateways, redirection servers and proxies. Patent at issue was US RE46,459 to Ikudome and Yeung. Submitted experts reports. No deposition testimony. No trial. Case No. 8:18-cv-00662-AG-JDE (C. D. Cali.).

2019–2021 ***United Access Technologies, LLC v. CenturyTel Broadband Services LLC and Qwest Corporation* (D. Del.)**, Retained by defendants, collectively "CenturyLink," via their via their counsel Duane Morris LLP. Patents at issue were U.S. 5,844,596, 6,243,446 and 6,542,585. Accused products were splitterless ADSL systems with POTS. Wrote non-infringement report. Court found non-infringement on motion for summary judgement. No trial nor trial testimony..

2019–Present ***Uniloc v. Blackberry* (N. D. Tex.)**, Retained by Blackberry via their counsel Baker Botts LLP. Case No. 3:18-cv-03068-N (N.D. Texas) Patents in-suit are US6,868,079, US6,993,049, US7,020,106 and US7,167,487.

2019 ***Traxcell v. Sprint and Verizon* (E. D. Tex.)**, Retained by Sprint via their counsel McGuireWoods. Retained by Verizon via their counsel Holland & Knight LLP. Patents deal with network tuning, location determination and navigation. Patents at issue are US Patents 8,977,284, 9,510,320, 9,642,024 and 9,549,399. Wrote invalidity reports for Sprint and Verizon, and wrote a non-infringement report for Verizon. Depositions taken. No trial testimony, since cases settled shortly before trial due to granted summary judgement motions on non-infringement.

2019 ***Blitzsafe v. Daimler* (E. D. Tex.)**, Retained by Daimler via their counsel Quinn Emmanuel. Patents asserted against the use of USB and Bluetooth in vehicles.

2018–2020 ***Sol IP v. Sprint* (E. D. Tex.)**, Retained by Sprint via their counsel McGuire-Woods. Sol IP, LLC v. Sprint Corporation, et al., Civil Action No. 2:18-cv-00527 (E.D. Tex.).

2018–2019 ***Parity Networks v. Hewlett Packard Enterprise Co.* (E. D. Tex.)**, Retained by HPE via their counsel Morgan Lewis. No reports, testimony nor depositions. HPE was dismissed from the case in March 2019 for unknown reasons.

2018–Present ***Uniloc v. AT&T* (E. D. Tex.)**, Retained by AT&T via their counsel Baker Botts LLP. Matter pertains to LTE License Assisted Access (LAA).

2018–2019 ***Bell North Research LLC v. Kyocera Corp.* (S. D. Cali.)**, Retained by Kyocera. via their counsel Jones Day. Bell Northern Research LLC v. Kyocera Corp. Case No. 3:18-cv-1785 (S.D. Cal.).

2018–2019 ***Koninklijke KPN N.V. v. Sierra Wireless, Inc., et al.* (D. Del.)**, Retained by Sierra Wireless Inc. via their counsel Kirkland & Ellis LLP. Matter involves ETSI and TIA licensing obligations. Expert report(s) submitted.

2018–2019 ***Hewlett Packard Enterprise Company v. ChriMar Systems, Inc.***, Retained by Hewlett Packard Enterprise Company via their counsel Morgan Lewis. Matter involves *inter partes* review of certain US Patents. Matter relates to power-over-ethernet (PoE). Patents owned by ChriMar Systems include 8,155,012, 8,942,107, 8,902,760, 9,019,838, 9,049,019, and 9,812,825.

2018–2020 ***Hera Wireless and Sisvel v. Belkin Int'l. and ARRIS Group***, Retained by Belkin International and ARRIS Group via their counsel Duane Morris LLP. Case Nos. 1:17-cv-00948-RGA and 1:17-cv-00949-RGA. No reports, declarations nor deposition testimony. Case resolved before trial.

2018–2020 ***Blackberry v. Facebook***, Retained by Blackberry in patent case dealing with text messaging and user interfaces.

2018–Dec 2019 ***Fundamental Innovation systems v. ZTE Corporation***, Retained in USB power case by ZTE via their counsel McDermott Will & Emory.

2018 **Intel Corporation**, Retained via Intel's counsel, Kirkland & Ellis, in matter related to Wi-Fi in notebook computers.

2017–2018 **Intel Corporation**, Retained via Intel's counsel, Weil, Gotshal & Manges LLP. Matter relates to patents asserted against MIMO and/or beamforming in wireless OFDM communication systems.

2017–2018 ***PrefNet v. Sprint***, Working with Sprint's counsel, McGuireWoods. Case relates to management of bandwidth in network servers.

2017–Present ***XR Communications, LLC, dba Vivato Technologies v. Cisco Systems, Inc.*, 2:17-cv-02951 (C.D. Cal. 2017)**, Patent case regarding US Pat. No. 6,611,231 and adaptive antenna arrays. Retained via Kirkland & Ellis LLP.

2017–2018 **Sharp Corporation**, Retained by Sharp's counsel, K&L Gates. Matter concerns intellectual property and Wi-Fi. No deposition nor trial testimony.

2017 **Harmon International Industries**, Retained by Harmon's counsel, McDermott, Will & Emory. Matter relates to car stereos and audio equipment in vehicles. No deposition nor trial testimony. .

2017-2018 **Wistron Corporation**, Retained by Wistron's counsel, JW Law Group. Matter relates to alleged Wi-Fi patents.

2017–2019 ***Blitzsafe v. Mitsubishi***, Retained via Mitsubishi Electric Corporation's counsel, Pillsbury, Winthrop, Shaw, Pittman LLP. Case relates to the use of Bluetooth and USB in vehicles. No deposition nor trial testimony.

2016–2017 ***Mtel v. Google***, Retained by Quinn Emanuel for Google. Case is a patent infringement case regarding US Patents 5,809,428, 5,894,506, 5,581,804 and 5,754,946. Case no. is 2:16-cv-00002 in E.D. Texas Marshall Division.

2016–2017 ***SPH America LLC v. Huawei Technology Co. Ltd.***, Retained by Foley and Lardner LLP for Huawei. Case no. is 13-cv-2323-CAB-KSC (S.D. Cal). No deposition nor trial testimony.

2016–2017 ***IV v. AT&T***, Retained by AT&T. AT&T's counsel is Baker Botts. Case is a patent infringement case related to DSL. No depositions nor trial testimony at this time.

2016–2019 ***Fujifilm v. Sony***, Retained on half of Fujifilm by their counsel Baker Botts. Cases relate to alleged standards and LTO data storage products. The matters are being heard in the ITC and in an associated district court case. Deposition and trial testimony.

2016–2017 ***Blitzsafe v. Honda***, Retained via Honda's counsel, Jones Day. Case relates patent infringement and use of Bluetooth and USB in vehicles. Deposition take. No trial testimony.

2016 ***Network-1 vs. Dell Inc.***, Retained via Dell's counsel K&L Gates in a patent litigation related to power over Ethernet. No depositions nor trial testimony.

2016–Present ***California Institute of Technology (Caltech) vs. Broadcom Corporation and Apple Inc.***, Retained via Caltech's counsel, Quinn Emanuel. Case relates to use of forward error correction in Wi-Fi products. Technology tutorial presented to district court. Expert reports submitted. Testimony provide to court at various hearings. Testified on infringement and technical value of patents at trial in January 2020. Was sole expert witness for Caltech. Jury found Apple and Broadcom infringe and awarded $1.1B in damages.

2015–2016 **California Institute of Technology (Caltech)**, Analysis of IEEE 802.11 patents. No depositions nor trial testimony.

2015–2016 **Wistron Corporation**, Retained to analyze certain communication system patents in the LTE space. No depositions nor trial testimony.

2015–2016 **Wistron Corporation**, Retained via Wistron's counsel, K&L Gates, to perform analysis related to Wi-Fi. No depositions nor trial testimony.

2015–2016 ***LSI v. Funai***, Retained by Baker & Hostetler to provide services in connection with LSI Corp. et al. v. Funai Electric Co. Ltd. Case relates OFDM patent asserted against Wi-Fi products. No deposition nor trial testimony.

2015–2016 ***Mtel v. Blackberry***, Retained by Blackberry via their counsel McDermott Will & Emery LLP. Patent case related to pagers. Patents asserted against mobile phones. Deposition taken. No trial testimony.

2015 ***Ericsson v. Apple***, Retained by Apple via their counsel Fish & Richardson. Patent case related to Wi-Fi and cellular. Deposition and trial testimony in ITC case..

2015 ***Antennatech LLC v. Mercedes-Benz USA LLC***, Retained by Mercedes-Benz via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. Patent case related to Wi-Fi inside vehicles. No deposition nor trial testimony..

2015 **Samsung**, Retained via Williams & Connolly LLP on behalf of their their client Samsung. Case relates to cross license between two parties, including access by Samsung to Nokia's Wi-Fi patent portfolio. No deposition nor trial testimony.

2015 ***Cablevision v. Verizon***, Retained via Kirkland & Ellis on behalf of their client Verizon. Matter relates to false advertising claims tied to use of IEEE 802.11ac routers. No deposition. Testified at trial.

2014 **Blitz Stream Video LLC**, Retained as consultant related to portfolio of video patents. No deposition nor trial testimony.

2014-2016 ***SPH America v. Blackberry Limited***, Retained by Blackberry via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. No deposition nor trial testimony.

2014-2015 ***CSIRO v. MediaTek***, Nokia, Texas Instruments, Realtek and Barnes & Noble via a joint defense group including Covington & Burling LLP. Serving both as expert for JDG and 30(b)(6) witness for Texas Instruments. No trial testimony.

2014-2018 ***ChriMar v. Cisco***, Retained by Cisco via their counsel Kirkland & Ellis. Matter relates to power over Ethernet. Deposition. No trial testimony.

2014-2016 ***Intellectual Ventures v. CenturyLink, et al.***, Retained by CenturyLink via their counsel O'Melveny & Myers LLP. No deposition nor trial testimony.

2013-2015 ***Intellectual Ventures v. Canon Inc., et al.***, Retained by Canon Inc, et al. via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. Deposition. No trial testimony.

2013-2017 ***Intellectual Ventures v. AT&T Mobility LLC, et al.***, Retained by Sprint Spectrum LP via their counsel McGuireWoods LLP. Case relates to security in IEEE 802.11 networks. No deposition nor trial testimony.

2014 ***NXP v. Blackberry***, Services retained by Blackberry via their counsel McDermott Will & Emery. No deposition. Testified at trial..

2013-2014 ***Realtek Semiconductor Corp v. LSI Corporation et al.***, Retained by Realtek Semiconductor Corp via their counsel ReedSmith. Deposition and trial testimony.

2013-2017 ***CSIRO v. Cisco System Inc.***, Retained by Cisco via their counsel Duane Morris. Deposition and trial testimony..

2013 ***Cisco Systems, Inc. and Motorola Solutions, Inc. v. Innovatio IP Ventures LLC***, Retained by Kirkland and Ellis on behalf of Cisco Systems, Motorola Solutions, Inc. and NETGEAR. Deposition and trial testimony.

2013 ***Wi-LAN v. HTC, et al.***, Retained HTC Corporation, HTC America Inc., and Exedea, Inc. via their counsel Sheppard Mullin Richter & Hampton, Novatel via their counsel K&L Gates, and Sierra Wireless via their counsel Nixon Peabody. Expert reports also filed on behalf of other defendants including Apple and Alcatel Lucent. Deposition. Case settled prior to trial.

2012-2013 ***Ericsson, et al. v. D-Link, et al.***, Retained via Intel via their counsel Kirkland & Ellis. Deposition and trial testimony.

2011-2013 ***Mosaid Technologies Incorporated v. Dell, Inc. et al.***, Retained by Intel via their counsel WilmerHale, and retained by Marvell via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. No deposition. Case settled prior to trial..

2011-2012 ***Broadcom Corporation and Atheros Communications, Inc. vs. Commonwealth Scientific and Industrial Research Organization.***, Retained by Broadcom via Potter Minton. Deposition. Case settled prior to trial.

2010-2011 ***Wi-LAN vs. RIM, PCD, Motorola, LG, et al.***, Was an expert witness for the defense. Retained by PCD and a major Korean cell phone manufacturer. PCD distributes phones made by HTC. Deposition. No trial testimony.

2009-2011 ***Wi-LAN vs. Acer, Intel, Broadcom, Atheros, Marvell, et al.***, Was expert witness for defense. Focused specifically on US Patent 5,282,222 related to OFDM technology. Served as expert related to wireless, the IEEE standards process and provided testimony related to damages. Retained by Intel, Broadcom and Marvell. Deposition. Case settled on the eve of trial.

2008-2009 ***CSIRO vs. Intel, Broadcom, Microsoft, HP, Dell, D-Link, et al.***, Served as fact witness related to 802.11 standardization, rules, process and events related to the formation of the 802.11 standard. Testified at trial.

Articles

[1] Chris Heegard et al. "High Performance Wireless Ethernet". In: *IEEE Communications Magazine* 39 (11 Nov. 2001), pp. 64–73. DOI: 10.1109/35.965361. URL: https://ieeexplore.ieee.org/document/965361/.

[2] Chris Heegard et al. "Combined Equalization and Decoding for IEEE 802.11b Devices". In: *IEEE Selected Areas in Communications* 21 (2 Feb. 2002). DOI: 10.1109/JSAC.2002.807558. URL: https://ieeexplore.ieee.org/document/1177178/.

[3] Matthew B. Shoemake and Sridhar Rajagopal. "IEEE 802.11g Jells as Applications Mount". In: *EE Times* (2002-04-02). URL: https://www.eetimes.com/document.asp?doc_id=1205335.

[4] Matthew Shoemake Michael Yonker and Jie Liang. "Merging WLAN, WWAN Radios in Mobile Designs". In: *EE Times* (2002-06-19). URL: https://www.eetimes.com/document.asp?doc_id=1277665.

[5] Matthew B. Shoemake and Sridhar Rajagopal. "Low Peak-to-Average Ratio Channel Estimation Sequences for MultiBand OFDM systems". In: *EE Times* (2004-05-17). URL: https://www.eetimes.com/document.asp?doc_id=1271119.

[6] Jason Wilcox and Steve Cherny. "Standardised uncertainty". In: *IAM Magazine* (2014-12-01). URL: https://www.iam-media.com/law-policy/standardised-uncertainty.

Books

[1] Chris Heegard et al. "Wireless Local Area Networks - The New Wireless Revolution". In: *Evolution of 2.4 GHz Wireless LANs*. Ed. by B. Bing. John Wiley, 2002. Chap. 2. ISBN: 978-0-471-22474-7.

Conferences and Standard Meetings

[1] Matthew Shoemake and Chris Heegard. "Computationally Efficient Turbo Decoding with Bi-Directional Viterbi". In: *1997 IEEE Information Theory Symposium*. Ulm, Germany, June 1997.

[2] Chris Heegard and Matthew B. Shoemake. "Proposal for High Data Rate 2.4 GHz PHY With Variable Rate Binary Convolutional Coding on QPSK". In: IEEE 802.11 Working Group. IEEE 802.11-98/82. Mar. 11, 1998.

[3] Chris Heegard, Matthew B. Shoemake, and Stanley Ling. "Short Preamble for High Performance 802.11 Physical Layer". In: IEEE 802.11 Working Group. IEEE 802.11-98/366. Oct. 7, 1998. URL: http://www.ieee802.org/11/Documents/DocumentArchives/1998_docs/83667A-Short%20Preamble%20for%20High%20Performance.pdf.

[4] Matthew B. Shoemake, Chris Heegard, and Stanley Ling. "Replacement Description of CCK". In: IEEE 802.11 Working Group. IEEE 802.11-98/367. Nov. 4, 1998.

[5] Matthew B. Shoemake, Stanley Ling, and Chris Heegard. "Performance of PBCC". In: IEEE 802.11 Working Group. IEEE 802.11-98/304. Sept. 16, 1998.

[6] Matthew Shoemake and Chris Heegard. "A New Turbo Code for 8-PSK Modulation". In: *1998 IEEE Information Theory Symposium*. Cambridge, MA, Aug. 1998.

[7] Matthew Shoemake, Chris Heegard, and Eric Rossin. "Turbo Codes for High Order Constellations". In: IEEE Information Theory Workshop. IEEE 802.11-98/304. Killarney, Kerry, Ireland, June 1998.

[8] Chris Heegard et al. "Texas Instruments Proposal for IEEE 802.11 TGg High Rate Standard". In: IEEE 802.11 Working Group. IEEE 802.11-00/384. 2000.

[9] Matthew B. Shoemake and Paul Lowry. "IEEE 802.11b Coexistence Testing Data". In: IEEE 802.15 Working Group. IEEE 802.15-01/84. Jan. 2001. URL: http://grouper.ieee.org/groups/802/15/pub/2001/Jan01/01084r0P802-15_TG2-IEEE-802.11b-and-Bluetooth-Coexistence-Testing-Results.ppt.

[10] Matthew B. Shoemake and Sridhar Rajagopal. "Proposal for Reduced PAR Channel Estimation Sequence for MB-OFDM". In: IEEE 802.15 Working Group. IEEE 802.15-04/106. Mar. 13, 2004.

[11] Matthew B. Shoemake. "UWB: Performance Matters". In: Texas Wireless Symposium. Oct. 27, 2005.

[12] Matthew B. Shoemake. "How to Raise Capital from Tier 1 VCs". In: Dallas Blue. Aug. 21, 2008.

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Recent Talks

8 March 2019 Texas A&M University Department of Electrical & Computer Engineering, Distinguished Speaker Series for Leaders & Innovators. Talk on LDPC error correction coding in the IEEE 802.11 standard.

21 July 2019 Duke University TIP program. Talk on the history of security in IEEE 802.11 with focus on cryptological errors made in WEP.

Community Service

27 Feb 2019 Southern Methodist University judge of business plans for entrepreneurship course.

2019 Official Scorekeeper for D-Bat Elite 13U Majors Boys Baseball Team.

2016-2018 Official Scorekeeper for NTX Eagles 10U-12U Majors Boys Baseball Team.

2017 Head Coach of Patriots 12U Boys Competitive Basketball in Allen Sports Association.

2013-2015 Head and Assistant Coaching Positions for 8U-9U Boys Competitive Baseball in Allen Sports Association.

2009 Advocated and Succeeded in Moving Entire Grade of Elementary School Children from Temporary to Permanent Facilities.

2008 Advocated and Established After School Science Program at Local Elementary School.

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