

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INFINERA CORPORATION,
Petitioner,

v.

ALEXANDER SOTO AND WALTER SOTO,
Patent Owner.

U.S. Patent 10,771,181 B2
Issue Date: Sep. 8, 2020

Title: SYSTEM AND METHOD FOR PERFORMING HIGH-SPEED
COMMUNICATIONS OVER FIBER OPTICAL NETWORKS

Inter Partes Review No.: IPR2023-000838

DECLARATION OF DR. PAUL MIN IN SUPPORT OF
PETITIONS FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO 10,771,181

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I, Dr. Paul Min, declare as follows:

I. INTRODUCTION

1. I am over the age of eighteen (18) and otherwise competent to make this declaration.

2. I have been retained by Infinera Corporation (Petitioner) as an independent, technical expert consultant in this proceeding before the United States Patent and Trademark Office (USPTO). I am being compensated at my rate of \$595.00 per hour for my services. No part of my compensation is dependent on my opinions or on the outcome of this proceeding. I have no financial interest in any of the parties to this proceeding.

3. This Declaration is in support of the Petitions for *inter partes* review involving U.S. Patent 10,771,181 (the “’181 Patent” or “the Patent”) (EX-1001), entitled “SYSTEM AND METHOD FOR PERFORMING HIGH-SPEED COMMUNICATIONS OVER FIBER OPTICAL NETWORKS” and listing Alexander Soto and Walter Soto as inventors.

4. I assume for purposes of this proceeding that Alexander Soto and Walter Soto are the Patent Owners.

5. For the purposes of this *inter partes* review, as I discuss later, I have been instructed to assume that the effective filing date of the Claims of the ’181 Patent challenged by the Petitioner in this *inter partes* review is no earlier than June

10, 2003, the filing date of the provisional application to which the '181 Patent claims priority.

6. The '181 Patent is generally directed to optical fiber communications, and more specifically to m-ary modulation in optical communications networks. I am familiar with the technology described in the '181 Patent as of the earliest possible priority date of June 10, 2003.

7. In preparing this Declaration, I have reviewed the '181 Patent (EX-1001) and its prosecution history (EX-1002), as well as the patents and documents cited herein, and I have considered these documents in light of the general knowledge in the art as of June 10, 2003. In formulating my opinions, I have relied upon my experience in the relevant art. I have also considered the viewpoint of a person of ordinary skill in the art ("POSA") in the relevant field, as of June 10, 2003, who I describe below (§V.E). For convenience, the materials I considered in arriving at my opinions are listed in Appendix A.

8. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. The findings presented herein are made to a reasonable degree of scientific certainty. I have made every effort to accurately and completely investigate all areas of concern identified during our investigation.

9. I have been asked to provide my technical expertise, analysis, insights

and opinions regarding the '181 Patent and relevant references that form the basis of the arguments set forth in the accompanying Petitions for *inter partes* review of the '181 Patent. As described in detail below, I offer the following opinions in this Declaration:

- A POSA would have found Claims 1-3, 5, 6, 8, 10, 12-17, 22, and 23 are unpatentable over *Vrazel* in view of *Pang* and a POSA would have been motivated to combine the teachings of these references.
- A POSA would have found Claim 11 are unpatentable over *Vrazel* and *Pang* in further view of *Fujimori* and a POSA would have been motivated to combine the teachings of these references.

II. QUALIFICATIONS

10. I received a B.S. degree in Electrical Engineering in 1982, an M.S. degree in Electrical Engineering in 1984, and a Ph.D. degree in Electrical Engineering in 1987 from the University of Michigan in Ann Arbor. I received several academic honors, including my B.S. degree with honors, a best graduate student award and a best teaching assistant award during my M.S. study, and a best paper award from a major international conference for reporting results from my Ph.D. thesis.

11. After receiving my Ph.D., I worked at Bellcore in New Jersey from August 1987 until August 1990. At Bellcore, I was responsible for evolving the

public switched telephone network (PSTN) into a multi-services voice and data network that incorporated packet switches, optical technologies, and wireless technologies, which included the deployment of the Synchronous Optical Network (SONET) as part of the digital backbone networks.

12. In September 1990, I joined the faculty at Washington University in St. Louis. In July 1996, I was promoted to an Associate Professor of Electrical Engineering with tenure. I am currently a Senior Professor at Washington University in the Department of Electrical and Systems Engineering. I have also served as the Chair of the Graduate Curriculum (2000-2002) and the Chair of the Undergraduate Curriculum (2011-2014) for the Department of Electrical and Systems Engineering.

13. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. I have received several grants from the U.S. Federal Agencies, including the National Science Foundation and the Defense Advanced Research Project Agency, and numerous contracts from companies and organizations around the world. I have researched a variety of communication, computing, and electronic technologies, including wireless communication, broadband communication, transmission and switching, integrated circuit design, software application and protocol design, and system prototype. I have an extensive background and experience in each of these

technologies. Specifically related to the technology matters in this litigation, I developed several packet processing methods that can address the speed and processing mismatch between the optical transport networks and the switching infrastructure in data communication.

14. As a faculty member at Washington University, I have taught a number of courses in electronics, communication, and computing at both the undergraduate and graduate levels. For example, I have taught electronic circuits (Washington University ESE 232), communication theory (Washington University ESE 471), transmission and multiplexing (Washington University ESE 571), and signaling and control of communication networks (Washington University ESE 572).

15. I have supervised numerous graduate and undergraduate students, many of whom received a doctoral degree under my guidance. The doctoral theses that I have supervised relate to wireless communication, broadband communication, transmission and switching, integrated circuit design, software application and protocol design, and system prototype. My students and I have published a number of peer-reviewed articles on transmission and switching, electronic circuit and integrated circuit design, resource allocation, scheduling, modulation, mobility management, switching and transmission, and multiplexing. Several of these articles received accolades in the field. For example, in 2011, we received a best paper award in 3G WCDMA-related mobility and resource management at the

prestigious Mobility 2011 international conference.

16. In addition to my responsibilities as a university faculty member, I have founded two companies. In May 1997, I founded MinMax Technologies, Inc., a fabless semiconductor company that developed switch fabric integrated circuit chips for the Internet. In March 1999, I founded Erlang Technology, Inc., a fabless semiconductor company that focused on the design and development of integrated circuit chips and software for the Internet. One of Erlang's products received a best product of the year award in 2004 from a major trade journal for the electronics industry. In these companies, I have designed a number of circuits and software protocols, including high speed interface devices with transmission media, which address the issues of the optical/electrical conversion and packet processing, a key technology aspect of this litigation.

17. Outside my own start-up companies, I have also served in various technology and business advisor roles for other companies and organizations around the world. I was the main technical author for one of two winning proposals to the Korean government for CDMA wireless service licenses (1996). I was responsible for designing a commercial scale IS-95 CDMA cellular network, which I understand to be one of the earliest such networks deployed in the world. I worked with numerous engineers and scientists around the world to implement this commercial-scale cellular network before IS-95 CDMA was widely accepted. This provided me

with extensive insight into various components of CDMA technology, which extensively use various transmission technologies incorporating packet framing techniques. I have also been involved in a semiconductor company that specializes in semiconductor memories such as flash EEPROMs as a board member and as a technical advisor (2007-2011).

18. I am a member of and have been actively involved in a number of professional organizations. For example, I have served as the Chair of the Saint Louis Section of the IEEE with more than 3,000 members (2014), and a member of the Eta Kappa Nu Honor Society for electrical engineers. I have also been an Ambassador of the McDonnell International Scholars Academy (2007-2013).

19. In my 30+ years of experience with telecommunications technology, I have acquired significant knowledge about telecommunications systems industry standards, standard setting organizations such as Bellcore, IEEE, ATM Forum, IETF, ITU, 3GPP, and the rules and document policies that those organizations have in place to develop industry standards.

20. I am a named inventor on eleven U.S. patents, many of which focus on algorithm and device designs. I have extensively published technical papers in international conferences and journals, technical memoranda and reports, and given a number of seminars and invited talks. I have organized several international conferences and served as an international journal editor.

III. RELEVANT LEGAL STANDARDS

21. I do not provide any legal opinions in this Declaration. I have been informed and understand that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims. I have been asked to provide my opinions regarding whether the claims of the '181 Patent would have been obvious to a person having ordinary skill in the art at the time of the alleged invention, in light of the prior art.

22. Further, I have been informed and understand that a patent claim is not patentable as obvious (a requirement I understand to be governed by a statute, 35 U.S.C. § 103) if the differences between the patent claim and the prior art are such that the claimed subject matter as a whole would have been obvious at the time the claimed invention was made to a person having ordinary skill in the relevant art. Obviousness, as I have been informed and understand, is based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and, to the extent that they exist, certain objective indicia of non-obviousness.

23. I understand that objective indicia can be important evidence regarding whether a patent is obvious or nonobvious, if it has an appropriate nexus to the claimed invention, i.e., is a result of the merits of a claimed invention (rather than the result of design needs or market-pressure advertising or similar activities). Such

indicia include: commercial success of products covered by the patent claims; a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results achieved by the invention as compared to the closest prior art; praise of the invention by the infringer or others in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; the patentee proceeded contrary to the accepted wisdom of the prior art, and, the contemporaneous development of the subject matter claimed by others.

24. I have been informed that whether there are any relevant differences between the prior art and the claimed invention is to be analyzed from the view of a person of ordinary skill in the relevant art at the time of the invention. As such, my opinions below as to a person of ordinary skill in the art are as of the time of the invention, even if not expressly stated as such; for example, even if stated in the present tense.

25. In analyzing the relevance of the differences between the claimed invention and the prior art, I have been informed that I must consider the impact, if any, of such differences on the obviousness or non-obviousness of the invention as a whole, not merely some portion of it. The person of ordinary skill faced with a problem is able to apply his or her experience and ability to solve the problem and also look to any available prior art to help solve the problem.

26. I have been informed that a precise teaching in the prior art directed to the subject matter of the claimed invention is not needed. I have been informed that one may take into account the inferences and creative steps that a person of ordinary skill in the art would have employed in reviewing the prior art at the time of the invention. For example, if the claimed invention combined elements known in the prior art and the combination yielded results that were predictable to a person of ordinary skill in the art at the time of the invention, then this evidence would make it more likely that the claim was obvious. On the other hand, if the combination of known elements yielded unexpected or unpredictable results, or if the prior art teaches away from combining the known elements, then this evidence would make it more likely that the claim that successfully combined those elements was not obvious.

27. I have been informed and understand that there are recognized, exemplary, rationales for combining or modifying references to show obviousness of claimed subject matter. Some of the rationales include the following: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to yield predictable results; use of a known technique to improve a similar device (method or product) in the same way; applying a known technique to a known device (method or product) ready for improvement to yield predictable results; choosing from a finite number of

identified, predictable solutions, with a reasonable expectation of success; known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; and some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art teachings to arrive at the claimed invention.

IV. OVERVIEW

28. The Challenged Claims are unpatentable as obvious over the prior art. The claims are directed to processing optical and electrical signals using conventional modulation and signal processing techniques, including known m-ary modulation and signal processing techniques and components in a pluggable optical transceiver.

29. Although the Challenged Claims were allowed and distinguished over the prior art during prosecution based on the claimed optical transceiver being “pluggable,” as I explain below, pluggable optical transceivers designed according to industry-standardized pluggable form factors were already well known in the art at the time of the alleged invention. By simply adding the term “pluggable” to the claims, the ’181 Patent failed to advance or make any patentable improvement to the existing state of the art, and merely described implementing conventional m-

ary modulation and signal processing techniques on a conventional pluggable optical transceiver.

V. BACKGROUND

A. Summary of the '723 Patent

30. The '181 Patent is directed to a system and method for performing high-speed communications over fiber optical networks using admittedly known m-ary modulation and signal processing techniques and components in a pluggable optical transceiver. EX-1001 1:1-4, 1:36-38, 9:7-11:20, 10:20-31. The '181 Patent describes signal processing techniques, including m-ary modulation/demodulation, channel equalization, multiplexing/demultiplexing, encoding/decoding and error correction (EX-1001 6:12-17)—all of which were well known in the art before the alleged priority date. The '181 Patent admits that m-ary modulation techniques, including Quadrature Amplitude Modulation (QAM), Pulse Amplitude Modulation (PAM), and Quadrature Phase Shift Keying (QPSK) were “known in the art.” EX-1001 10:20-31. The '181 Patent also admits that small form factor pluggable standards, including, example.g., “SFP and SFP+” were known and “[c]ommon” industry standards for pluggable optical transceivers. EX-1001 11:24-26, 34-37 (identifying “form factor[s] of standard optical modules such as . . . XFP or SFP and SFP+” as “[c]ommon optical module standards”).

The '181 Patent issued with 23 claims. Claim 1 is representative:

[1pre] A pluggable optical transceiver module comprising of:

[1a] an electrical system interface for receiving a first electrical data signal and for transmitting a second electrical data signal;

[1b] an m-ary modulator for increasing the number of bits per symbol in the first electrical data signal to produce a first m-ary modulation signal;

[1c] a digital to analog converter for converting the first m-ary modulation signal to a first electrical m-ary analog modulation signal;

[1d] a driver for amplifying the first electrical m-ary analog modulation signal to an amplified first electrical m-ary analog modulation signal to drive an optical transmitter;

[1e] the optical transmitter for emitting a first optical signal on a first wavelength responsive to and representative of the amplified first electrical m-ary analog modulation signal from the driver;

[1f] an optical detector for receiving a second optical signal on a second wavelength to produce an electrical analog signal;

[1g] an amplifier for amplifying the electrical analog signal to an amplified electrical analog signal;

[1h] a clock data recovery unit for recovering clock and data information to produce a second m-ary modulation signal from the amplified electrical analog signal;

[1i] an equalizer for performing equalization on the second m-ary modulation signal to remove noise; and

[1i] an m-ary demodulator for decreasing the number of bits per symbol in the equalized second m-ary modulation signal to produce the second electrical data signal.

EX-1001 15:2-33.

B. Prosecution History

31. I have been informed by counsel that the '181 Patent issued from U.S. Patent Application No. 16/297,610, filed March 9, 2019. EX-1001 (21), (22). I have been informed by counsel that in the sole rejection, the Examiner rejected the claims of the '181 Patent application for nonstatutory double patenting over U.S. Patent 10,263,723 (EX-1016, "'723 Patent"). EX-1002 77, 124. I have been informed by counsel that, in response, Patent Owner ("PO") filed a terminal disclaimer to overcome that rejection. EX-1002 53, 64-72. The '181 Patent is a continuation of the '723 Patent. EX-1001 (63); EX-1002 48, 52.

32. The '723 Patent issued from U.S. Patent Application No. 15/884,351, filed January 30, 2018. EX-1001 (63). The Examiner issued allowance without any rejections. See generally EX-1027. Both the '181 Patent and the '723 Patent are continuations of U.S. Patent 9,887,795 (EX-1008, "'795 Patent"). EX-1001 (63); EX-1016 (63).

33. I have been informed by counsel that, unlike the '181 Patent and the '723 Patent, the '795 Patent was subject to multiple rejections. EX-1004 126, 174, 177. I have been informed by counsel the Examiner rejected claims as anticipated by U.S. Patent No. 6,603,822 ("Brede"). EX-1004 174-177. I have been informed by counsel that, in response, Patent Owner amended the claims to include the "pluggable" limitation. EX-1004 148. I have been informed by counsel that the Examiner, however, maintained the rejection. EX-1004 121. I have been informed by counsel that, in response, PO argued that Brede disclosed a "Host Digital Terminal" (HDT) and because its mounting process required "eight screws to [a] metal frame of a shelf of a rack," it did not function as a "pluggable" unit. EX-1004 69-71. I have been informed by counsel that PO argued that Brede disclosed "a collection of rack mounted units that collectively as a whole do not function to plug into an aperture or gap." EX-1004 71.

34. I have been informed by counsel that the Examiner rejected claims, which recited "form factors" and "a pluggable form factor standard," as obvious over Brede and U.S. Patent Publ. No. 2007/0031153 A1 ("Aronson") and then again, as obvious over Brede and U.S. Patent 7,729,617 B2 ("Sheth"). EX-1004 126-127, 177-178. I have been informed by counsel that the Examiner stated that "standardized pluggable form factors are well known in the art." EX-1004 126. I

have been informed by counsel that, in response, PO argued that the Examiner failed to establish a motivation to combine the references. EX-1004 72-73.

35. I have been informed by counsel that the Examiner subsequently allowed the claims and the patent issued without any further comments. EX-1004 60.

C. Claim Construction

36. I have been advised by counsel that, in order to properly evaluate the claims of the '181 Patent, the terms of the claims must first be interpreted. I have been asked to give each claim term in the Challenged Claims its plain and ordinary meaning in view of the specification and the prosecution history as would have been understood by a POSA (which I define below in §V.E) as of June 10, 2003 in this proceeding. It is my opinion that no specific construction of any claim term is required because the prior art I have relied upon meets each of the claim terms under any reasonable construction. I have been informed by counsel that the Board does not construe claim terms unless the terms are in controversy, and then only to the extent necessary to resolve the controversy.

D. Priority Date of the Challenged Claims

37. I have been informed that the '181 Patent claims priority to U.S. Provisional Application No. 60/477,845, filed June 10, 2003. EX-1001 (60). For

purposes of this declaration, I have been instructed to assume the priority date is June 10, 2003.

E. Person of Ordinary Skill in the Art

38. I have been informed by counsel that a POSA in the relevant art is a hypothetical person who is presumed to be aware of all pertinent prior art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

Unless otherwise stated, my testimony below refers to the knowledge of a POSA as of June 10, 2003, the date that I was advised by counsel to use as the priority date of the '181 Patent. I am familiar with the knowledge and capabilities of one of ordinary skill in the art as of that priority date. In my opinion, as to the '795 Patent, a POSA in June of 2003 would have had at least a Bachelor's degree in Computer Science, Computer Engineering, Electrical Engineering or a similar degree and at least two years of professional experience with optical communications, networking, and signal processing. More experience can supplement less education and vice versa. The level of skill in the art is further demonstrated by the references cited herein, including the asserted art and the background references I discuss in §V.F below. While I may occasionally use the present tense, the analysis is from the perspective of a POSA as of the time of the purported invention.

F. State of the Art

39. In the following section, I describe the state of the art, including the general knowledge, skill, common sense, and creativity possessed by a POSA as of June 2003. I explain the conventional purposes, methods, and components in the art, informing the motivations and reasonable expectations of success.

1. Pluggable Optical Transceivers and Pluggable Form Factors

40. By June 2003, pluggable optical transceiver modules were well known. The justification for packaging optical transceivers into “pluggable” modules was that packaging transceiver modules into pluggable form factors meant that the physical layer in an optical communication network was placed on the pluggable transceiver itself. EX-1010 3095; EX-1011 1-2. These pluggable modules would in turn “plug” into a host system, such as a switch or router, via an electrical interface. A key advantage of pluggable transceivers was that system manufacturers could design and manufacture host systems that could support a variety of physical layers. EX-1010 3095; EX-1011 1-2. The Gigabit Interface Converter (GBIC) Multi-Source Agreement (MSA) was first published as an industry-wide form factor standard in 1995. EX-1012 xii; Other pluggable form factor standards were also published, including the Small Form Factor Pluggable (SFP), adopted in 2001. EX-1013 1.

2. M-ary Modulation

41. By June 2003, use of m-ary modulation techniques, including Quadrature Amplitude Modulation (QAM), Pulse Amplitude Modulation (PAM), and Quadrature Phase Shift Keying (QPSK) modulation was well known. M-ary modulation techniques, such as QAM, PAM, and QPSK were “known in the art” to increase the number of bits per symbol transmitted. EX-1001 10:20-31; EX-1014 876. For example, a four-level signal would mean two bits were transmitted per symbol period. An example of one such multilevel modulation format was PAM, with a four-level signal called “PAM-4.”

3. Coding and Error Correction

42. By June 2003, error correction coding in optical communication was well known. Error correction coding, also known as forward error correction (FEC), is a technique for encoding transmitted data according to an error correcting code. Encoding the data according to a code adds redundancy to an error correction coding scheme by adding redundancy to a message, and this redundancy allows a receiver to detect and correct errors in the message. By June 2003, numerous error correction codes were well known in communications including, e.g., Low Density Parity Check (LDPC) codes, Reed-Solomon codes, Turbo codes, and convolutional codes. EX-1015 952-961; EX-1018.

4. Equalization

43. By June 2003, use of equalization as an electrical signal processing technique in a receiver for removing distortion incurred by a signal transmitted through a channel was well known. EX-1031 1439. Indeed, equalization as a receiver signal processing technique had been known in the art since at least 1990. EX-1031 1439 (paper dated September 1990).

44. Equalization generally refers to the use of a filter to create a flat amplitude and phase response (versus frequency) of the combined channel and filter. In optical communications, equalization frequently refers to using such filters in a receiver to compensate for impairments such as intersymbol interference. EX-1031 1439. Known equalization methods can be classified by both the filter architecture and the algorithm that is used to adjust and set the filter tap weights. EX-1031 1441.

45. Equalization techniques can be implemented to aid in compensating and reducing the effects of these transmission impairments, and “the improvement from implementing [equalization] is large and the implementation is relatively simple.” EX-1017 965.

46. By June 2003, equalization techniques such as decision feedback equalization and blind equalization were widely used. EX-1017 991, 965. In decision feedback equalization, a known data sequence is transmitted during a training period and used to statistically model the signal distortion, *i.e.*, tap weights are set using a known training sequence. EX-1017 991. These weights can be used

to cancel and/or compensate the distortions of the transmitted signal. EX-1017 991. In blind equalization, a training sequence is not used to determine the state of the channel; instead, the received signal itself is used for equalization without knowing the state of the transmission channel. EX-1017 991. Decision-Directed (DD) equalization is a primitive Blind Equalization method to set filter weights and thereby cancel of Inter-Symbol-Interference in data channel.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

47. I have been informed that Petitioners are Challenging Claims 1-3, 5, 6, 8, 10-17, 22 and 23 of the '181 Patent.

B. Statutory Grounds for Challenges

48. The Challenges are set forth in detail below and summarized as follows:

Ground	Claim(s)	Basis	Reference
1	1-3, 5, 6, 8, 10, 12-17, 22, and 23	§ 103	Pang in view of Vrazel
2	11	§ 103	Pang in view of Vrazel and Fujimori

C. Prior Art Basis

49. U.S. Patent Application Publication No. 2003/0020986 A1 (“Pang”) titled “Method and Apparatus for Pluggable Fiber Optic Modules” was filed Apr. 8, 2002 and published Jan. 30, 2003. EX-1007. I have been informed that Pang is

prior art. Pang was not cited or applied by the Examiner during '181 Patent Prosecution. EX-1001 (56); EX-1002.

50. U.S. Patent Application Publication No. 2002/0167693 A1 ("Vrazel") titled "Increasing Data Throughput in Optical Fiber Transmission Systems" was filed Dec. 21, 2001 and published Nov. 14, 2002. EX-1006. I have been informed that Vrazel is prior art. Vrazel. was not cited or applied by the Examiner during '181 Patent Prosecution. EX-1001 (56); EX-1002.

51. U.S. Patent 7,206,366 B2 ("Fujimori") titled "System and Method for Programmably Adjusting Gain and Frequency Response in a 10-Gigabit Ethernet/Fibre Channel System" was filed Jan. 7, 2003 and issued Apr. 17, 2007. EX-1006. I have been informed that Fujimori is prior art. Fujimori was not cited or applied by the Examiner during '181 Patent Prosecution. EX-1001 (56); EX-1002.

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1-3, 5, 6, 8, 10, 12-17, 22, and 23 Are Obvious Over Pang and Vrazel

1. Pang (EX-1007)

a. Analogous Art

52. It is my opinion that Pang is analogous art to the claimed invention. Pang is in the same field of endeavor as the '181 Patent because it is directed to pluggable fiber optic modules for "transducing communication by light . . . with communication by electrical signals," including fiber optic transceivers having both

transmit and receive functionality. EX-1007 Abstract, [0003], [0004]; EX-1001 1:36-38, 9:7-8, FIG. 3. It is my opinion that Pang is reasonably pertinent to the problem addressed by the '181 Patent's claimed invention because Pang's solution provides for "high transmission" communications over fiber optic networks. EX-1007 [0005]; EX-1001 Title, 1:1-3, 6:12-13.

b. Overview of Pang

53. Pang discloses a pluggable fiber optic module 100 that includes transmit printed circuit board (PCB) 106, receive PCB 108, light transmitter 110, light receiver 111, and an edge connection to plug into and out from a host PCB. EX-1007 Abstract, [0066], [0156]; FIG. 1. The transmit PCB and receive PCB each include electrical components. EX-1007 [0159], [0160]. Transmit PCB 106 includes electrical components 112 (transmitter integrated circuit (laser driver)) and receive PCB 111 includes electrical components 116 (receiver integrated circuit (transimpedance amplifier and post amplifier). EX-1007 [0067]. The optical transmitter and the optical receiver are configured to convert or transduce light into an electrical signal (or convert an electrical signal into light) to communicate over optical fibers using light of various wavelengths. EX-1007 [0067].

54. In one embodiment, Pang describes fiber optic module 1700 is an "MTRJ-SFP pluggable fiber optic module" (small form factor pluggable) having an

edge connection 1730 to “allow for hot pluggability . . . into a powered up host printed circuit board.” EX-1007 [150], [0156], FIG. 17A.

2. Vrazel (EX-1006)

a. Analogous Art

55. It is my opinion that Vrazel is analogous art to the claimed invention. Vrazel is in the same field of endeavor as the '181 Patent because it “relates to optical fiber communication systems and . . . increasing the throughput of data transmission over an optical fiber communication system through the use of multilevel modulation.” EX-1006 [0002]; EX-1001 1:1-3, 1:36-38. It is my opinion that Vrazel is reasonably pertinent to the problem addressed by the '181 Patent's claimed invention because Vrazel's solution is aimed at “increasing the throughput of data transmission over an optical fiber communication system.” EX-1006 [0002]; EX-1001 Title, 1:1-3, 6:12-13.

b. Overview of Vrazel

56. Vrazel discloses to signal processing methods and techniques for “increasing the throughput of data transmission over an optical fiber communication system through the use of multilevel modulation.” EX-1006 [0002]. Vrazel describes signal processing methods that enhance the transmission of a multilevel optical signal over existing fiber optics communications systems.” EX-1006 [0012]. Vrazel describes fiber optic transmitter and receiver systems utilizing known m-ary modulation techniques including, e.g., “ 2^n -ary amplitude shift keying (2^n -ASK), 2^n -

ary frequency shift keying (2^n -FSK), 2^n -ary phase shift keying (2^n -PSK), as well as combinations of these techniques such as quadrature amplitude modulation (QAM).” EX-1006 [0010]. These modulation techniques “add little or no complexity to the optical components of the channel transmitter and receiver.” EX-1006 [0011].

57. Figure 5 of Vrazel depicts multilevel optical transmitter 500 comprising error protection coding (EPC) module 510, n-channel encoder 502, Digital to Analog DAC 504, pre-compensation circuitry 506, and optical source 508. EX-1006 [0050], FIGs. 5, 6. Figure 18 shows multilevel optical detector (receiver) 1802 comprising distortion post-compensation circuits 1804, Analog to Digital Converter 1806, a transimpedance amplifier, n-channel decoder 1808, and error protection decoding (EPD) module 1816. EX-1006 [0113], [0114], FIG. 18.

3. Motivation to Combine Pang and Vrazel

58. A POSA would be motivated to combine Pang’s teaching of a pluggable small form factor optical transceiver with Vrazel’s teaching of known modulation techniques for use with optical transceivers with a reasonable expectation of success because Vrazel’s techniques enhance the transmission of optical signals over existing fiber optics communications systems and add little or no complexity to their optical components. EX-1006 [0011], [0012].

59. Pang explains that the trend “towards greater usage of fiber optic communication requiring improved connectivity and smaller optical fiber connectors to more densely pack them on a system printed circuit board.” EX-1007 [0006]. This made it “desirable to minimize the size of system printed circuit boards (PCBs)” and “reduce the footprint of the fiber optic module which will attach to such system PCBs.” EX-1007 [0006]. Pang discloses pluggable fiber optic transceiver modules with transmit and receive PCBs arranged “within the [same] fiber optic module to reduce the footprint of the fiber optic module.” EX-1007 [0006], [0065]. Pang discloses a pluggable fiber optic module 1700 having a transmit PCB 1708, receive PCB 1710, transmitter 110, receiver 111, and interface PCB 1704. EX-1007 [0150]. Transmit and receive PCBs 1708 and 1710 are electrically connected to interface PCB 1704, which in turn connects to a host system via edge connection 1730. EX-1007 [0155]. Edge connection 1730 allows for “hot pluggability” of the fiber optic module 1700 into a powered up host system. EX-1007 [0155]. Pang explains that “the invention may be extended to a plurality of channels in parallel which can be all transmit channels, all receive channels or both receive and transmit channels into multiple fiber optic cables.” EX-1007 [0191].

60. A POSA would have been aware that “extending to a plurality of channels in parallel” was a way of increasing the number of channels carrying information and, in turn, increasing the data throughput of the system. EX-1007

[0191]; EX-1006 [0004]. Pang relates primarily to the physical arrangement of components in a pluggable optical transceiver, and does not provide a detailed description of the operation of the electrical components and techniques used in its transceiver. In contrast, Vrazel provides a detailed description of the operation of electrical components and techniques suitable for use with Pang's pluggable transceiver.

61. Vrazel discloses increasing data rates by using spectrally efficient modulation techniques that increase channel data rates. EX-1006 [0010]. Vrazel discloses that its solution may be used in combination with conventional techniques, such as Wavelength Division Multiplexing (WDM) techniques, to achieve even greater increases in data transmission rates, and that the use of such modulation techniques can achieve these increases without replacing existing optical fiber. EX-1006 [0010]. These modulation techniques allow for greater amounts of data to be encoded and then transmitted at the same time over an optical fiber. EX-1006 [0010], [0011]. These techniques add little or no complexity to the optical components of the transmitter and receiver, i.e., Vrazel's techniques provide an increase in data rate while using the same lasers and photodetectors. EX-1006 [0011]. To do this, these techniques use interface circuits that have increased signal processing capability both for encoding (i.e., transmitting) and decoding (i.e., receiving) signals that use modulation. EX-1006 [0011].

62. A POSA would be motivated to combine Pang's teaching of a pluggable optical transceiver with Vrazel's teaching of modulation techniques for optical transmission for several reasons. First, a POSA would recognize that applying Vrazel's modulation techniques to Pang's pluggable transceiver would increase the data rate in optical links while maintaining existing fiber installations. Second, a POSA understood that market pressures would make such data rate increases necessary and desirable. In this regard, a POSA was aware of the increased demand for faster optical communication. EX-1007 [0006] ("the trend is towards greater usage of fiber optic communication requiring improved connectivity.").

63. Third, a POSA understood that Vrazel's modulation techniques, which are performed in electronic circuits, complement Pang's smaller form factor transceiver and add little or no complexity to the optical components. For example, Pang discloses pluggable optical transceiver modules having smaller form factors, thus reducing the footprint of the module and its manufacturing costs without affecting the optical link. EX-1007 [0005], [0006]. Vrazel's teachings complement Pang's teachings by increasing the data rate for each optical link without increasing the overall size or footprint of the module. Vrazel's teachings, including error correction coding, multilevel modulation, and equalization, all relate to functionality in the electronics of an optical transceiver. EX-1006 [0050], [0052] (electronic

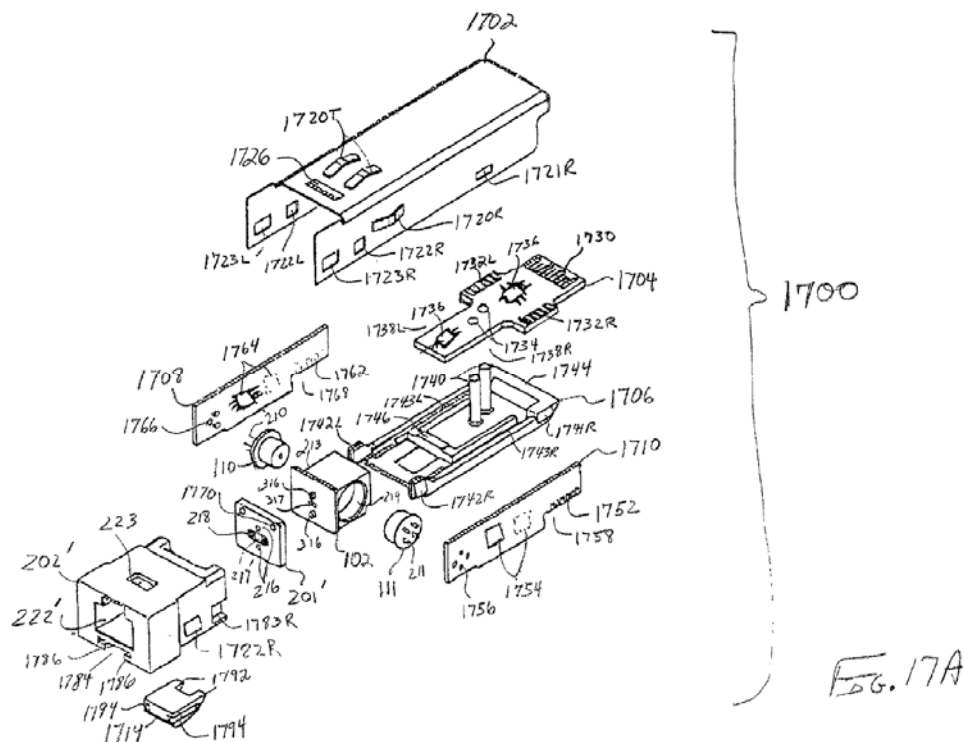
functional blocks of the transmitter can be integrated into one circuit), [0113] (electronic functional blocks of the receiver can be integrated into one circuit).

64. Vrazel's modulation techniques "add little or no complexity to the optical components of the channel transmitter and receiver, further reducing the cost of a system upgrade." EX-1006 [0011]. Vrazel further states that an increase in data rate can be provided using the same optics as those used in conventional optical links. EX-1006 [0011]. Thus, a POSA would be motivated to combine Pang's pluggable optical transceiver teachings with Vrazel's teachings of additional signal processing because doing so would enable pluggable transceivers at higher data rates without modifying the optical components that are the core of Pang's pluggable transceiver.

65. Further, a POSA would have a reasonable expectation of success in combining Pang's pluggable optical transceiver teachings with Vrazel's teachings of additional signal processing because it would be a routine modification for a POSA. For example, Vrazel, in Figures 5 and 6, discloses a transmitter that includes an error protection coding module, an encoder, a Digital to Analog Converter, and pre-compensation circuitry. EX-1006 [0049], [0050], [0054]. Vrazel explains that these transmit electronics "can be integrated into one circuit or multichip module." EX-1006 [0054]. Vrazel also discloses a receiver in Figure 18 that includes a transimpedance amplifier, distortion post-compensation circuits, an Analog to

Digital Converter, a decoder, and an error protection decoding module. EX-1006 [0112]-[0114]. Vrazel explains that all of these receive electronics “can be integrated in one circuit or multi-chip module.” EX-1006 [0113].

66. Pang discloses using transmit and receive electronics, as shown in Pang’s Figure 17A (below). Pang discloses transmit PCB 1708 and receive PCB 1710 that connect to interface PCB 1704. EX-1007 [0155]. Pang explains that transmit PCB 1708 includes one or more solder pads 1762 for connecting to the interface PCB, and these solder pads 1762 may be electrically coupled to one or more integrated circuits 1764 and the transmitter 110. EX-1007 [0160]. Pang explains that receive PCB 1710 includes one or more solder pads 1752 for connecting to the interface PCB and may be electrically coupled to one or more integrated circuits 1754 and receiver 111. EX-1007 [0159]. Pang discloses a laser driver as a transmitter integrated circuit, and a transimpedance amplifier (TIA) and post amplifier receiver integrated circuits. EX-1007 [0067].



67. Thus, a POSA understood that Pang's transmit and receive PCBs 1708 and 1710 include signal processing circuitry, including transmit circuitry for driving a laser (i.e., a laser driver) and receive circuitry for amplifying a received signal (i.e., a TIA and post amplifier). A POSA further understood that adding Vrazel's teaching of transmit and receive electronics to Pang's teaching would simply be adding additional signal processing that Pang contemplates for integrated circuits 1754 and 1764, and adding little or no complexity to the optical components. These combined teachings would have been a routine modification well within the skill of a POSA because it involves merely combining known optical communications components and signal processing techniques according to known methods to yield predictable results.

4. Detailed Application to the Challenged Claims

a. Claim 1

[1pre] A pluggable optical transceiver module comprising of:

68. To the extent the preamble is limiting, Pang discloses this limitation.

69. Pang is directed to a “[m]ethod and apparatus for **pluggable** fiber optic modules” and discloses “[p]luggable fiber optic modules having a receive printed circuit board and a transmit printed circuit board” and an “interface printed circuit board to plug into and out from an edge connector of a host printed circuit board.” EX-1007 Title, Abstract. A transmitter optoelectronic device is coupled to the transmit printed circuit board and a receiver optoelectronic device is coupled to the receive printed circuit board. EX-1007 Abstract. Pang discloses a fiber optic module 100 (*a pluggable optical transceiver*) that includes transmit PCB 106, receive PCB 108, light transmitter 110, light receiver 111, and an edge connection to plug into and out from a host system. EX-1007 Abstract, [0066], [0156], FIG. 1.

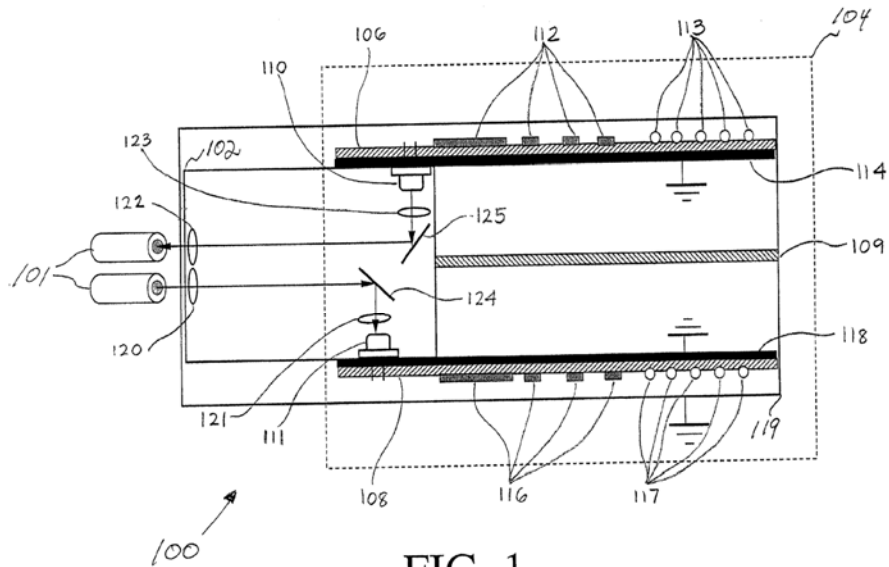
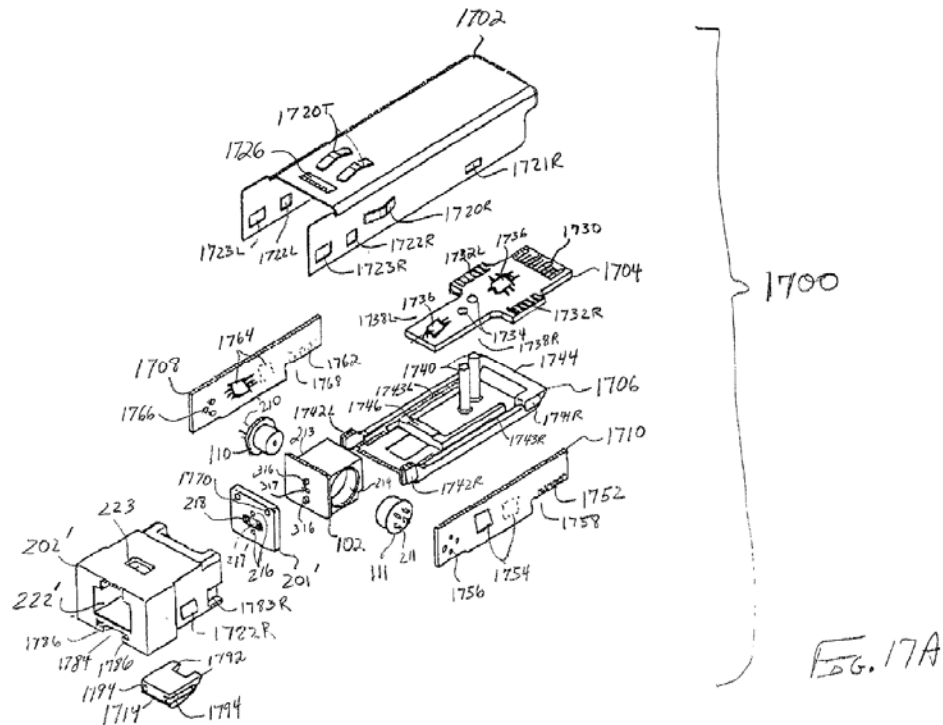


FIG. 1

70. Pang discloses that “**pluggable** optical module 1700” is an “MTRJ-SFP **pluggable** fiber optic module,” which includes optical block 102, transmit PCB 1708, receive PCB 1710, and interface PCB 1704. EX-1007 [0150], FIGs. 17A-17D. Pang explains that interface PCB 1704 has an edge connection 1730 that “allows the fiber optic module 1700 to be plugged into and out of an edge connector of a host printed circuit board” and “for hot pluggability . . . into a powered up host printed circuit board.” EX-1007 [0155], [0156], FIG. 17A.



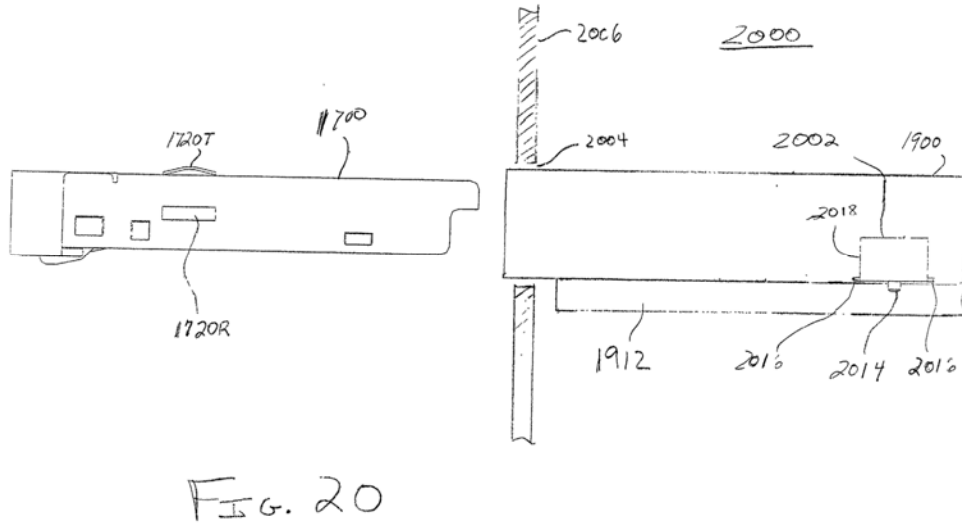
71. Based on Pang’s disclosure, a POSA understood that pluggable optical module 1700 is a *pluggable optical transceiver module* because it includes an edge connection or hot pluggable electrical connector that allows for pluggability into a host system.

[1a] an electrical system interface for receiving a first electrical data signal and for transmitting a second electrical data signal;

72. Pang, alone or in view of Vrazel, discloses this limitation.

73. Pang discloses an edge connection 1730 that “may allow for hot pluggability of the fiber optic module 1700 into a powered up host printed circuit board.” EX-1007 [0155], FIG. 17A. Pang discloses that fiber optic module 1700 couples to a host system 2000 such that edge connection 1730 of module 1700

couples to an edge connector 2002 of a host system 2000. EX-1007 [0180], [0182], FIG. 20.

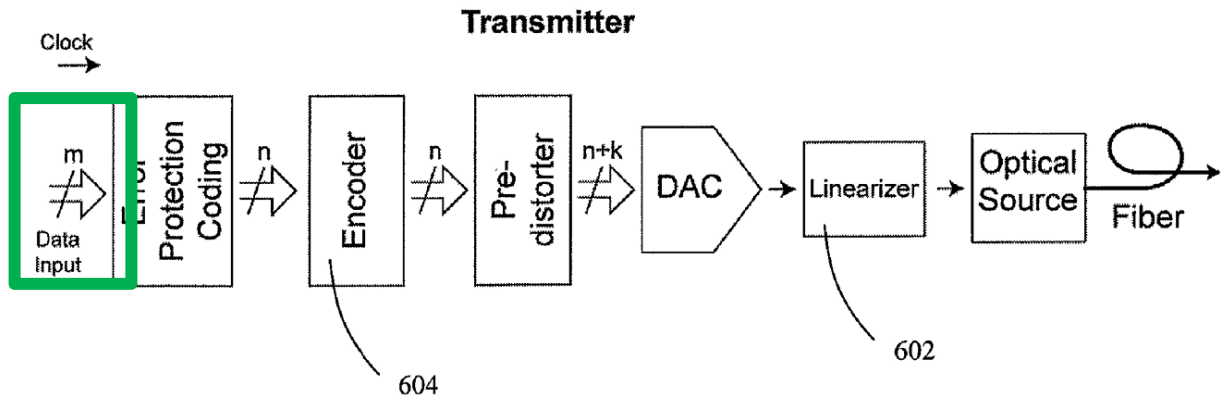


74. Pang explains that fiber optic module 1700 is inserted into host system 2000 such that an electrical connection is formed between the fiber optic module and the host system via edge connection 1730 and edge connector 2002. EX-1007 [0185], [0188]-[0190]. Pang discloses that this connection interface is used to provide “connections for signal or data lines.” EX-1007 [0190]. A POSA understood that the interface where fiber optic module 1700 connects to host system 2000 via edge connection 1730 and edge connector 2002 is *an electrical system interface for receiving a first electrical data signal and transmitting a second electrical data signal* because it is where the electrical connection is formed between the fiber optic module and the host system. Based on Pang’s disclosure, a POSA would find it obvious to include, for example, a XAUI interface because, as the ’181

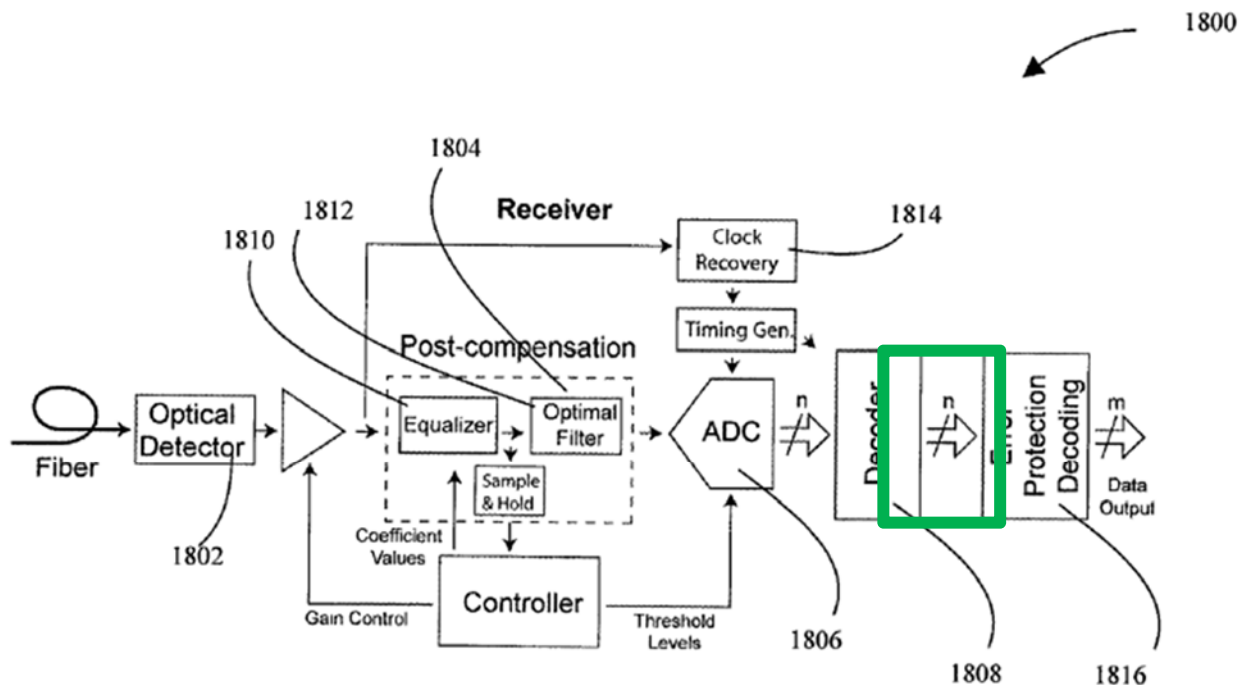
Patent admits, it was a “conventional interface[]” and well known in the art for use with optical transceivers for high speed communications. EX-1001 9:22-26; EX-1028 6:43-7:2, FIGs. 1, 3; EX-1029 1:13-16, 3:49-5:1, FIG. 1; EX-1030 16, 27.

75. To the extent PO argues that Pang does not expressly disclose the details of the signal processing, Vrazel discloses those details. Vrazel discloses, in Figures 6 and 18, m bits of electrical data that are input and output. First, in Figure 6 (below),¹ Vrazel discloses a transmitter receiving an m -bit input word that is received by an error protection coding (EPC) module (green). EX-1006 [0050]. Vrazel explains that, “four digital channels can be input to the EPC module” (using $m=4$ as an example). EX-1006 [0052].

¹ The citations to Vrazel are a description of Vrazel’s Figure 5. Vrazel explains that Figure 6 is an “alternative exemplary transmitter” that differs from Figure 5 only in that pre-compensation is performed in the digital domain as opposed to the analog domain. EX-1006 [0018]-[0019], [0054].



76. Similarly, for the receiver in Figure 18 (below), Vrazel discloses that error protection decoding (EPD) module 1816 outputs m-bits of electrical data. EX-1006 [0113]. Vrazel explains that the receiver outputs “four digital data streams.” *Id.*



77. A POSA understood that Vrazel’s m-bit input is *an electrical system interface for receiving a first electrical data signal* because it is where the electrical

data signal inputs the transceiver on the transmit side and is received by the EPC module as “Data Input.” EX-1006 [0050], FIG. 6. Likewise, a POSA understood that the m-bit output is *an electrical interface for transmitting a second electrical data signal* because it is where the electrical signal outputs the transceiver on the receive side and transmitted (output from the EPD module) as “Data Output.” EX-1006 [0113], FIG. 18. A POSA would be motivated to modify Pang’s teachings with the signal processing techniques taught by Vrazel for the reasons discussed in §VII.A.3.

[1b] an m-ary modulator for increasing the number of bits per symbol in the first electrical data signal to produce a first m-ary modulation signal;

78. Vrazel discloses this limitation in at least two ways. First, Vrazel discloses an encoder 502 (red) (*an m-ary modulator*) shown in Figure 5. EX-1006 [0018], [0019], [0054].

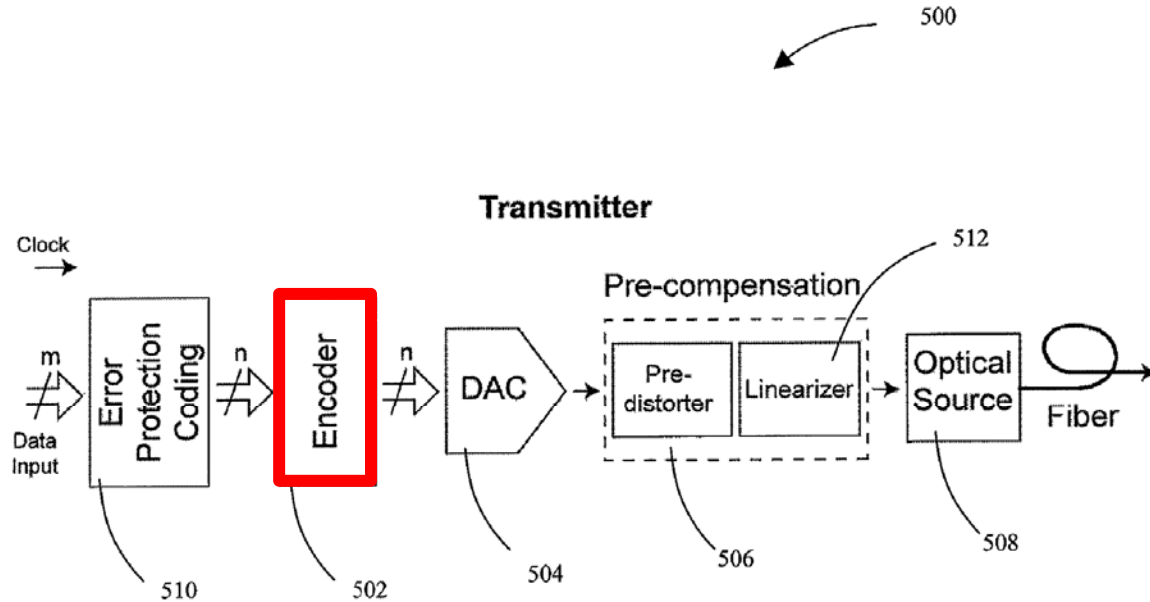


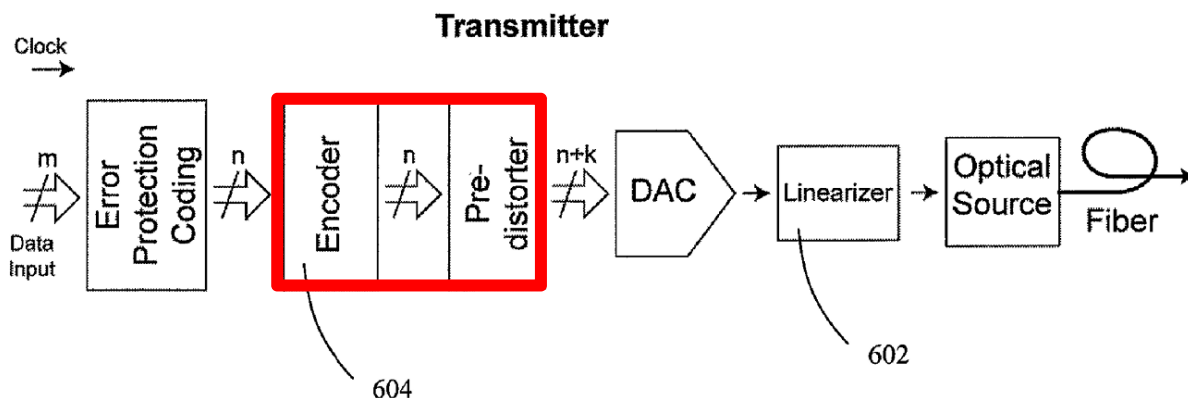
Fig. 5

79. The encoder 502 receives an encoded data signal from EPC module 510 and converts it to an n-channel “Q-Gray code” encoded signal, which increases the number of bits per symbol. EX-1006 [0051], [0053], [0010] (encoding “greater amounts of data into the transmitted spectrum of a channel”). That encoded signal is then input to DAC 504, which “generates a 2^n -level electrical signal that can be used to modulate the optical source 508.” EX-1006 [0051]. Vrazel describes, for example, encoder 502 encoding data channels into a four-bit output that is then input to the DAC and “converted to one of 16 possible amplitude levels for a four times increase in data throughput.” EX-1006 [0051], [0053], [0043] (“allow[ing] for more

than one bit to be transmitted per clock cycle” and “combining four bits (i.e., 16 possible amplitude levels) into each single transmitted pulse, or symbol”).

80. A POSA understood that encoder 502 is an *m*-ary modulator because it takes an input encoded data signal (*first electrical data signal*) on the transmit side and converts it to a Q-Gray code encoded signal (*first m-ary modulation signal*) having multiple bits per symbol (*increasing the number of bits per symbol*), which is then input to the DAC to generate a 2^n -level electrical signal that is used to modulate the optical source.

81. Second, Vrazel discloses encoder 604 and a digital pre-distortion circuit (red) (collectively, an *m*-ary modulator), as shown in Figure 6 (below):



82. Vrazel explains that Figure 6 is an alternate embodiment of Figure 5, which discloses encoder 502. EX-1006 [0018], [0019], [0054]. Like encoder 502,

the encoder of Figure 6² receives encoded data from EPC module 510 and converts it to an n -channel “Q-Gray code” encoded signal, increasing the number of bits per symbol. EX-1006 [0051], [0053], [0010]. The output of encoder 604 is an n -bit encoded signal that is passed to a pre-distorter that operates in the digital domain. EX-1006 [0054]. The pre-distorter adds k bits to the input encoded signal and outputs an $n+k$ -bit Q-Gray code encoded signal. EX-1006 [0051], FIG. 6. The $n+k$ -bit Q-Gray coded encoded signal is then input to the DAC, which generates a 2^n -level electrical signal that can be used to modulate the optical source. EX-1006 [0051], [0053], [0054].

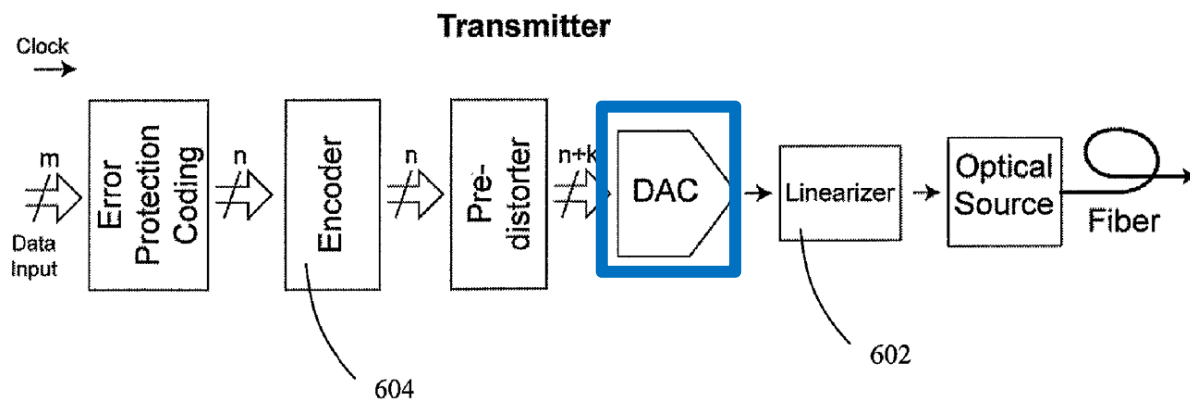
83. A POSA understood that the encoder and pre-distorter in Vrazel’s Figure 6, collectively, is an *m*-ary modulator because it takes an input n -bit encoded data signal (*first electrical data signal*) and converts it to an $n+k$ -bit Q-Gray code encoded signal (*first m-ary modulation signal*) having an additional k bits per symbol (*increasing the number of bits per symbol*) that is then input to the DAC to generate a 2^n -level electrical signal that can be used to modulate the optical source.

[1c] a digital to analog converter for converting the first m-ary modulation signal to a first electrical m-ary analog modulation signal;

84. Vrazel discloses this limitation.

² Note that there is a typographical error in paragraph [0056] of Vrazel, i.e., paragraph [0056] refers to encoder 603 instead of 604.

85. Vrazel discloses a *digital to analog converter* (DAC) that, in Figure 5 receives n bits, and in Figure 6 (below, in blue) receives an $n+k$ bits, of input data signal in the digital domain (*the first m-ary modulation signal*) and outputs an analog electrical signal (*a first electrical m-ary analog modulation signal*) “that can be used to modulate the optical source.” EX-1006 [0051].



86. Because, as discussed above for [1b], the $n+k$ bits the DAC receives is an m -ary modulation signal (*first m-ary modulation signal*) and outputs an analog electrical signal (*first electrical m-ary analog modulation signal*) that can be used to modulate the optical source, a POSA understood that the DAC *converts the first m-ary modulation signal to a first electrical m-ary analog modulation signal*. EX-1006 [0051], [0053], [0054], FIG. 6.

[1d] a driver for amplifying the first electrical m-ary analog modulation signal to an amplified first electrical m-ary analog modulation signal to drive an optical transmitter;

87. Pang, alone or in view of Vrazel, discloses this limitation.

88. Pang discloses that fiber optic module 100 includes an electrical element 104. EX-1007 [0066], FIG. 1. Electrical element 104 includes a light transmitter 110 and a transmit PCB 106. EX-1007 [0066]. Transmitter 110 is a packaged emitter that converts an electrical signal into light, such as a semiconductor laser or LED. EX-1007 [0066]. Pang explains that transmit PCB 106 includes electrical components 112, such as a “transmitter integrated circuit (**laser driver**),” pins, and a ground plane, and that these electrical components 112 control the operation of transmitter 110. EX-1007 [0067]. Similarly, Pang discloses that fiber optic module 1700 includes transmit PCB 1708 and transmitter 110. EX-1007 [0150], FIG. 17. Transmit PCB 1708 includes one or more integrated circuits 1764 and is electrically coupled to transmitter 110. EX-1007 [0160].

89. Based on Pang’s disclosure, a POSA understood that integrated circuits 1764 include a laser driver IC (*a driver*) because Pang expressly refers to a “laser driver IC” in describing the transmitter electrical components in Figure 1. A POSA further understood that Pang’s laser driver IC is a *driver for amplifying the first electrical m-ary analog modulation signal to an amplified first electrical m-ary analog modulation signal to drive an optical transmitter* because amplifying received signals to drive an optical transmitter, such as a semiconductor laser in these systems was the conventional use and purpose of laser driver circuits and well known in the art at the time. EX-1035 1:41-50, FIG. 5.

90. To the extent PO argues that Pang does not expressly disclose [1d], Vrazel discloses it. Vrazel discloses, in Figure 8, DAC 800 (*driver for amplifying the first electrical m-ary analog modulation signal*), “which can best be used to directly drive a laser diode.” EX-1006 [0021], [0056]. Vrazel explains that DAC 800 is a multilevel laser driver circuit that is similar to the “conventional laser driver circuit” in Figure 7 and exhibits very similar speed properties as a “conventional driver.” EX-1006 [0020], [0021], [0056].

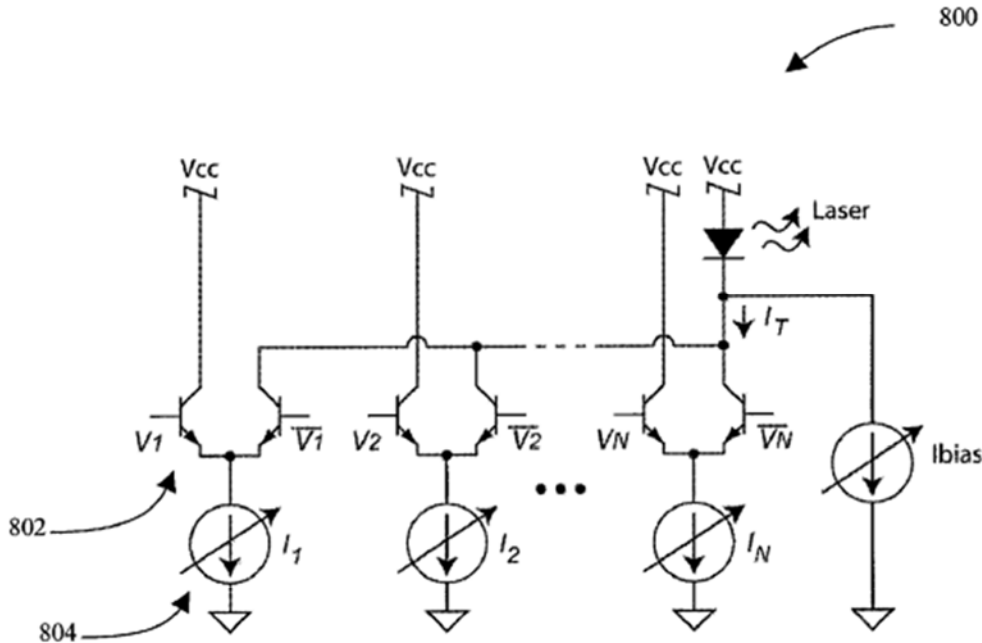


Fig. 8

91. Vrazel’s disclosure is consistent with Pang’s disclosure that transmit PCB 106 includes electrical components 112, such as a “transmitter integrated

circuit (**laser driver**)” and that these electrical components control the operation of the transmitter 110. EX-1007 [0067], FIG. 1.

92. As discussed above for [1c], Vrazel’s DAC outputs an analog electrical signal (*first electrical m-ary analog modulation signal*) that can be used to modulate the optical source. EX-1006 [0051], [0053], [0054], FIG. 6.

93. Based on Vrazel’s disclosure, a POSA understood that DAC 800 is *a driver for amplifying the first electrical m-ary analog modulation signal* because it is similar to a conventional laser driver circuit and used to directly drive a laser diode. A POSA understood that DAC 800 was used for *amplifying the first electrical m-ary analog modulation signal* (output from the DAC) *to an amplified first electrical m-ary analog modulation signal to drive an optical transmitter* (input to the optical transmitter) because that was the conventional use and purpose of laser driver circuits and well known in the art at the time. EX-1035 1:41-50, FIG. 5.

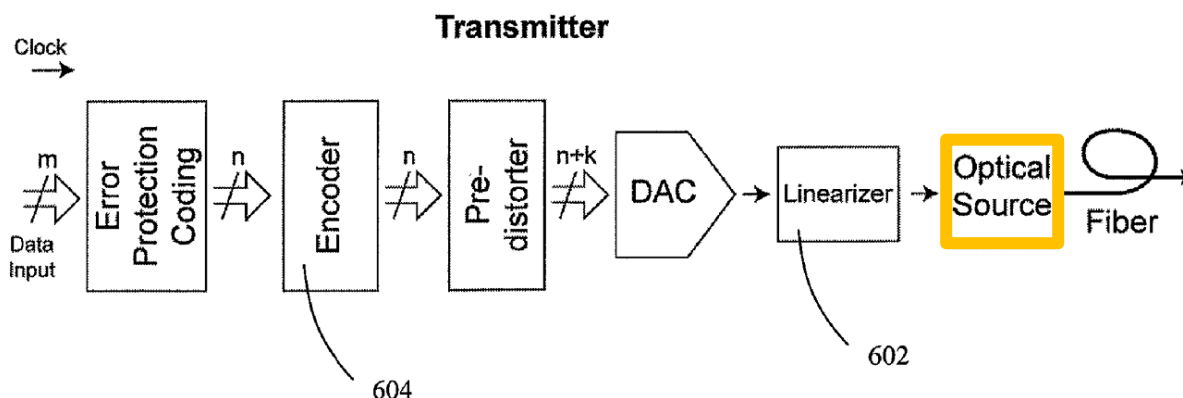
94. A POSA would be motivated to modify Pang’s teachings with the signal processing techniques, including the driver taught by Vrazel for the reasons discussed in §VII.A.3.

[1e] the optical transmitter for emitting a first optical signal on a first wavelength responsive to and representative of the amplified first electrical m-ary analog modulation signal from the driver;

95. Pang, alone or in view of Vrazel, discloses this limitation. Pang discloses a light transmitter 110 (*the optical transmitter*) that “is a packaged emitter

that converts an electrical signal into emitting light or photons, such as a semiconductor laser or LED.” EX-1007 [0066] [0089], FIG. 1. Pang explains that this transmitter is “communicating with optical fibers using light of various wavelengths.” EX-1007 [0066]. Thus, a POSA understood that Pang’s light transmitter 110 is an *optical transmitter for emitting a first optical signal on a first wavelength* because it converts electrical signals into emitting light and communicates with optical fibers using light of various wavelengths.

96. Pang’s disclosure is consistent with Vrazel’s teaching, in Figure 6 (below), that the optical source (yellow) receives via linearizer 602 the electrical signal from the DAC, including DAC 800 laser driver (*the amplified first electrical m-ary analog modulation signal from the driver*), and then generates an optical signal for transmission using a modulated laser. EX-1006 [0051], [0056], FIGs. 6, 8.



97. To the extent PO argues that Pang does not expressly disclose this limitation, based on Vrazel's disclosure, a POSA understood that the optical signal is *responsive to and representative of the amplified first electrical m-ary analog modulation signal from the driver* because, as discussed above for [1d], it is generated from the amplified electrical m-ary analog modulation signal received from the DAC, which includes the laser driver. A POSA would be motivated to modify Pang's teachings with Vrazel's teachings for the reasons discussed in §VII.A.3.

[1f] an optical detector for receiving a second optical signal on a second wavelength to produce an electrical analog signal;

98. Pang, alone or in view of Vrazel, discloses this limitation.

99. Pang discloses that fiber optic modules 100 and 1700 include light receiver 111 (*an optical detector*). EX-1007 [0066], [0151], FIG. 1. Pang explains that this receiver is a packaged photodetector that detects or receives light and converts it into an electrical signal, "such as a photodiode" and can communicate with optical fibers using light of "various wavelengths." EX-1007 [0066], [0089]. Thus, a POSA understood that Pang's light receiver 111 is *an optical detector for receiving a second optical signal on a second wavelength* because it detects or receives light and converts it into an electrical signal and communicates with optical fibers using light of various wavelengths.

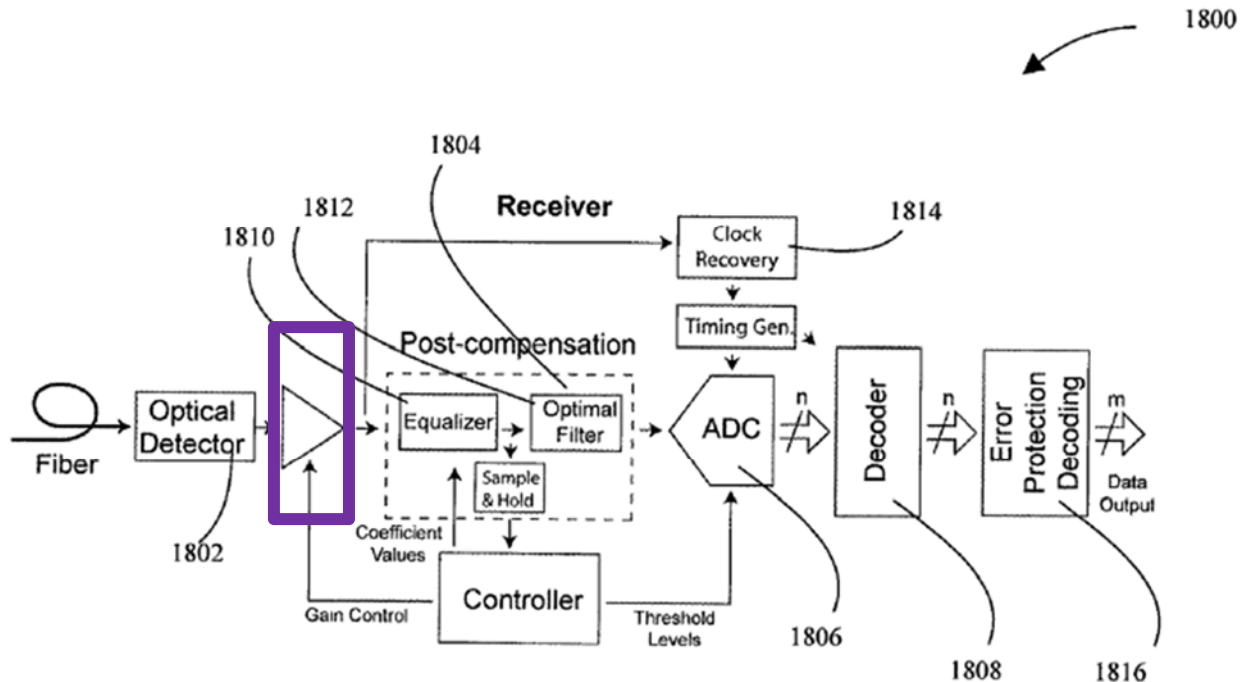
100. To the extent that PO argues that Pang does not disclose the signal processing details of the optical detector, Vrazel discloses that photodetector 1802 detects an incoming optical signal, and explains that it “converts a 2ⁿ-level optical signal into a 2ⁿ-level electrical signal.” EX-1006 [0113], [0114], FIG. 18. A POSA understood that the 2ⁿ-level electrical signal produced by Vrazel’s photodetector is *an electrical analog signal* because it is input to post-compensation circuitry 1804 prior to Analog to Digital Converter (ADC) 1806, and Vrazel discloses that the output of compensator 1804 is input to the ADC, which subsequently converts the 2ⁿ-level signal into n digital streams. EX-1006 [0113], FIG. 18. A POSA would be motivated to modify Pang’s teachings with the signal processing techniques, including the optical detector taught by Vrazel for the reasons discussed in §VII.A.3. ***[1g] an amplifier for amplifying the electrical analog signal to an amplified electrical analog signal;***

101. Pang, alone or in view of Vrazel, discloses this limitation.

102. Pang discloses that fiber optic module 100 includes receive PCB 108, which includes “electrical components 116” such as a “receiver integrated circuit **(transimpedance amplifier and post amplifier)**.” EX-1007 [0066], [0067], FIG. 1. Similarly, Pang discloses that fiber optic module 1700 includes receive PCB 1710 and receiver 111. EX-1007 [0150], FIG. 20. Pang explains that receive PCB 1710 includes “one or more integrated circuits (ICs) 1754” and is electrically coupled to receiver 111 via one or more solder pads. EX-1007 [0159].

103. Based on Pang’s disclosure, a POSA understood that integrated circuits
1754 include transimpedance and post amplifiers (*an amplifier for amplifying the
electrical analog signal*) because Pang expressly refers to “transimpedance and post
amplifiers” in describing the receiver electrical components in Figure 1. Thus, a
POSA understood that Pang’s transimpedance and post amplifiers are *for amplifying
the electrical analog signal to an amplified electrical analog signal* because
amplifying received signals was the conventional use and purpose of transimpedance
and post amplifiers and well known in the art at the time. EX-1019 1:19-26.

104. To the extent that PO argues that Pang does not disclose the details of
the transimpedance amplifier’s operation, Vrazel discloses that its optical detector
1802 is followed by an analog transimpedance amplifier (TIA) and its preferred
embodiment is “a conventional PIN detector in conjunction with an analog TIA.”
EX-1006 [0114], FIG. 18. Vrazel explains that “the TIA is assumed to have gain
control, which will be used to produce a signal output of fixed amplitude.” EX-1006
[0114]. This is illustrated in Figure 18, below, with the TIA (purple):

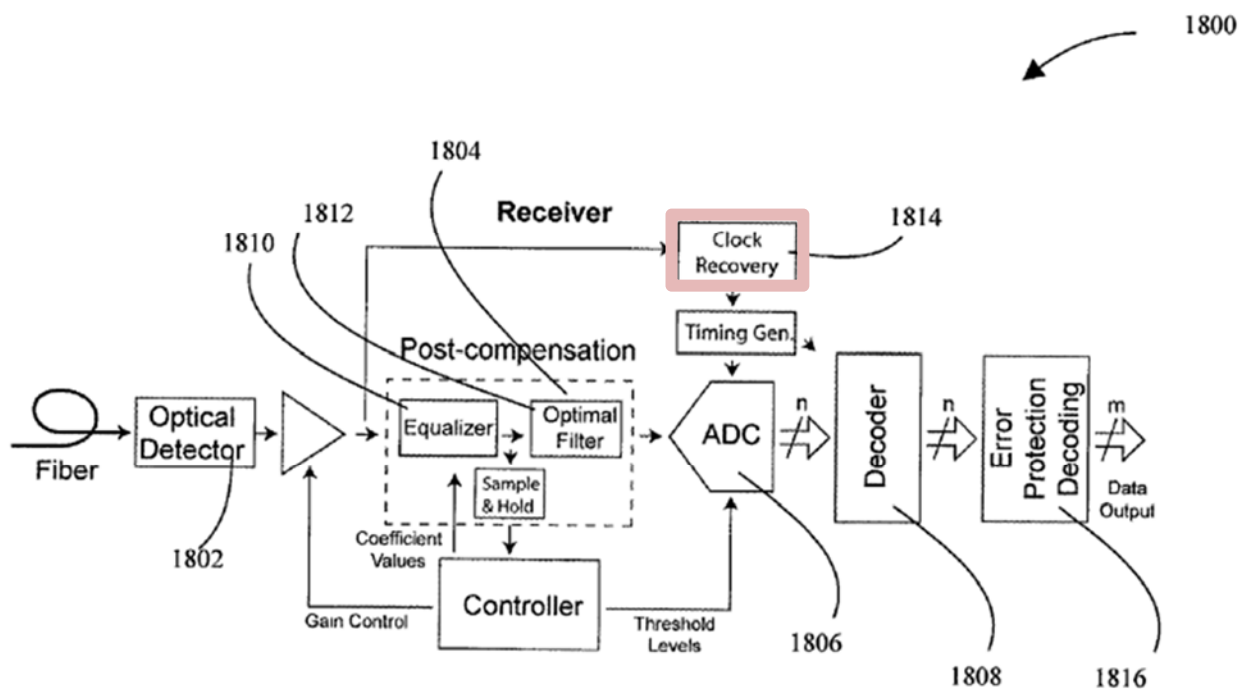


105. A POSA would find it obvious to use Vrazel's TIA *for amplifying the electrical analog signal to an amplified electrical analog signal* because it was well known that TIAs receive input current signals (*electrical signals*) and output a voltage signal that is proportional to the current signal (*an amplified electrical signal*). EX-1019 1:15-26 (explaining that TIAs are an integral components of fiber optic communication systems that are used to convert an input current signal into an output voltage signal). A POSA would be motivated to modify Pang's teachings with Vrazel's signal processing techniques, including the TIA taught by Vrazel for the reasons discussed in §VII.A.3.

[1h] a clock data recovery unit for recovering clock and data information to produce a second m-ary modulation signal from the amplified electrical analog signal;

106. Vrazel discloses this limitation.

107. Vrazel, in Figure 18 (below), discloses clock recovery circuit 1814 (pink) (*clock data recovery unit*). EX-1006 [0113].³ Post-compensation circuits 1804 receive a 2^n -level electrical signal (*i.e.*, an analog electrical signal received from the TIA) that outputs to ADC 1806, which converts the 2^n -level signal into n digital data streams. EX-1006 [0113]. These post-compensation circuits include equalizer circuit 1810 and optimal filtering circuit 1812. EX-1006 [0113], FIG. 18.



³ Vrazel’s disclosure is consistent with Pang’s teaching regarding including “clock/data recovery (CDR)” circuitry to its transceiver module. EX-1007 [0101] (disclosing that the motherboard “may also be used to mount components or circuits for increased electrical functionality such as clock/data recovery (CDR) function”).

108. Vrazel's optimal filtering circuit 2100, in Figure 21 (below), is used for post-compensation, and in the operation of the clock recovery circuit. EX-1006 [0122], FIG. 21. It receives a signal from equalizer circuit 1810 and then splits the signal into multiple integrate and dump filters (IDFs). EX-1006 [0122], [0123].

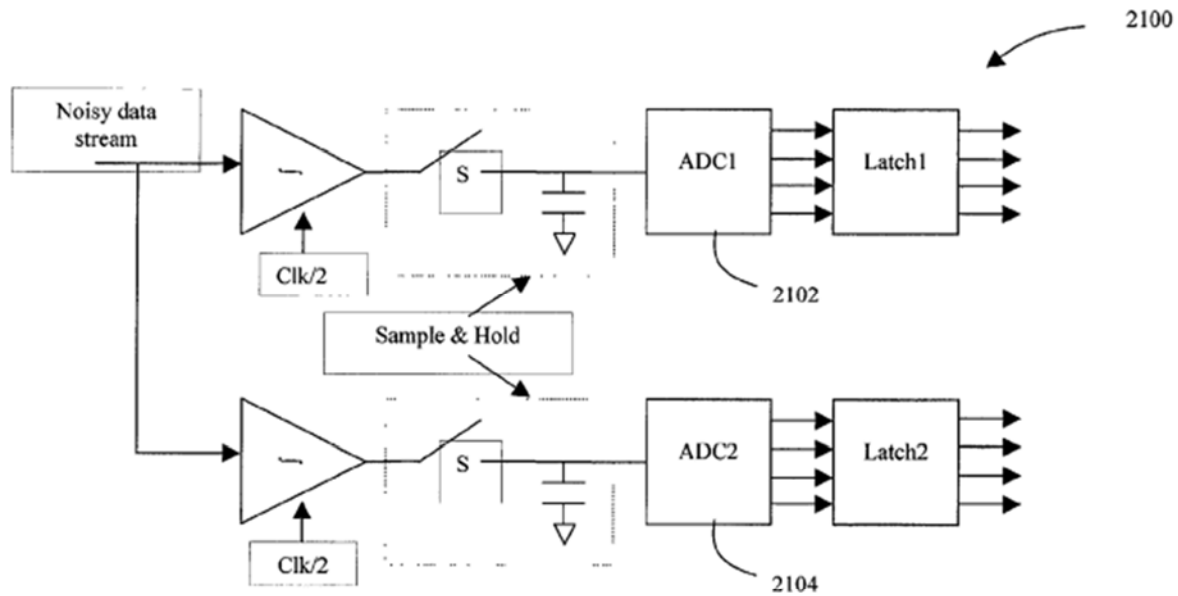


Fig. 21

109. In each IDF, clock information is extracted from the received signal “using a **clock recovery circuit** followed by a divide-by-two frequency divider,” and held to the end of a given symbol period for thresholding by the ADCs. EX-1006 [0123], FIG. 21. Because the clock information is extracted from the received signal using the clock recovery circuit and held for thresholding by the ADCs, a

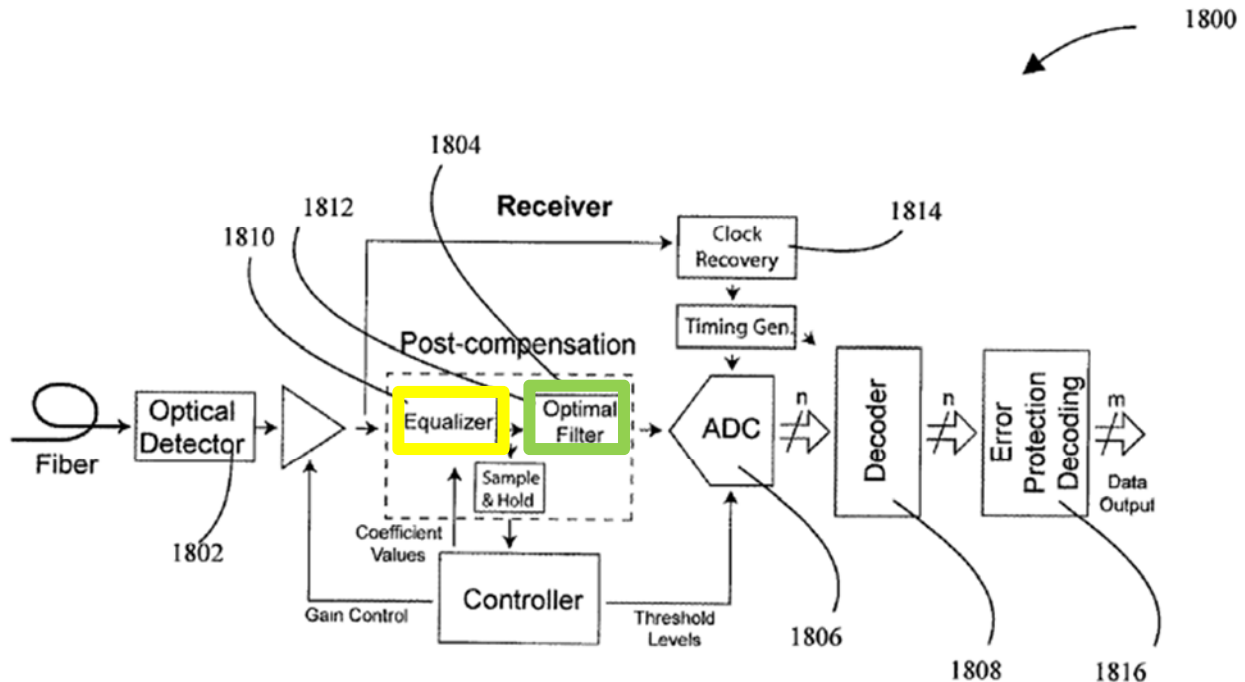
POSA understood that Vrazel's clock recovery circuit 1814 is *a clock data recovery unit for recovering clock and data information*.

110. A POSA further understood that Vrazel discloses recovering clock and data information *to produce a second m-ary modulation signal from the amplified electrical analog signal* because in connection with the clock recovery circuit and post-compensation circuitry outputs, the ADC converts the analog electrical signal output from the TIA into n digital data streams (*produces a second m-ary modulation signal from the amplified electrical analog signal*). EX-1006 [0113], [0123]. In other words, Vrazel teaches recovering clock and data information from the received amplified electrical analog signal (output of the TIA) to produce a second m-ary modulation signal, namely the n-channel data streams output by the ADCs.

[1i] an equalizer for performing equalization on the second m-ary modulation signal to remove noise; and

111. Vrazel discloses this limitation in at least three ways.

112. First, as discussed above for [1h], Vrazel discloses post-compensation circuitry 1804 that includes adaptive equalization circuitry 1810 (yellow) and optimal filtering detection circuitry 1812 (green). EX-1006 [0113], FIG. 18.



113. As part of this circuitry, Vrazel describes optimal filtering detection circuit 2100 that performs “parallel noise filtering and detection implementation using integrate and dump filters.” EX-1006 [0122]. A POSA understood that optimal filtering circuit 2100 is *an equalizer for performing equalization on the second m-ary modulation signal to remove noise* because it performs parallel noise filtering (*removing noise*), which allows for parallel processing of the received data (*the second m-ary modulation signal*) and for serial to parallel data conversion without requiring an additional demultiplexer circuit in the receiver. EX-1006 [0122], FIG. 18.

114. Second, in Figure 20 (below), Vrazel describes adaptive equalization circuitry that includes adaptive transversal filter 2000 that adjusts the amplitude of a received symbol (*performing equalization on the second m-ary modulation signal*)

based on equalizer tap gains that are calculated in microcontroller 2002 to remove the effect of intersymbol interference. EX-1006 [0117]. This circuit includes programmable transversal filter (PTF) 2016 that frequency equalizes the signal, followed by a low pass filter (optimal filter 2100) to remove noise. EX-1006 [0121]. Thus, a POSA understood that this adaptive transversal filter is *an equalizer for performing equalization on the second m-ary modulation signal to remove noise* because it adjusts the amplitude of the received symbol based on equalizer tap gains to remove intersymbol interference and, via the PTF, frequency equalizes the signal to remove noise. EX-1006 [0117], [0121].

115. A POSA understood that adjusting the amplitude of a received symbol based on equalizer tap gains is a technique for noise removal well-known in the art. EX- 1020 1:14-20 (employing equalizer taps for minimizing noise and intersymbol interference in signals conveyed over high-speed data service loop).

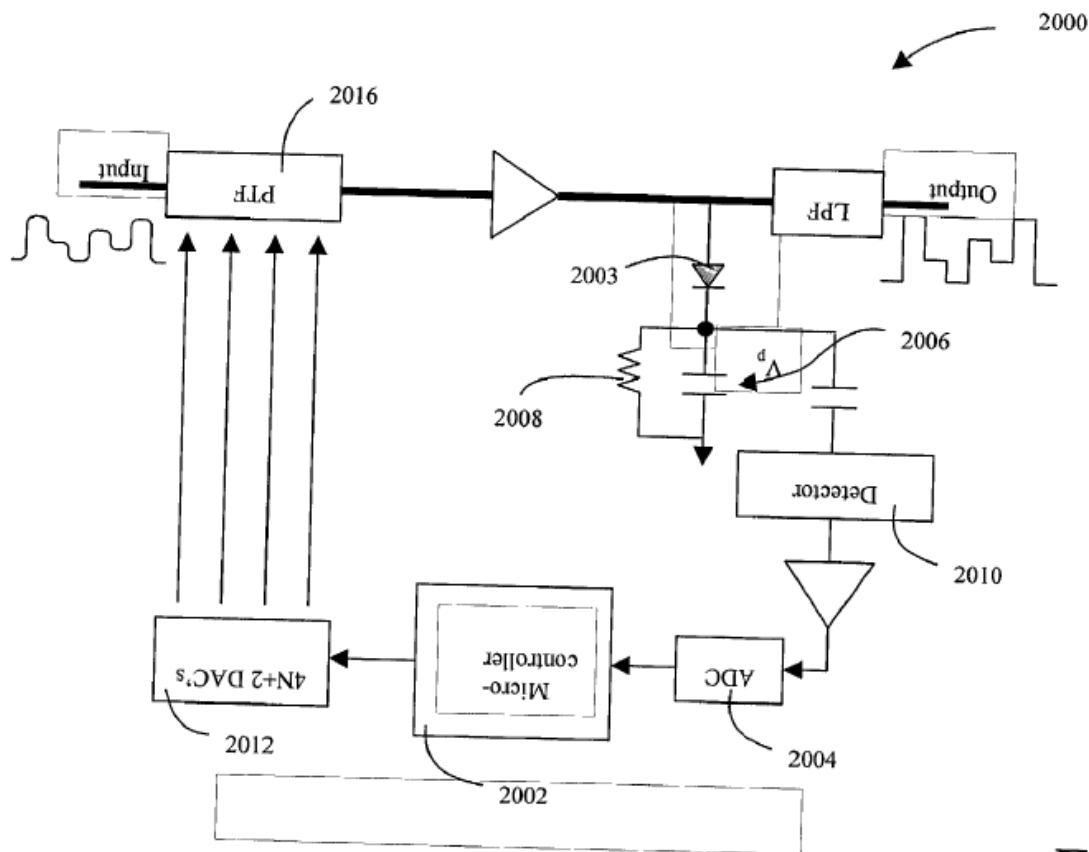


Fig. 20

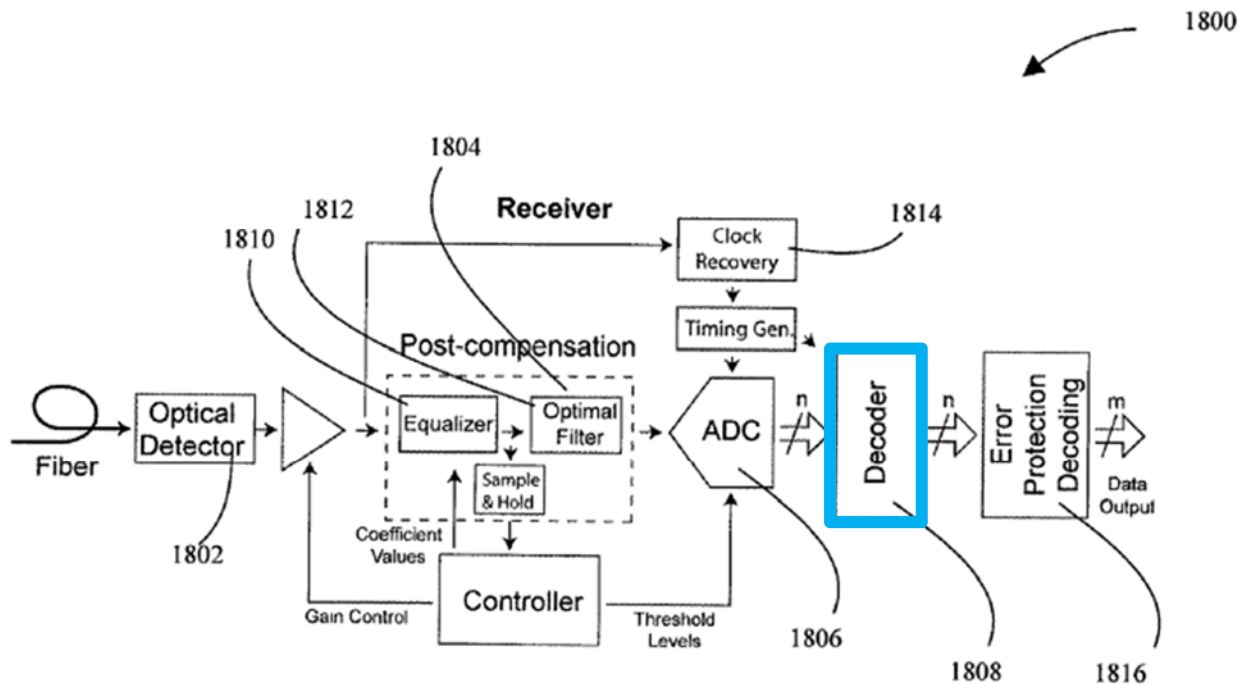
116. Third, Vrazel discloses that its ADC receives input signals distorted by the optical link. EX-1006 [0128]. Vrazel describes sampling the received signal at random points in time based on a history of received inputs, and via Digital Signal Processor (DSP) 2502, using that history to adjust the ADC thresholds. EX-1006 [0130], [0134], [0135]. Vrazel explains that using this sampling approach to adjust detection thresholds compensates for “time varying distortion/noise of the received signal.” EX-1006 [0135]. A POSA understood that using the DSP in conjunction with the post-compensation circuitry (*an equalizer*) to adjust the detection thresholds to compensate for distortion/noise of the received signal is performing equalization

to remove noise from the signal output by the post-compensation circuitry (*for performing equalization on the second m-ary modulation signal to remove noise*).

[1j] an m-ary demodulator for decreasing the number of bits per symbol in the equalized second m-ary modulation signal to produce the second electrical data signal.

117. Vrazel discloses this limitation.

118. Vrazel, in Figure 18 (below), discloses that Analog to Digital Converter 1806 outputs n digital data streams, and these n data streams are then input into decoder 1808 (blue) (*an m-ary demodulator*). EX-1006 [0113], FIG. 18. This decoder “converts a coded n-bit word each clock cycle into [a] corresponding n-bit word” that was initially input to the transmitter encoder shown in Figures 5 and 6, as discussed above for [1c]. EX-1006 [0113]. The output of this decoder is error-protected data that is then input to error protection decoding module 1816. EX-1006 [0113]. For example, a 16-level amplitude-modulated signal detected by optical detector 1802 can be ultimately converted to four digital data streams, thereby reducing the number of bits per symbol. EX-1006 [113].



119. A POSA understood that decoder 1808 is an m -ary demodulator for decreasing the number of bits per symbol because it receives the coded n -bit m -ary modulation signal output from the ADC (the equalized second m -ary modulation signal) on the receive side and converts it to an n -bit signal corresponding to the n -bit signal initially input to the transmitter encoder in [1b] having fewer bits per symbol, and outputs an error protected data signal (a second electrical data signal) that is then input to error protection decoding module 1816. EX-1006 [0113], FIG. 18.

b. Claim 2

[2pre] The pluggable optical transceiver module of claim 1, [2a] wherein the form factor of the pluggable optical transceiver module is a pluggable form factor standard.

120. Pang discloses [2a]. As discussed above for [1pre], Pang discloses that pluggable fiber optic module 1700 is an “MTRJ-SFP pluggable fiber optic module,” which can be plugged into and out of a host system. EX-1007 [150], [0155], [0156], FIG. 17A; [1pre]. Pang discloses that the “form factor or size of the fiber optic module is of concern” and “it is desirable to reduce the footprint of the fiber optic module.” EX-1007 [0006]. A POSA understood that the acronym “SFP” referred to “**Small Form-Factor Pluggable**,” which, as discussed above, and the ’181 Patent admits, was a common *pluggable form factor standard* known in the art at the time of the alleged invention. EX-1001 11:24-26, 34-37 (identifying “SFP and SFP+” as “[c]ommon” form factors); EX-1013 1. A POSA further understood that pluggable form factor standards, such as SFP, had the advantage of allowing interoperability between pluggable transceivers and host systems. EX-1013 1-3, 34-35.

c. Claim 3

[3pre] The pluggable optical transceiver module of claim 2, [3a] wherein the pluggable form factor standard of the pluggable optical transceiver module is a small form factor pluggable (SFP) or SFP+ form factor standard.

121. Pang, alone or in view of Vrazel, discloses claim 3 for the reasons discussed for claim 2. *See* [2a].

d. Claim 5

[5pre] The pluggable optical transceiver module of claim 1, [5a] wherein the m-ary modulator and the m-ary demodulator perform m-ary quadrature amplitude modulation and de-modulation, respectively, that uses two or more bits per symbol.

122. Vrazel discloses [5a]. As discussed above for [1b] and [1j], Vrazel discloses the *m*-ary modulator and demodulator of claim 5. See [1b], [1j]. Vrazel discloses that “quadrature amplitude modulation (QAM)” was a known multilevel modulation technique and that its system performs “2ⁿ-QAM” to increase system throughput. EX-1006 [0010], [0041] (QAM was a “representative advanced modulation technique”), [0042]. A POSA understood that “Quadrature Amplitude Modulation (QAM)” is an *m*-ary modulation technique that, as the ’181 Patent admits, was “known in the art” to increase the number of bits per symbol transmitted. EX-1001 10:20-31; EX-1006 [0010], [0041], [0042].

123. A POSA would be motivated to modify Pang’s teaching to perform “quadrature amplitude modulation (QAM)” (*m*-ary quadrature amplitude modulation and de-modulation) taught by Vrazel because it was a well-known modulation technique to increase the number of bits per symbol transmitted and adds little or no complexity to the optical components of the transmitter and receiver. EX-1006 [0010], [0011], [0041], [0042]; EX-1001 10:20-31.

e. Claim 6

[6pre] The pluggable optical transceiver module of claim 1, [6a] wherein the *m*-ary modulator and the *m*-ary demodulator perform *m*-ary quadrature phase shift keying modulation and de-modulation, respectively, that uses two or more bits per symbol.

124. Vrazel discloses [6a]. As discussed above for [1b] and [1j], Vrazel discloses the *m*-ary modulator and demodulator of claim 6. See [1b], [1j]. Vrazel

discloses that “ 2^n -ary phase shift keying (2^n -PSK)” was a known multilevel modulation technique and that its system performs “ 2^n -PSK” to increase system throughput. EX-1006 [0010], [0039] (“representative advanced modulation techniques include multilevel . . . phase shift keying modulations”), [0041], [0042]. A POSA understood that “Quadrature Phase Shift Keying (QPSK)” is a form of 2^n -ary phase shift keying where $n = 2$, and an m -ary modulation technique that, as the ’181 Patent admits, was “known in the art” to increase the number of bits per symbol transmitted. EX-1001 10:20-31.

125. A POSA would be motivated to modify Pang’s teaching to perform “ 2^n -ary phase shift keying (2^n -PSK)” taught by Vrazel where $n=2$, which corresponds to *m-ary quadrature phase shift keying modulation and de-modulation* because it was a well-known modulation technique to increase the number of bits per symbol transmitted and adds little or no complexity to the optical components of the transmitter and receiver. EX-1006 [0010], [0011], [0039], [0041], [0042]; EX-1001 10:20-31.

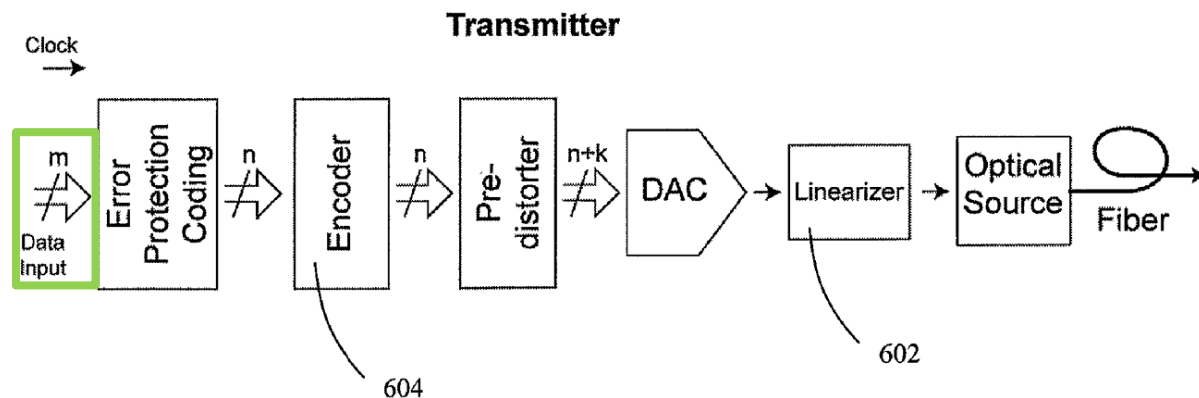
f. Claim 8

[8pre] The pluggable optical transceiver module of claim 1, [8a] wherein the electrical system interface includes parallel signals.

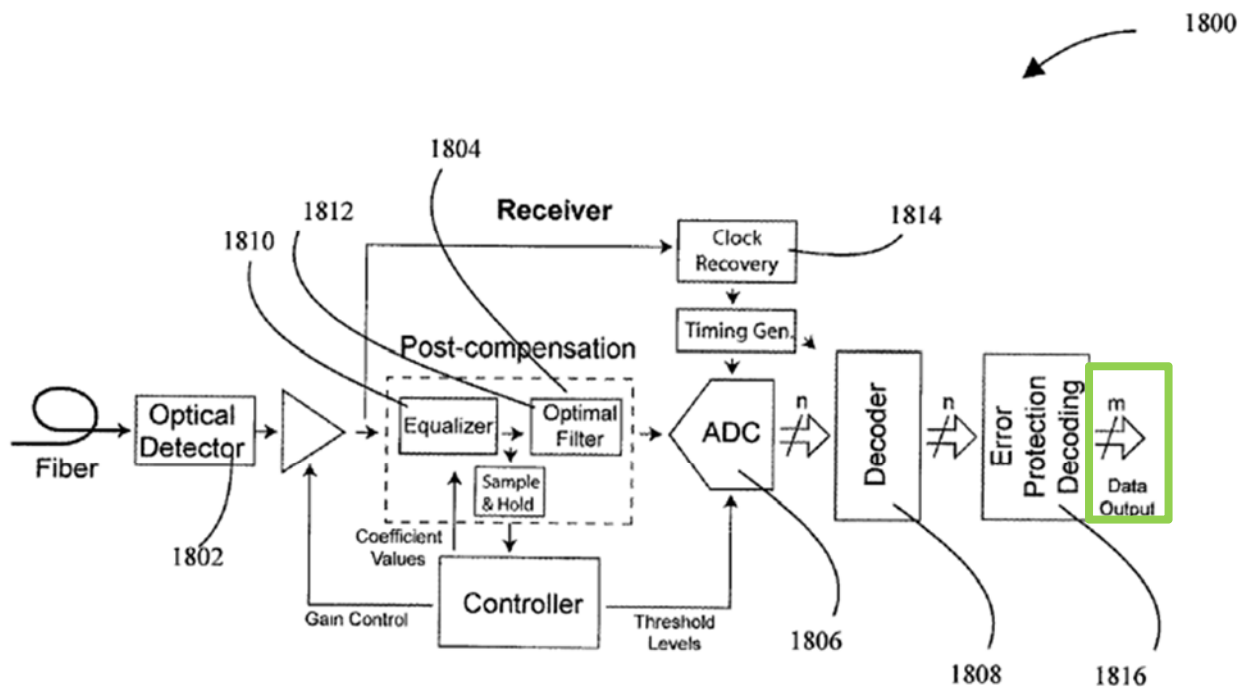
126. Pang, alone or in view of Vrazel, discloses [8a]. As discussed above for [1a], Pang discloses a pluggable transceiver having an edge connection coupled to an edge connector where it connects to the host system (*an electrical system*

interface). EX-1007 [0180], [0182], FIGs. 17A, 20. Pang discloses that this connection interface is used to provide “connections for signal or data lines.” EX-1007 [0190]. Pang discloses that the module can transmit/receive “a plurality of channels in parallel” (*parallel signals*). EX-1007 [0191]. Thus, a POSA understood that Pang’s *electrical system interface includes parallel signals*.

127. To the extent that PO argues that Pang does not expressly disclose *parallel signals*, Vrazel discloses this limitation because the electrical signals transmitted/received at Vrazel’s electrical interfaces each consists of multiple data streams that are transmitted/received in parallel. Vrazel discloses, in Figure 6, that its optical transmitter begins with an EPC module, which receives an m-bit input word that consists of “m input data streams.” EX-1006 [0050]. This is depicted in Figure 6 by the parallel arrow (green) to the left of the electrical system interface (where the m-bit word inputs the EPC module as “Data Input”). EX-1006 FIG. 6.



128. Vrazel discloses that its optical receiver includes an EPD module 1816, which decodes an n-bit word and, as shown in Figure 18, outputs an m-bit word, converting the received symbols back into “one or more binary output data streams.” EX-1006 [0113], FIG. 18. This is depicted in Figure 18 by the parallel arrow (green) to the right of electrical system interface (where the one or more data streams output the EPD as “Data Output”). EX-1006 [0113], FIG. 18.



129. A POSA understood that both the m-bit signal input to the EPC (depicted by the parallel arrow to the left of the EPC in Figure 6) and the m-bit signal output by the EPD (depicted by the parallel arrow to the right of the EPD in Figure 18) are *parallel signals* because they consist of corresponding data streams that are transmitted and received in parallel from the transmit side of the electrical interface

to receive side of the electrical interface. A POSA would be motivated to modify Pang's teachings with Vrazel's teachings for the reasons discussed in §VII.A.3.

g. Claim 10

[10pre] The pluggable optical transceiver module of claim 1, [10a] wherein the first electrical data signal and second electrical data signal includes parallel electrical data signals.

130. Pang, alone or in view of Vrazel, discloses claim 10 for the reasons discussed for claim 8. *See* [8a].

h. Claim 12

[12pre] The pluggable optical transceiver module of claim 1, [12a] wherein the first optical signal on a first wavelength is configured to emit into a first optical fiber and the second optical signal on a second wavelength is configured to be received from the first optical fiber.

131. Pang, alone or in view of Vrazel, discloses [12a].

132. Pang discloses that fiber optic module 1700 has a nose receptacle for coupling to a fiber optic connector or plug of an optical fiber. EX-1007 [0163]. Pang explains that the optical fiber may provide “bi-directional” optical communication, meaning that signals are transmitted and received on the same optical fiber. EX-1007 [0163]. A POSA understood that the technique of transmitting multiple wavelengths onto the same fiber optic cable is known as “Wavelength Division Multiplexing” (WDM). EX-1006 [0004]. As evidenced by Tan, for example, a POSA would recognize that transmit data and receive data are multiplexed onto the same optical fiber using two different wavelengths because

multiplexing data onto the transmit channel and demultiplexing data off of the output channel of the fiber optic cable was a well-known and conventional technique used for bi-directional communication in optical transceivers. EX-1006 [0010]; EX-1005 [0004], [0005], [0023], [0028], [0066], FIG. 6D.

133. A POSA would be motivated to modify Pang's teaching with the signal processing techniques taught by Vrazel such that for bidirectional communication, *the first optical signal on a first wavelength is configured to emit into a first optical fiber and the second optical signal on a second wavelength is configured to be received from the first optical fiber* because Vrazel teaches, for example, that its techniques may be used in combination with WDM techniques to achieve even greater increases in data transmission rates, and that the use of such modulation techniques can achieve these increases without replacing existing optical fiber and adds little or no complexity to the optical components of the transmitter and receiver. EX-1006 [0010], [0011].

i. Claim 13

[13pre] The pluggable optical transceiver module of claim 1, [13a] wherein the first optical signal on a first wavelength is configured to emit into a first optical fiber and the second optical signal on a second wavelength is configured to be received from a second optical fiber.

134. Pang discloses [13a]. Pang discloses that fiber optic module 1700 has a nose receptacle for coupling to a fiber optic connector or plug of an optical fiber. EX-1007 [0163]. Pang explains that the optical fiber may provide "unidirectional"

communication, such that optical signals are transmitted on one fiber and received on another. EX-1007 [0163] (disclosing the “optical fiber may be one or more optical fibers to provide unidirectional . . . communication”), [0006] (stating that “in [certain] small form factor optical modules . . . the two optical fibers are separated by a distance of only 0.75 mm”), claim 12 (requiring transmission into a first optical fiber), claim 13 (requiring receiving from a second optical fiber).

135. A POSA would find it obvious that, for unidirectional communication, Pang’s first optical signal is configured to emit *into a first optical fiber* and the second optical signal is configured *to be received from a second optical fiber* because Pang teaches that the optical fibers may be unidirectional and thus that optical signals are transmitted on one fiber and received on another.

j. Claim 14

[14pre] The pluggable optical transceiver module of claim 1, [14a] wherein the noise removed by the equalizer includes intersymbol interference (ISI).

136. Vrazel discloses [14a]. As discussed above for [1i], Vrazel discloses the *equalizer* of claim 14. *See* [1i]. Vrazel discloses adaptive transversal filter 2000 that adjusts the amplitude of a received symbol based on equalizer tap gains that are “calculated in microcontroller 2002 in order to remove the effect of intersymbol interference.” EX-1006 [0117], FIG. 20.

k. Claim 15

[15pre] The pluggable optical transceiver module of claim 1, [15a] wherein the equalizer performs decision directed equalization on the second m-ary modulation signal to remove noise.

137. Vrazel discloses [15a]. According to the '181 Patent, “[d]ecision-directed equalization is an equalization method in which a known training sequence is sent during the training period and the receiver/transceiver uses the knowledge of the training sequence to learn about the channel characteristics.” EX-1001 12:30-34. As discussed above for [1i], Vrazel discloses adaptive transversal filter 2000 (*the equalizer*) that adjusts the amplitude of a received symbol based on equalizer tap gains that are calculated in the microcontroller 2002 to remove the effect of intersymbol interference. EX-1006 [0117], [0118], FIG. 20. Vrazel discloses that this circuit includes programmable transversal filter (PTF) 2016 that frequency equalizes the signal, followed by a low pass filter (optimal filter 2100) to remove noise. EX-1006 [0121]. Microcontroller 2002 selects the gain coefficients of the PTF and may use a number of known numerical techniques including, “e.g., minimum mean-squared error method, ***gradient methods***, bisection, genetic algorithm.” EX-1006 [0118]. A POSA was aware that “gradient methods” refers to “gradient search algorithms,” (GSAs) which a POSA knew were “generally suitable for fiber-optic systems since their computational complexity is much lower.” EX-1017 982-83. Further, a POSA was aware that GSAs include algorithms that require

“very reliable estimates of data symbols,” and that this was “generally achieved by initially using a known sequence to train the equalizer.” EX-1017 983.

138. A POSA understood that Vrazel’s adaptive transversal filter 2000 *performs directed decision equalization on the second m-ary modulation signal to remove noise* because it adjusts the amplitude of the received symbol (*the second m-ary modulation signal*) based on equalizer tap gains to remove intersymbol interference and, via microcontroller 2002, calculates equalizer tap weights using known algorithms such as gradient search algorithms that rely on using a known sequence to train the equalizer to achieve initial channel estimates. EX-1006 [0117], [0118], [0121]; EX-1017 982-983.

I. Claim 16

[16pre] The pluggable optical transceiver module of claim 1, [16a] wherein the equalizer performs blind equalization on the second m-ary modulation signal to remove noise.

139. Vrazel discloses [16a]. According to the ’181 Patent, “[b]lind equalization is a process during which an unknown input data sequence is recovered from the output signal of an unknown channel.” EX-1001 12:36-38. As discussed above for [1i], Vrazel discloses an adaptive transversal filter 2000 (*the equalizer*) that adjusts the amplitude of a received symbol based on equalizer tap gains that are calculated in the microcontroller to remove the effect of intersymbol interference. EX-1006 [0117], [0118], FIG. 20. Vrazel discloses that this circuit includes

programmable transversal filter (PTF) 2016 that frequency equalizes the signal, followed by a low pass filter (optimal filter 2100) to remove noise. EX-1006 [0121].

140. Vrazel explains that “[s]ince there may be no knowledge of the frequency content of the random data at any given time . . . the microcontroller must perform a multidimensional optimization to minimize a single scalar quantity.” EX-1006 [0118].

141. A POSA understood that Vrazel’s adaptive transversal filter 2000 *performs blind equalization on the second m-ary modulation signal to remove noise* because it adjusts the amplitude of the received symbol (*the second m-ary modulation signal*) based on equalizer tap gains to remove intersymbol interference and, via PTF 2016, frequency equalizes the signal to remove noise where there may be no knowledge of the frequency content of the random data at any given time. EX-1006 [0117], [0118], [0121].

m. Claim 17

[17pre] The pluggable optical transceiver module of claim 1, [17a] wherein the digital to analog converter is configured to shape, condition, or emphasize the first electrical m-ary analog modulation signal for improved transmission performance.

142. Vrazel discloses [17a]. As discussed above for [1c], Vrazel discloses a *digital to analog converter* (DAC) that receives, e.g., an *n*-bit input data signal in the digital domain and outputs an analog electrical signal (*first electrical m-ary analog modulation signal*) “that can be used to modulate the optical source.” EX-1006

[0051]. Vrazel, in Figure 5, discloses analog precompensation circuitry 506 that includes a pre-distortion circuit 511 and a linearizer 512 that modify the transmitted signal based on known link performance and known non-linearities of the optical source in order “to produce a faithful output at the receiver.” EX-1006 [0069]. These circuits modify the transmitted signal to account for transmission impairments, *i.e.*, they *condition the first electrical m-ary analog modulation signal for improved transmission performance*.

143. A POSA understood that because the DAC converts the digital input data signal to an analog signal that can be used to modulate the optical source, it *conditions the first electrical m-ary analog modulation signal for improved transmission performance*, since the DAC’s operation is necessary for transmission of the analog signal via the optical transmitter to the receive side of the optical transceiver. EX-1006 [0051].

n. Claim 22

[22pre] A pluggable optical transceiver module comprising of:

144. *See [1pre].*

[22a] an electrical system interface for receiving a first electrical data signal and for transmitting a second electrical data signal;

145. *See [1a].*

[22b] an m-ary modulator for increasing the number of bits per symbol in the first electrical data signal to produce a first m-ary modulation signal;

146. *See [1b].*

[22c] a digital to analog converter for converting the first m-ary modulation signal to a first electrical m-ary analog modulation signal;

147. See [1c].

[22d] a driver for amplifying the first electrical m-ary analog modulation signal to an amplified first electrical m-ary analog modulation signal to drive an optical transmitter;

148. See [1d].

[22e] the optical transmitter for emitting a first optical signal on a first wavelength responsive to and representative of the amplified first electrical m-ary analog modulation signal from the driver;

149. See [1e].

[22f] an optical detector for receiving a second optical signal on a second wavelength to produce an electrical analog signal;

150. See [1f].

[22g] an amplifier for amplifying the electrical analog signal to an amplified electrical analog signal;

151. See [1g].

[22h] a clock data recovery unit for recovering clock and data information to produce a second m-ary modulation signal from the amplified electrical analog signal;

152. See [1h].

[22i] an equalizer for performing equalization on the second m-ary modulation signal to remove noise;

153. See [1i].

[22j] an m-ary demodulator for decreasing the number of bits per symbol in the equalized second m-ary modulation signal to produce the second electrical data signal; and

154. See [1j].

[22k] wherein the m-ary modulator and the m-ary demodulator perform m-ary pulse amplitude modulation and de-modulation, respectively, that uses two or more bits per symbol.

155. Vrazel discloses [22k]. As discussed above for [1b] and [1j], Vrazel discloses the *m-ary modulator and demodulator* of claim 22. See [1b], [1j]. Vrazel discloses that “ 2^n -ary amplitude shift keying (ASK)” was a known multilevel modulation technique. EX-1006 [0010]. A POSA understood that, for values of n greater than 1, 2^n -ary ASK is “Pulse Amplitude Modulation (PAM),” which the ’181 Patent admits is an m -ary modulation technique “known in the art” to increase the number of bits per symbol transmitted. EX-1001 10:20-31. A POSA would know that, when $n=2$ for example, 4-ary ASK has four levels or amplitudes, and thus is the same as PAM 4, which *uses two or more bits per symbol*. EX-1021 1:59-60 (referring to m -ary amplitude shift keying as pulse amplitude modulation).

156. A POSA would be motivated to modify Pang’s teaching to perform “ 2^n -ary amplitude shift keying (ASK)” modulation taught by Vrazel for values of n greater than 1, which corresponds to *m-ary pulse amplitude modulation and de-modulation*, because it was a well-known modulation technique to increase the number of bits per symbol transmitted and adds little or no complexity to the optical

components of the transmitter and receiver. EX-1006 [0010], [0011]; EX-1001 10:20-31.

o. Claim 23

[23pre] pluggable optical transceiver module comprising of:

157. See [1pre].

[23a] an electrical system interface for receiving a first electrical data signal and for transmitting a second electrical data signal;

158. See [1a].

[23b] an m-ary modulator for increasing the number of bits per symbol in the first electrical data signal to produce a first m-ary modulation signal;

159. See [1b].

[23c] a digital to analog converter for converting the first m-ary modulation signal to a first electrical m-ary analog modulation signal;

160. See [1c].

[23d] a driver for amplifying the first electrical m-ary analog modulation signal to an amplified first electrical m-ary analog modulation signal to drive an optical transmitter;

161. See [1d].

[23e] the optical transmitter for emitting a first optical signal on a first wavelength responsive to and representative of the amplified first electrical m-ary analog modulation signal from the driver;

162. See [1e].

[23f] an optical detector for receiving a second optical signal on a second wavelength to produce an electrical analog signal;

163. See [1f].

[23g] an amplifier for amplifying the electrical analog signal to an amplified electrical analog signal;

164. See [1g].

[23h] a clock data recovery unit for recovering clock and data information to produce a second m-ary modulation signal from the amplified electrical analog signal;

165. See [1pre].

[23i] an equalizer for performing equalization on the second m-ary modulation signal to remove noise;

166. See [1i].

[23j] an m-ary demodulator for decreasing the number of bits per symbol in the equalized second m-ary modulation signal to produce the second electrical data signal; and

167. See [1j].

[23k] wherein the equalizer includes coefficients or weights configured to remove noise from the second m-ary modulation signal.

168. Vrazel discloses [23k]. Vrazel discloses adaptive transversal filter 2000 that adjusts the amplitude of a received symbol based on equalizer tap gains that are calculated in microcontroller 2002 in order to remove the effect of intersymbol interference. EX-1006 [0117], FIG. 20. Vrazel discloses that “the job of the microcontroller 2002 ***is to appropriately select the gain coefficients.***” EX-1006 [0118]. Vrazel explains that one of the techniques employed by the microcontroller is to “repeat this procedure to determine the appropriate equalizer tap gains (***weights***).” EX-1006 [0118]. As discussed for [1i], a POSA understood

that adjusting the amplitude of a received symbol based on equalizer tap gains is a technique for noise removal well-known in the art. EX- 1020 1:14-20.

169. A POSA understood that Vrazel's adaptive transversal filter is *an equalizer that includes coefficients or weights adapted to remove noise from the second m-ary modulation signal* because it adjusts the amplitude of the received symbol based on equalizer tap gains (weights) and selected gain coefficients to remove intersymbol interference and via the PTF 2016, frequency equalizes the signal to remove noise. EX-1006 [0117], [0118], [0121], FIG. 20.

B. Ground 2: Claim 11 Is Obvious Over Pang in view of Vrazel and Fujimori

1. Fujimori (EX-1028)

a. Analogous Art

170. It is my opinion that Fujimori is analogous art to the claimed invention. Fujimori is in the same field of endeavor as the '181 Patent because it relates to "optical networking hardware," including "optical-based transceiver[s]" and "small form factor optical modules." EX-1028 1:34-35, 2:36-41, 2:42-43, FIG. 3. It is my opinion that Fujimori is reasonably pertinent to the problem addressed by the '181 Patent's claim invention because Fujimori's solution provides for "higher bandwidth in digital communications," "higher data rates and bandwidth" and "high-speed" optical transceivers. EX-1028 1:43-44, 2:7-12; EX-1001 Title, 1:1-3, 6:12-13.

b. Overview of Fujimori

171. Fujimori discloses a method and system for adjusting a gain and/or frequency response of an input signal for a multimode device, including an optical transceiver. EX-1028 Abstract, 2:9-10, 2:36. In one embodiment, Fujimori describes the use of a XAUI (attachment unit interface) that allows for higher-speed communications between the optical transceiver and host system. EX-1028 5:65-67, FIG. 1. Fujimori discloses that the host system may interface with transceiver module 100 through a 10 Gbps Ethernet attachment unit interface (XAUI) 135. EX-1028 6:43-46. Fujimori discloses that the XAUI may configured via its transmit and receive interfaces to achieve “compatible . . . operational speeds” and “throughput of about 10 Gbps.” EX-1028 6:58-64.

2. Motivation to Combine Pang, Vrazel, and Fujimori

172. A POSA at the time of the alleged invention was aware of the 10 Gigabit Attachment Unit Interface, or “XAUI.” EX-1033 [page 2]. XAUI is “a full duplex interface” that “dramatically improves and simplifies the routing of electrical interconnections,” and was known to be “ideal for chip-to-chip, board-to-board, and chip to optics module applications.” EX-1033 [page 2]. A POSA was aware that by 2002, “ASIC, FPGA, and optical module vendors [were] all introducing products with XAUI interfaces” and industry efforts were underway to ensure that “vendors’ offerings [were] interoperable.” EX-1033 [page 2]; EX-1034 8. Indeed, XAUI had

been selected as the electrical interface for pluggable module multisource agreements such as XGP and XENPAK. EX-1033 [page 6].

173. A POSA would be motivated to combine Pang’s teaching of a pluggable optical transceiver, as modified with Vrazel’s m-ary modulation and signal processing techniques, with Fujimori’s teaching of a XAUI interface because a POSA would know that XAUI had already been widely adopted by 2002 and because XAUI was known to be suitable for “chips to optic module applications,” *i.e.*, XAUI was suitable for pluggable optical transceivers and optics module vendors were introducing products with XAUI interfaces. A POSA would have a reasonable expectation of success because Fujimori teaches that the use of XAUI interfaces was conventional and well known in the art for use in optical transceiver systems requiring higher data rates and bandwidth, and both Pang and Vrazel involve high transmission rate communications over fiber optic networks. EX-1028 2:7-11; EX-1007 [0005], [0006]; EX-1006 [0002] (addressing “increasing the throughput of data transmission over an optical fiber communication system”).

174. Further, a POSA would be motivated to implement Fujimori’s teaching of using a XAUI interface in modified-Pang’s teaching to achieve higher communication speeds and adding little or no complexity to the transceiver’s optical components. EX-1028 2:7-11, 6:58-64; EX-1006 [0010]-[0012].

3. Detailed Application to the Challenged Claims

a. Claim 11

[11pre] The pluggable optical transceiver module of claim 1, [11a] wherein the electrical system interface includes an attachment unit interface (AUI) based interface.

175. Pang in view of Vrazel and Fujimori discloses claim 11. Pang in view of Vrazel discloses [11pre] for the reasons discussed above for claim 1.

176. Fujimori discloses [11a]. As discussed for [1a], Pang or modified-Pang discloses *the electrical system interface*. Fujimori describes the use of a XAUI that allows for higher-speed communications between the optical transceiver and host system. EX-1028 5:65-67, 6:43-46, FIG. 1. 6:43-46. Based on Fujimori's disclosure, a POSA would find it obvious to include a XAUI (*an attachment unit interface (AUI) based interface*) because, as the '181 Patent admits, it was a "conventional interface[]" and well known in the art for use with optical transceivers for high speed communications. EX-1001 9:22-26; EX-1028 6:43-7:2, FIGs. 1, 3; EX-1029 1:13-16, 3:49-5:1, FIG. 1; EX-1030 16, 27. A POSA would be motivated to modify modified-Pang's teachings with the XAUI taught by Fujimori for the reasons discussed in §VII.B.2.

CONCLUSION AND DECLARATION

My findings and opinions set forth in this Declaration are based on my research and analysis to date. I may continue my examinations in view of additional documents or other factual evidence over the course of this proceeding that may necessitate supplementing and/or refining my opinions. I reserve the right to add to, alter, or delete my opinions and my Declaration upon discovery of additional information. I reserve the right to make such changes as necessary.

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

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001, of Title 18 of the United States Code.

[SIGNATURE ON FOLLOWING PAGE]

Date: 4-14-2023 By: 

Paul Min

APPENDIX A – MATERIALS RELIED UPON

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent 10,771,181 (“’181 Patent”)
1002	Prosecution History of the ’181 Patent
1004	Prosecution History of the ’795 Patent
1005	U.S. Patent Application Publication No. 2004/0208601 A1 to Tan et al. (“Tan”)
1006	U.S. Patent Application Publication No. 2002/0167693 A1 to Vrazel et al. (“Vrazel”)
1007	U.S. Patent Application Publication No. 2003/0020986 A1 to Pang et al. (“Pang”)
1008	U.S. Patent 9,887,795 to Soto et al. (“’795 Patent”)
1009	U.S. Provisional Application 60/480,488 (“’488 Provisional”)
1010	Casimer DeCusatis, <i>Optical Data Communication: Fundamentals and Future Directions</i> , Optical Engineering 37(12), December 1, 1998
1011	Reynaud Lavoie, <i>The Evolution of the Pluggable Module</i> , Broadcast Engineering Magazine (2012)
1012	SFF Committee, INF-8053 Specification for Gigabit Interface Converter (GBIC), Rev. 5.5 (2000)
1013	SFF Committee, INF-8074i Specification for SFP (Small Form Factor Pluggable) Transceiver, Rev. 1.0 (2001)
1014	Jan Conradi, <i>Bandwidth-Efficient Modulation Formats for Digital Fiber Transmission Systems</i> , Optical Fiber Telecommunications IV.B Chapter 16, edited by Ivan Kaminow (Elsevier 2002)
1015	P Vijay Kumar et al., <i>Error-Control Coding Techniques and Applications</i> , Optical Fiber Telecommunications IV.B Chapter 17, edited by Ivan Kaminow (Elsevier 2002)
1016	U.S. Patent 10,263,723 to Soto et al. (“the ’723 Patent”)
1017	Moe Z. Win, et al., <i>Equalization Techniques for Mitigating Transmission Impairments</i> , Optical Fiber Telecommunications IV.B Chapter 18, edited by Ivan Kaminow (Elsevier 2002)
1018	U.S. Patent 2,552,629

<i>Exhibit #</i>	<i>Description</i>
1019	U.S. Patent 6,552,605
1020	U.S. Patent 5,561,687
1021	U.S. Patent 7,580,380
1022	U.S. Patent 4,908,827
1023	U.S. Patent 4,656,633
1024	NextGen’s Infringement Contentions Against Petitioner for the ’181 Patent in <i>NextGen Innovations, LLC v. Infinera Corporation</i> , No. 2:22-cv-00306-JRG-RSP (E.D. Tex.)
1025	Docket Control Order, <i>NextGen Innovations, LLC v. Fujitsu Network Communications, Inc. et al.</i> , No. 2:22-cv-00307-JRG-RSP (E.D. Tex.) (consolidated cases)
1026	U.S. District Courts – Federal Court Management Statistics – Comparison Within Circuit – During the 12-Month Period Ending September 30, 2022, available at https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0930.2022.pdf
1027	Prosecution History of the ’723 Patent
1028	U.S. Patent 7,206,366 (“Fujimori”)
1029	U.S. Patent 7,020,729 B2
1030	SFF Committee, INF-8474i Specification for Xenpak 10 Gigabit Ethernet Transceiver, Rev. 3.0 (2002)
1031	Jack H. Winters & Richard D. Gitlin, <i>Electrical Signal Processing Techniques in Long-Haul Fiber-Optic Systems</i> , IEEE Trans. Comm. Vol. 38, No. 9, Sep. 1990
1032	Jack H. Winters et al., “Reducing the Effects of Transmission Impairments in Digital Fiber Optic Systems,” IEEE Comm. Magazine, June 1993
1033	XAUI: An Overview, Version 1.0, March 2002
1034	10 Gigabit Ethernet Technology Overview White Paper, Revision 2, Draft A, April 2002, published by 10 Gigabit Ethernet Alliance
1035	U.S. Patent 5,880,869

APPENDIX B – *CURRICULUM VITAE*

Paul S. Min, Ph.D.
Washington University in Saint Louis
(Webpage : <https://engineering.wustl.edu/faculty/Paul-Min.html>)

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Campus Box 1223
Academy Building Room 218A
St. Louis, MO 63130

Education

<u>Year</u>	<u>College or University</u>	<u>Degree</u>
1987	The University of Michigan	Ph.D. in Electrical Engineering
1984	The University of Michigan	M.S. in Electrical Engineering
1982	The University of Michigan	B.S. in Electrical Engineering

Professional Experience

From: 1990
To: Present
Organization: Washington University, St. Louis

Summary:

2015 - Senior Professor - Department of Electrical Systems Engineering

2011 – 2014 Chair – Undergraduate Curriculum, Department of Electrical and Systems Engineering

2000 – 2002 Chair – Graduate Curriculum, Department of Electrical and Systems Engineering

2002 - 2014 Associate Professor - Department of Electrical and Systems Engineering

1997 - 2008 On leave from full-time duty at Washington University – as Presidents of MinMax Technologies and Erlang Technology.)

1996 - 2002 Associate Professor - Department of Electrical Engineering

1996 Promoted with Tenure

1990 - 1996 Assistant Professor - Department of Electrical Engineering

- Teaching Experience
- “Transmission System and Multiplexing,” Washington University, ESE 571
 - “Electrical Laboratory I,” Washington University, EE 250.
 - “Communication Theory,” Washington University, ESE 471.
 - “Reliability and Quality Control,” Washington University, ESE 405/505
 - “Signaling and Control of Communications Networks,” Washington University, ESE 572.
 - “Introduction to Electronic Circuits,” Washington University, ESE232
 - “Queueing Systems and Discrete Stochastic Processes,” Washington University, EE 536 / CS 567.
 - “Digital Computer,” Washington University, EE 260M / CS 260.
 - “Data Networks,” Washington University, EE 530.
 - “Electrical Circuit Analysis,” Washington University, ESE 230.
 - “Computer/Communications System Analysis I,” Washington University, EE 557/ CS 557.
 - “Computer/Communications System Analysis II,” Washington University, EE558 / CS 558.
 - “Digital Systems Laboratory,” Washington University, EE 455 / CS 455.

From: 1999
To: 2008
Organization: Erlang Technology, Inc., St. Louis, Missouri
Title: Founder and President
Summary: Up to 70 employees, \$40M in total capital raised from 5 VCs and 3 Corporations
Received “Product of Year” Award from Analog Zone Magazine in 2004

From: 1997
To: 1999
Organization: MinMax Technologies, Inc., St. Louis, Missouri
Title: Founder and President
Summary: Fabless semiconductor company, designing high performance switching ASICs

From: September 1987
To: August 1990
Organization: Bellcore, New Jersey
Title: Member of Technical Staff
Summary: Member of New Network Architecture Development Group

From: 1983
To: 1987

Organization: Department of Electrical Engineering, The University of Michigan
Title: Graduate Instructor
Summary: Instructor for senior level Electrical Engineering Laboratory Class. Received a Best “Best Graduate Instructor Award” from the Department of Electrical Engineering

Professional Affiliations, Achievements & Awards

- Technical Program Committee, COMCAS 2019, Tel Aviv, November 2021.
- Technical Program Committee, COMCAS 2019, Tel Aviv, November 2019.
- Technical Program Committee, COMCAS 2017, Tel Aviv, November 2017.
- Technical Program Committee, COMCAS 2015, Tel Aviv, October 2015.
- Past-Chair, Saint Louis Section of the Institute of Electrical and Electronics Engineers (IEEE), 2015.
- Member of Executive Committee, Saint Louis Section of the IEEE, 2010-2015.
- Chair, Saint Louis Section of the IEEE, 2014.
- Technical Program Committee, COMCAS 2013, Tel Aviv, October 2013.
- Vice Chair, Saint Louis Section of the IEEE, 2013
- Treasurer, Saint Louis Section of the IEEE, 2012.
- The Best Paper Award at MOBILITY 2011, October 2011, Barcelona, Spain.
- Counselor, Student Chapter of the Year, the Institute of Electrical and Electronics Engineers, 2011.
- Award of Appreciation, Saint Louis Section of the Institute of Electrical and Electronics Engineers, 2011, for contribution to various activities of the Saint Louis Section the Institute of Electrical and Electronics Engineers.
- Secretary, Saint Louis Section of the IEEE, 2010.
- Counselor, Student Chapter of the Year, the Institute of Electrical and Electronics Engineers, 2010.
- Wall Street Journal Businessmen of Year, 2003.
- American Men and Women of Science, listed in 1997.
- Member, Eta Kappa Nu (Honor Society for Electrical Engineers), inducted in 1992
- Outstanding Achievement Award, Bellcore, 1990.
- 18th ISATA Award of Technical Excellence, the best paper award at ISATA 1988.
- Rockwell Fellow, Rockwell International, 1985, 1986.
- Outstanding Graduate Student Award, the University of Michigan, 1985.
- Outstanding Teaching Award, the University of Michigan, 1984, 1986.
- Member of Honor's College, the University of Michigan, 1979, 1980.

- Honor's Convocation, the University of Michigan, 1979.
- Outstanding Freshman Award, the University of Michigan, 1979.
- Woodhaven Rotary Club Scholarship, Woodhaven Rotary Club, 1978.
- Second Place Winner, the State of Michigan Mathematics Prize Competition, 1977.
- International Program Committee, *IASTED International Conference on Communications, Internet and Information Technology (CIIT 2005)*, Cambridge, Massachusetts from October 31-November 2, 2005.
- International Program Committee, *IASTED International Conference on Communications 2003*, Scottsdale, Arizona, 2003.
- International Program Committee, *Wireless and Optical Communications 2003*, Banff, Canada, 2003.
- International Program Committee, Session Chair, *Wireless and Optical Communications 2002*, Banff, Canada, 2002.
- Invited participant, *NSF Workshop on Enhancing International Cooperation in CS/CE Research and Education*, Portland, 1997.
- Session Chair, *the 1993 Conference on Information Sciences and Systems*, Baltimore, March 1997.
- Member, Board of Editors, *Journal of Network and Systems Management*, 1996-1998.
- Program Committee, *International Symposium on Integrated Network Management*, San Diego, 1997.
- Guest Editor, *Journal of Network and Systems Management, Special Issue on Routing in Broadband Networks*, December 1995 and June 1996.
- Invited participant, *ARPA Workshop on Survivability of Large Scale Systems*, Washington D.C., 1996.
- Special Event Organizer, *International Symposium on Integrated Network Management*, Santa Barbara, 1995.
- Organizing Committee, *International Symposium on Integrated Network Management*, Santa Barbara, 1995.
- Local Arrangements Chair, *IEEE Information Theory Workshop on Information Theory Multiple Access and Queueing*, St. Louis, 1995.
- Chair, *Communications Chapter, St. Louis Section of the IEEE*, 1995.
- Participant, *IEEE Information Theory Workshop on Information Theory, Multiple Access and Queueing*, St. Louis, 1995.
- Participant, *ARPA/AFOSR Non-Linear Optics and Communication Workshop*, Denver, 1994.
- Participant, *CNRI Giga Bit Network Workshop*, Washington D.C., 1993.
- Participant, *IFIP/IEEE International Workshop on Distributed Systems*, New Jersey, 1993.
- Program Committee, *International Conference on Computer Communications and Networks*, San Diego, 1992.
- Session Chair, *ISMM International Conference*, New Orleans, 1990.
- Senior Member, *IEEE*.

- Member, *IEEE Committee on Network Operations and Management*.
- Member, *IEEE Committee on Computer Communications*.
- Registered Specialist, *Hong Kong Research Grant Council*.
- Reviewer, *IEEE Transactions on Communications*.
- Reviewer, *IEEE Transactions on Networking*.
- Reviewer, *IEEE Journal on Selected Areas in Communications*.
- Reviewer, *Journal of Network and Systems Management*.
- Reviewer, *Telecommunication Systems*.
- Reviewer, *Computers and Electrical Engineering*.
- Reviewer, *ETRI Journal*.
- Reviewer, *IEEE Transactions on Automatic Control*.
- Reviewer, *IEEE Communications*.
- Book Reviewer, *Prentice Hall*.
- Book Reviewer, *Morgan Kaufmann Publishers, Inc.*
- Book Reviewer, *Irwin Publishing Co.*

University Activities:

- Undergraduate Studies Committee, School of Engineering and Applied Science (2012 – Present)
- Faculty Advisor for IEEE Student Chapter (2009 – Present)
- Ambassador for McDonnell International Scholar Academy (2007 – 2013)
- Web Development Committee (2006 – 2008)
- University Judicial Board (1998 - 2000)
- Resource Generation Committee (1994 - 1995)
- Top 20 Committee (1992 - 1995)
- Telecommunications Committee, Chair (1991 - 1997)
- Library Planning Committee (1991 - 1992)
- Computer Engineering Committee (1990 - 1996)
- Communications Curriculum Committee (1990 - 1992)
- Resources Committee (1990 - 1992)

Patents

<u>Patent No.</u>	<u>Date</u>	<u>Title</u>
10,623,323	04/14/20	Network Devices and a Method for Signature Pattern Detection
10,284,476	05/07/19	Hierarchical Pattern Matching Devices and Methods

7,110,411	09/19/06	Method of and Apparatus for WFQ Scheduling Using a Plurality of Scheduling Queues to Provide Fairness, High Scalability, and Low Computational Complexity
7,106,738	09/12/06	Method of and Apparatus for High Speed Packet Switching Using Train Packet Queuing and Providing High Scalability
6,859,455	02/22/05	Method of and Apparatus for Building and Using Multi-Dimensional Index Trees for Multi-Dimensional Data Objects
6,614,789	09/02/03	Method of and Apparatus for Matching Strings of Different Lengths
6,359,885	3/19/02	Multi-Channel Packet Switching Apparatus Having Traffic Flow Controlling and Checking Functions
6,128,292	10/03/00	Packet Switching Apparatus with Multi-Channel and Multi-Cast Switching Functions and Packet Switching System Using the Same
5,788,161	12/13/98	Network Designer for Communication Networks
5,526,352	06/11/95	Integrable Low Complexity Multi-Channel Switch
5,440,549	08/08/95	Nonblocking Multi-Channel Switching with Multicasting Capability

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- Yu, Qixiang, Luo, Z., and Min, P.S., “Intrusion Detection in Wireless Sensor Networks for Destructive Intruders.” Proceedings of the APSIPA 2015 conference. December 16-19, 2015.
- Hung, C.P., and Min, P.S., “Simple Web Application Framework.” Submitted for publication in the IEEE Transactions on Cloud Computing.
- Luo, Z., and Min, P.S., “Parallel Implementation of Energy-Based Target Localization Methods in Wireless Sensor Networks.” Proceeding of the 2014 IEEE SOUTHEASTCON.
- Yu, Q., Luo, Z., and Min, P.S., “Intrusion Detection in Wireless Sensor Networks for Destructive Intruder.” Proceeding of 2014 International Conference on Smart Computing (SMARTCOMP 2014).
- Luo, Z., and Min, P.S., “Survey of Target Localization Methods in Wireless Sensor Networks,” 19th IEEE International Conference on Networks (ICON 2013), Singapore, December 11-13, 2013.
- Hung, C.P., and Min, P.S., “Deriving and Visualizing the Lower Bounds of Information Gain for Prefetch Systems,” 19th IEEE International Conference On Networks (ICON 2013), Singapore, December 11-13, 2013.
- Hung, C.P., and Min, P.S., “Access LUT without CAM - Improved Pearson Hashing for Collision Reduction,” 19th IEEE International Conference On Networks (ICON 2013), Singapore, December 11-13, 2013.
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- Hung, C.P., and Min, P.S. “Performance Evaluation of Distributed Mobile Application Virtualization Services,” International Journal on Advances in Internet Technology, Vol. 5, no. 3&4, 2012, pp. 65-83.

- Hung, C.P. and Min, P.S., "Performance evaluation of distributed application virtualization services using the UMTS mobility model," *MOBILITY 2011 The First International Conference on Mobile Services, Resources, and Users*, 23-29 Oct. 2011.
- Hung, C.P. and Min, P.S., "Service Area Optimization For Application Virtualization Using UMTS Mobility Model," *International Conference on Internet Computing*, pp. 128-134, Las Vegas, July 18-21, 2011.
- Hung, C.P. and Min, P.S., "Application Virtualization Using UMTS Mobility Model," *ICOMP'11*, September, 2011.
- Hung, C.P. and Min, P.S., "Infrastructure Arrangement for Application Virtualization Service," the 9th International Information and Telecommunication Technologies Symposium, Vol.1, pp. 78-85, Rio de Janeiro, December 2010.
- Hung, C.P. and Min, P.S., "Probabilistic Approach to Network-Based Virtual Computing," the 9th International Information and Telecommunication Technologies Symposium, Vol.1, pp. 117-124, Rio de Janeiro, December 2010.
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- Shiravi, A. and Min, P. S., "LOOFA-PB: A Modified LOOFA Scheduler for Variable-Length Packet Switching." *2007 IEEE International Conference on Communications (ICC 2007)*, Glasgow, June 2007.
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- Shiravi, A., Kim, Y. G., and Min, P. S., "Traffic Dispatching Algorithm in Three-Stage Switch," *Proceedings of 5th International Conference on Networking*, April 2006, Mauritius.
- Shiravi, A., Kim, Y. G., and Min, P. S., "Proportional Nested Deficit Round Robin with Credit Adjusting," *Proceedings of 2nd Int'l Conf. on Quality of Service in Heterogeneous Wired/Wireless Networks (QShine 2005)*, Orlando, August 2005.
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- Yoon, U., Park, S., Min, P.S., "Performance Analysis of Multiple Rejects ARQ at RLC (Radio Link Control) for Packet Data Service in W-CDMA System," *IEEE Globecom*, November 2000, San Francisco.
- Yoon, U., Park, S., Min, P.S., "Performance Analysis of Multiple Rejects ARQ for RLC (Radio Link Control) in the Third Generation Wireless Communication," *WCNC*, September 2000, Chicago.
- Yoon, U., Park, S., Min, P.S., "Network Architecture and Wireless Data Service Protocol based on Mobile IP toward the Third Generation Wireless Communication," *3G Wireless*, June 2000, San Francisco, pp. 211-215
- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Multi-Cell CDMA Network Design," *IEEE International Conference on Communications*, June 2000.
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- R.G. Akl, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," *IEEE Vehicular Technology Conference*, May 1999, Volume 2, pp. 1643-1647.

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- Min, P.S., Hegde, M.V., Chandra, A., and Maunder, A.S., "Analysis of Banyan Based Copy Networks with Internal Buffering," *Journal of High Speed Networks*, Volume 5, No. 3, pp. 259-275 November 1996.
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- Shin, S.W., Kwon, S.M., and Min, P.S., "Capacity Analysis of CDMA with Nonuniform Cell Loading and Sizes," *Proceedings of the 34th Annual Allerton Conference*, October 1996.
- Hegde, M.V., Min, P.S., and Sohraby, K., "Note from Guest Editors," *Journal of Network and Systems Management*, Volume 4, No. 2, pp. 101-102, June 1996.
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Testimony Provided or Expected to Provide as Expert Witness

Matter: Patent Infringement for Network Switches
Law Firm: Charhon Callahan Robson & Garza, PLLC

Case Name: Sable Networks, Inc. and Sable IP, LLC v. CloudFlare, Inc. U.S.D.C. WD Tx
Case No. 6:21-cv-261
Testifying Expert for CloudFlare, Inc.
Retained in August 2021.
(Expert report submitted and deposited.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Fish and Richardson
Case Name: GComm v. Samsung, U.S.D.C. ED. TX. Case No.:2:22-cv-0078-JRG
Testifying Expert for Samsung
Retained in July 2022.

Patent Infringement for Wireless Networks

Law Firm: McKool Smith
Case Name: Certain Mobile Telephones, Tablet Computers with Cellular Connectivity, and
Smart Watches with Cellular Connectivity, Components Thereof, and Products
Containing Same. U.S.I.T.C. Inv. No. 337-TA-1299
Testifying Expert for Ericsson
Completed in July 2022.
(Expert report submitted and deposited.)

Patent Infringement for Optical Networks

Law Firm: Duane Morris
Case Name: NextGen Innovations, LLC v. Infinera Corporation. U.S.D.C. ED. TX (Marshall)
Case No. 2:22-cv-00306-JRG-RSP / IPR
Testifying Expert for Infinera
Retained in April 2023.

Matter: Patent Infringement for Wireless Devices
Law Firm: King and Spalding LLP
Case Name: Intellectual Ventures, et. al. v. General Motors Company and General Company
Motors, LLC, Case No. 6:21-CV-1088 pending in the Western District of Texas,
Waco Division
Testifying Expert for General Motors
Retained in April 2021.
(Expert report submitted.)

Matter: Patent Infringement for Wireless Networks
Law Firm: Covington & Burling LLP
Case Name: XR Communications, LLC v. D-Link Systems, Inc., No. 8:17-cv-00596
(Consolidated) (C.D. Cal.)
Testifying Expert for Hewlett Packard Enterprise
Retained in June 2022.
(Expert report submitted and deposited.)

Matter: Patent Infringement for USB Charging System

Law Firm: Orrick, Herrington & Sutcliffe LLP
Case Name: Fundamental Innovation Systems International LLC v. TCT Mobile (US), TCT Mobile (US) Holdings, Inc., et al. U.S.D.C. Delaware No. 20-552-RGA-CJB
Testifying Expert for TCL
Completed in June 2022.
(Expert report submitted and deposed.)

Matter: Inter Parte Reexamination for Wireless Communications
Law Firm: Alston & Bird
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Nokia
Retained in May 2022.
(Expert report submitted.)

Matter: Patent Infringement for Network Management System
Law Firm: Morgan, Lewis & Bockius, LLP
Case Name: Certain Routers, Access Points, Controllers, Network Management Devices, Other Networking Products, and Hardware and Software Components Thereof, U.S.I.T.C. Inv. No. 337-TA-1227
Testifying Expert for Hewlett Packard, Netgear, and CommScope
Completed in August 2021.
(Expert report submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Security Systems
Law Firm: Forley and Lardner LLP
Case Name: Certain Residential Premises Security Monitoring and Automation Control Panels, and Components Thereof (ITC Inv. No. 337-TA-1273) and ADT LLC et al v. Vivint, Inc., Case No. 6:21-cv-00687 (W.D. Tex.)
Testifying Expert for Vivint, Inc.
Completed in April 2022.
(Expert report submitted, deposed, and testified during trial.)

Matter: Inter Parte Reexamination for Internet Communications
Law Firm: Perkins Coie
Case Name: Patent reexamination in front of the U.S.P.T.O.
Testifying Expert for Twitter
Retained in June 2020.
(Expert report submitted.)

Law Firm: Fisher Broyles
Case Name: Vaxcel International Co., Ltd. v. Heathco LLC, U.S.D.C. Delaware No. 20-224-LPS
Testifying Expert for Vaxcel
Retained in February 2021.
(Expert report submitted and deposed.)

Matter: Patent Infringement for Network Communication System
Law Firm: Charhon Callahan Robson & Garza, PLLC
Case Name: Sable Networks, Inc. and Sable IP, LLC, v. ClouFlare, Inc. U.S.D.C. WDTX,
Civil Action No. 6:21-cv-261
Testifying Expert for CloudFlare, Inc.,
Retained in August 2021.

Matter: Patent Infringement for Mobile Wireless Device
Law Firm: Pearl Cohen
Case Name: In the Matter Of Certain UMTS And LTE Cellular Communications Modules
And Products Containing The Same, U.S.I.T.C. Inv. No. 337-TA-1240
Testifying Expert for Telit Wireless Communication, Quectel, and Thales
Retained in March 2021.
(Expert reports submitted and deposed.)

Matter: Transactional Taxes for Internet Application
Law Firm: Ryan Rapp & Underwood, PLC
Case Name: ADP, LLC v. Arizona Department of Revenue (TX2018-000246),
Testifying Expert for ADP, LLC.
Completed in June 2020.
(Expert report submitted.)

Matter: Trade Secret Misappropriation in Digital Electronics
Law Firm: Goodwin Proctor LLP
Case Name: Guzik Technical Enterprises versus Keysight Technologies, Inc. Superior Court
of the State of California for the County of Santa Clara, Case No.: 19CV355879
Testifying Expert for Keysight Technologies, Inc.
Retained in August 2020.

Matter: Patent Infringement for Fiber Optic Devices
Law Firm: Cooley
Case Name: Certain High-Density Fiber Optic Equipment and Components Thereof,
U.S.I.T.C. Inv. No. 337-TA-1194
Testifying Expert for AFL Communications, Panduit, FS.Com, Wirewerk, and
Siemon
Completed in October 2020.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Optical Transport Networks
Law Firm: Venerble
Case Name: Huawei Technologies Co. Ltd v Verizon Communications, Inc., et. al., 2:20-cv-
0030
Testifying Expert for Verizon.
Retained in March 2020.
(IPR declarations submitted.)

Matter: Patent Infringement for Lighting System
Law Firm: Fisher Broyles
Case Name: Vaxcel International Co., Ltd., v. Jasco Products Company, LLC., (Case No. USDC Western District of Oklahoma, 5:19-CV-00154-JD)
Testifying Expert for Vaxcel.
Retained in August 2020.

Matter: Patent Infringement for Wireless Communication
Law Firm: McDermott Will & Emery
Case Name: Bell Northern Research LLC v. ZTE. (Case No. 3:18-cv-01786 - S.D. Cal)
Testifying Expert for ZTE.
Retained in July 2019.
(IPR declarations submitted.)

Matter: Patent Infringement for Wireless Communication
Law Firm: Jones Day
Case Name: Bell Northern Research LLC v. Kyocera Corp. (Case No. 3:18-cv-1785 - S.D. Cal)
Testifying Expert for Kyocera.
Completed in May 2019.
(Claim construction declaration submitted, and deposed.)

Matter: Patent Infringement for Electronic Payment Systems
Law Firm: Paul Hastings
Case Name: ID Tech Corp. v. Samsung Electronics Co., Ltd., et al. (Case No. No. 8:17-cv-1748-DOC-JDE (C.D. Cal))
Testifying Expert for Samsung.
Retained in January 2019.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Internet Switching
Law Firm: Maynard Cooper
Case Name: Parity Networks, LLC v. Juniper Networks, Inc., Case No. 6:17-CV-00495-RWS-KNM (U.S.D.C.E.D. Tx.)
Testifying Expert for Juniper.
Retained in April 2018.
(IPR declarations submitted.)

Matter: Patent Infringement for Internet Switching
Law Firm: Morgan Lewis
Case Name: Parity Networks, LLC v. Hewlett Packard Enterprise Company, Case No. 6:17-CV-00682 (U.S.D.C.E.D. Tx.)
Testifying Expert for Hewlett Packard Enterprise Company.
Retained in September 2018.
(IPR declarations submitted.)

Matter: Inter Parte Reexamination for Covered Business Method
Law Firm: Reed Smith LLP
Case Name: NASDAQ v. Miami International
Expert for Miami International.
Retained in February 2018.
(Expert declarations submitted, and deposited.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Quinn Emanuel
Case Name: Qualcomm v. Apple, Case No. 3:17-cv-00108-GPC-MDD (U.S.D.C.S.D. Cal.)
Testifying Expert for Qualcomm.
Completed in April 2019.
(Expert reports submitted, and deposited.)

Matter: Patent Infringement for Communication Devices
Law Firm: Venable
Case Name: Sycamore IP Holdings LLC v. Verizon Communications Inc, Case No. 2:16-cv-591-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Verizon and Level 3.
Completed in September 2017.
(Expert reports submitted, and deposited.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Alston Bird
Case Name: Huawei Technologies Co. Ltd. V. Nokia Solutions and Networks, Case No. 2:16-cv-0056-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Nokia.
Completed in December 2017.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Quinn Emanuel
Case Name: Huawei Technologies Co. Ltd. V. Samsung Electronics C. Ltd, Case No. 3:16-cv-02787 (U.S.D.C. N.D. Cal)
Testifying Expert for Samsung.
Completed in March 2019.
(Expert reports submitted, and deposited.)

Matter: Arbitration for Licensing
Law Firm: Alston Bird
Case Name: Nokia v. LG Electronics, International Chamber of Commerce Arb. No. 21326
Testifying Expert for Nokia.
Completed in October 2016.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Ropes and Gray
Case Name: Godo Kaisha IP Bridge 1 v. TCL Communication Technology Holdings, Case No. 15-634-SLR-SRF (U.S.D.C.S.D. Delaware.)
Testifying Expert for IP Bridge.
Completed in October 2018.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Paul Hastings
Case Name: Odyssey Wireless, Inc., v. Samsung Electronics Co., Ltd., et al, Case No. 3:15-cv-1738-H-RBB (U.S.D.C.S.D. Cal.)
Testifying Expert for Samsung.
Completed in October 2016.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Greenberg Traurig
Case Name: Mobile Telecommunications Technologies LLC v. Amazon.com, Inc., 2:13-cv-883-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Amazon.
Completed in April 2015.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Mayer Brown
Case Name: Mobile Telecommunications Technologies LLC v. LG Electronics Mobilecomm U.S.A., Inc., 2:13-cv-947-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for LG Electronics Mobilecomm.
Completed in February 2016.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Semiconductor Devices
Law Firm: Mayer Brown
Case Name: Inter Parte Reexamination for U.S. Patent Nos. 6,895,520 and 6,899,332
Expert for LG Electronics.
Completed in February 2016.
(Expert declaration submitted, and deposed.)

Matter: Patent Infringement in Vehicular Electronics
Law Firm: Gardner, Linn, Burkhardt & Flory, L.L.P
Case Name: *Magna Electronics Inc. v. TRW Automotive Holdings Corp. et al.*, Civil Action No. 1:12-cv-00654 (Western District of Michigan), and relating to the action styled *Magna Electronics Inc. v. TRW Automotive Holdings Corp. et al.*, Civil Action No. 1:13-cv-00324 (Western District of Michigan).
Testifying Expert for Magna Electronics

Completed in February 2016.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement in Electronic Circuits
Law Firm: Ropes and Gray
Case Name: Certain Devices Containing Non-Volatile Memory and Products Containing the Same (USITC Inv. Nos. 337-TA-922)
Testifying Expert for Spansion Inc.
Completed in February 2015.
(Expert reports submitted.)

Matter: Trade Secret Misappropriation in Software Method for Cable Television Advertisement
Law Firm: Brownstein Hyatt Farber Schreck
Case Name: Cross MediaWorks v. EMT Holdings, USDC Southern District of New York, Case No. 1:14-cv-00561-VSB
Testifying Expert for Cross MediaWorks.
Completed in April 2015.
(Testified during injunction hearing.)

Matter: Patent Infringement in Vehicular Electronics
Law Firm: Steptoe and Johnson
Case Name: Certain Vision-Based river Assistance System Cameras and Components Thereof (USITC Inv. Nos. 337-TA-899 and 907)
Testifying Expert for Magna Electronics
Completed in February 2015.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Vehicular System
Law Firm: Susman Godfrey
Case Name: Eagle Harbor Holdings, LLC, and Mediustech, LLC, v. Ford Motor Company, 3:11-cv-05503-BHS (U.S.D.C. Western District of Washington at Tacoma)
Testifying Expert for Mediustech.
Completed in March 2015.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Communication Networks
Law Firm: Davis Polk & Wardwell LLP
Case Name: Sprint Communications Company L.P., v. Comcast Cable Communications, LLC, Comcast IP Phone, LLC, and Comcast Phone of Kansas, LLC. 2:11-cv-02684-KHV-DJW (U.S.D.C. Kansas)
Testifying Expert for Comcast.
Retained in March 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Communication Networks

Law Firm: Quinn Emanuel
Case Name: France Telecom S.A. v. Marvell Semiconductor, Inc., 12-Civ-4986 (S.D.N.Y.)
Testifying Expert for Marvell.
Completed in September 2014.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Wireless Image Distribution
Law Firm: Jones Day
Case Name: *Inter Partes* Review of U.S. Patent No. 8,437,797
Expert for Google Inc.
Completed in November 2014.
(Expert declaration submitted.)

Matter: Nonvolatile Semiconductor Memories
Law Firm: Jones Day
Case Name: *Inter Partes* Review of U.S. Patent Nos. 8,301,833 and 8,516,187
Expert for SanDisk.
Completed in May 2014.
(Expert declaration submitted.)

Matter: Communication Protocols for Wireless Device
Law Firm: Dorsey & Whitney, LLP
Case Name: Certain Point-To-Point Network Communication Devices and Products
Containing Same (USITC Inv. No. 337-TA-892)
Testifying Expert for Toshiba
Completed in May 2014.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Networks
Law Firm: Ropes and Gray
Case Name: In the Matter of Certain Wireless Devices With 3G and/or 4G Capabilities and Components Thereof (USITC Inv. No. 337-TA-868) InterDigital Comms., Inc. v. Huawei Techs. Co., Ltd., No. 13-00008 (D. Del., filed January 2, 2013), InterDigital Comms., Inc. v. ZTE Corp., No. 13-00009 (D. Del., filed January 2, 2013), InterDigital Comms., Inc. v. Nokia Corp., No. 1:13-cv-00010 (D. Del., filed January 2, 2013), InterDigital Comms., Inc. v. Samsung Elec. Co., Ltd., No. 13-00011 (D. Del., filed January 2, 2013)
Testifying Expert for Joint Defense Group.
Completed in February 2014.
(Expert reports submitted, deposed, and testified during trials.)

Matter: Patent Infringement for Mobile Communication
Law Firm: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
Case Name: Certain Digital Media Devices, Including Televisions, Blu-Ray Disc Players, Home Theater Systems, Tablets and Mobile Phones, Components Thereof and Associated Software (USITC Inv. No. 337-TA-882)

Testifying Expert for LG Electronics, Inc.
Completed in February 2014.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Wireless Networks
Law Firm: Vinson & Elkins LLP
Case Name: Wi-LAN USA, Inc. and Wi-LAN, Inc. v. Telefonaktiebolaget LM Ericsson and Ericsson, Inc. (USDC: Southern District of FL - Case #1: 12-cv-23569), Wi-LAN USA, Inc. and Wi-LAN, Inc. v. Alcatel-Lucent USA, Inc. (USDC: Southern District of FL - Case #1: 12-cv-23568-Altonaga/Simonton)
Testifying Expert for Wi-LAN.
Completed in May 2015.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Data Storage
Law Firm: Ropes and Gray, Weil Gotshal
Case Name: Summit Data Systems, LLC v. EMC Corporation., et al. 1:10-cv-00749-GMS (U.S.D.C. Delaware)
Testifying Expert for EMC Corporation and Netapp, Inc.
Completed in December 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Mobile Device
Law Firm: Ashurst Australia
Case Name: Samsung v. Apple, Australian Federal Court Proceeding No. NSD 1243 of 2011
Testifying Expert for Samsung Electronics.
Completed in December 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Wireless Mobile Devices
Law Firm: Quinn Emanuel
Case Name: Apple Inc. v. Samsung Electronics Co., Ltd., et al., 4:11-cv-01846-LHK (N.D. Cal.) and Samsung Electronics Co., Ltd., et al. v. Apple Inc., 4:11-cv-02079 (N.D. Cal.)
Testifying Expert for Samsung Electronics.
Completed in July 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Mobile Device
Law Firm: Quinn Emanuel
Case Name: Certain Electronic Devices, Including Wireless Communication Devices, Portable Music And Data Processing Devices, And Tablet Computer, U.S.I.T.C. Inv. No. 337-TA-794
Testifying Expert for Samsung Electronics.
Completed in June 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Portable Storage Device
Law Firm: White and Case
Case Name: CERTAIN UNIVERSAL SERIAL BUS (“USB”) PORTABLE STORAGE DEVICES, INCLUDING USB FLASH DRIVES AND COMPONENTS THEREOF, US International Trade Commission Investigation No. 337-TA-788
Testifying Expert Witness for Trek
Completed in May 2012.
(Expert reports submitted, and deposed.)

Matter: Copyright Infringement for Petroleum Processing Software
Law Firm: Osha Liang LLP
Case Name: Aspen Technology, Inc. v. Tekin A. Kunt and M3 Technology, Inc., Case Number: H-10-1127, US District Court, Texas, Houston Division.
Testifying Expert for M3 Technology, Inc.
Completed in May 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Trade Secret Misappropriation for DC-DC converter
Law Firm: Covington & Burling, Haynes Boone
Case Name: Certain DC—DC Controllers and Products Containing Same, US International Trade Commission Investigation No. 337-TA-698
Testifying Expert for UPI.
Completed in March 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Parallel Processor
Law Firm: Orrick, Herrington, & Sutcliffe. Kirkland and Ellis.
Case Name: BIAx Corporation v. Nvidia and Sony Civil Action No. 09-cv-01257-PAB-MEH
Testifying Expert for Nvidia and Sony
Completed in March 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Call Center Technology
Law Firms: Duffy, Sweeney, and Scott. Foley Lardner.
Case Name: Ronald Katz Technology Licensing v. Citizens Financial Group 7-ML-1816-C RGK (FFM)
Testifying Expert Witness for Citizens Financial Group.
Completed in 2011.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Storage Area Network
Law Firm: DLA Piper
Case Name: Network Appliance, Inc., v. Sun Microsystems, Inc., Case Number: C-07-06053 EDL, US District Court, Northern District of California, San Francisco Division.
Testifying Expert for Sun Microsystems, Inc.

Completed in 2010.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Flat Panel Display Controller
Law Firm: Jones Day
Case Name: Certain Video Displays, Components Thereof, and Products Containing Same, US International Trade Commission Investigation No. 337-TA-687
Testifying Expert for Vizio, Inc.
Completed in 2010.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Call Center Technology
Law Firms: Foley Lardner
Case Name: Ronald Katz Technology Licensing v. US Bank 7-ML-1816-C RGK (FFM)
Testifying Expert Witness for US Bank
Completed in May 2009.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for USB to VGA Converter
Law Firm: Wang Hartmann, Gibbs, & Cauley, P.C.
Case Name: Displaylink Corporation v. Magic Control Technology Corporation, Case No. 5:07-CV-01998-RMW, US District Court, Northern District of California, San Francisco Division.
Testifying Expert for Magic Control Technology Corporation
Completed in 2009.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Flash Memory
Law Firm: Jones Day and Wilson Sansini
Case Name: Certain Flash Memory Controllers, Drives, Memory Card, and Media Players and Products Containing Same. US International Trade Commission Investigation No. 337-TA-619
Testifying Expert for SanDisk Corporation.
Completed in 2008.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Semiconductor Packaging
Law Firm: Jones Day
Case Name: Certain Semiconductor Chips with Minimized Chip Package Size and Products Containing the Same. US International Trade Commission Investigation No. 337-TA-605
Testifying Expert for Freescale Semiconductor
Completed in 2008.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Automatic Switching System

Law Firms: Jones Day, and Heller Ehrman, LLP.
Case Name: ATEN International Co., Ltd and ATEN Technology, Inc. v. Belkin Corporation, Belkin Logistics, Inc. and Emine Technology Co., Ltd. US International Trade Commission Investigation No. Ltd 337-TA-589
Testifying Expert for Belkin Corporation, Belkin Logistics, Inc., and Emine Technology Co., Ltd.
Completed in 2007.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Dual Mode Communication
Law Firm: Wilmer Cutler Pickering Hale and Dorr, LLP
Case Name: Broadcom Corporation v. Qualcomm Incorporated SACV05-467-JVS (RNBx)
Testifying Expert Witness for Broadcom Corporation
Completed in 2007.
(Expert reports submitted, deposed, and testified during trial.)