

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

Patent No. 9,866,438

Filing Date: February 16, 2017

Issue Date: January 9, 2018

TITLE: METHOD AND SYSTEM FOR SERVICE GROUP MANAGEMENT IN
A CABLE NETWORK

Inter Partes Review No.: IPR2025-00184

DECLARATION OF SAYFE KIAEI

**IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq.***

Declaration in Support of Petition 2 of 3

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I, Sayfe Kiaei, declare that I have personal knowledge of the facts set forth in this declaration and, if called to testify as a witness, could and would do so competently.

I. INTRODUCTION

1. I have been retained as an expert witness on behalf of the Petitioner, Comcast Cable Communications, LLC, for the above-referenced *inter partes* review proceeding.

2. I have been asked to provide a declaration regarding certain matters pertaining to U.S. Patent No. 9,866,438 (“the ’438 patent”) (Ex. 1101) and the unpatentability grounds set forth in the Petition for this proceeding. I understand the ’438 patent is owned by Entropic Communications, LLC.

3. I am being compensated at my usual consulting rate of \$685 per hour for my work on this matter. My compensation is in no way dependent upon my opinions or testimony or the outcome of this proceeding. I have no financial interest in the parties or in the outcome of this proceeding.

II. PROFESSIONAL BACKGROUND AND QUALIFICATIONS

4. A full description of my educational background, professional achievements, qualifications, and publications in the past 30+ years are set forth more fully in my curriculum vitae, which is attached to this Declaration as Exhibit 1103. Here, I provide a brief summary of my background and qualifications.

5. I received my Ph.D. in Electrical and Computer Engineering from Washington State University in 1987. My dissertation research areas were in signal processing, communication system, and networks. I have several patents and over 200 journal and international conference publications. I have graduated over 100 MS and PhD students working under my supervision on their thesis, and many of them are professors in academia or have senior positions in industry. My research is funded by various sources, including industry and federal agencies, such as NSF, USAID, DARPA, JPL, and NASA.

6. Since 2001, I have held the position of Motorola¹ Endowed Chair Professor in communication and RF system at the School of Electrical, Computer, and Energy Engineering at Arizona State University (“Arizona State”) in Tempe, Arizona.

¹ This position refers to a historical endowment established in 1998 for supporting communication, manufacturing, and supply chain programs at Arizona State. The objective of this endowment was to strengthen Arizona State’s capabilities in these technologies. Three other Arizona State professors have this endowment title in manufacturing, communication, and supply management. I do not receive any funding from Motorola and have not since I joined Arizona State.

7. I am also the Director of the National Science Foundation Center, Connection One. Connection One is a research center focused on developing wireless communication system and networking technologies.

8. I have been involved in research, teaching, and developing products in the areas of communications, networking, wireless systems, satellite systems, analog and digital circuits, linear and switching power management integrated circuits (PMIC), sensors, electronics, and related areas for the last 30 years.

9. From 1987 to 1993, I was an assistant and tenured associate professor at Oregon State University (“Oregon State”).

10. From 1997 to 2002, I was also an adjunct professor at the University of Texas at Austin.

11. At Oregon State, the University of Texas, and Arizona State, I taught courses in the areas of communication systems; wireline systems, wireless systems; networks; systems and circuits; digital integrated circuits, including HDL, Verilog, and VHDL; digital signal processing; and related areas.

12. At Arizona State, I also developed a new course on wireless transceiver systems. I have been doing research in the wireline and wireless communication and transceiver design. I joined Arizona State in 2001. My research has been funded by the National Science Foundation, DOD, DARPA, and industry in the wireless communication system.

13. In industry and academia, I have been working on wireline communication systems including DSL, MODEMS, CABLE MODEM, DOCIS, and wireless communication including cellular (1G, 2G, 3G, 4G-LTE, 5G), Land-mobile, satellite communication, ZIGBEE, Bluetooth, WiFi, wireless sensors since 1990.

14. I have been involved in research, teaching, and developing products in the areas of communication system, DSL, Cable MODEM, T1/E1, LAN, WAN, 2-way radios, Land-Mobile radio systems, cellular systems, GPS, location, RF Integrated circuits, Analog and Digital Integrated Circuits, HDL, Verilog, VHD, communications, digital signal processing, and related areas for the last 30 years, starting with the first generation of mobile phones.

15. I have also worked on second generation (2G) and third generation (3G) mobile phone technologies including GSM, EDGE, IS-95, 1X CDMA, UMTS, Wide band CDMA, GPS, Bluetooth, and related areas. These terms all refer to leading mobile phone standards and technologies, which enjoyed widespread use in mobile telephone networks throughout the world. I have also worked on other wireless data communication technologies including Bluetooth, the global positioning system (GPS), Wireless local area networks (LAN) (often known as WiFi), and related areas.

16. I have written and reviewed software code in HDL, Assembly, C, C++, DSP code, and MATLAB for processors. I have written, debugged, and reviewed software code for DSL, embedded microprocessors, and processors used for both wireline and wireless transceivers at Motorola, ASU, and as an expert witness.

17. From 1993-2001, I worked at Motorola and worked at the Land-mobile products Sector (LMPS), wirelines transceivers, and Wireless integrated Technology Center.

18. At Motorola LMPS, and cellular group, I was responsible for the design and development of system, architecture, DSP, analog, and RF integrated circuits for 1G (AMPS, Digital AMPS), 2-way radios, 2G (GSM, EDGE), and 3G (CDMA, WCDMA / UMTS, CDMA2000) transceiver. The products were Motorola flip phone, Razor, iDEN, etc. At LMPS, I worked in the Land-Mobile Products Sector (LMPS) and cellular group. I have designed and contributed to the design of many communications wireless systems including 2-way radios, trucking systems, 2-way radios, land-mobile products, satellite communications, cellular systems, GPS and Bluetooth.

19. I also worked on the interaction of the Iridium satellite system with the cellular and LAN system networking.

20. At Motorola Telecomm group, I worked on a single chip DSL transceiver "COPPERGOLD", Cable modem transceiver (DOCIS I and II) and other

wireline systems. I represented Motorola and regularly attended many standards including ITU (International Telecommunication Unit), ETSI (European Telecommunications Standards Institute), and other standards as a technical expert.

21. I have over 200 journal and conference publications, 13 patents, and standards contributions. Several of these patents and publications are in the areas of communications, networking and radio systems. At Oregon State, UT, and Arizona State, I taught courses and researched in the areas of communication system, cellular system, land-mobile communication system, analog and digital integrated circuits, power management integrated circuits (PMIC), communication systems; radio frequency (“RF”) systems and circuits; (“RFID”); magnetic and electronic sensors; including HDL, Verilog, and VHDL; digital signal processing; and related areas. The list of my publications is included in my resume in Exhibit 1003.

22. I have been an active member of IEEE communication, radio frequency, and networking societies since 1985 and have published, organized sessions, and been on various IEEE committees. I am an IEEE Fellow, which is the highest level of IEEE membership awarded by the IEEE directors to recognize a high level of demonstrated extraordinary accomplishments. The IEEE Fellow Award is a special recognition for members with extraordinary accomplishments in the IEEE technical fields. To ensure that the recognition is extraordinary, the total number of recipients each year cannot exceed 0.1% of the total higher grade

membership. The IEEE is the Institute of Electrical and Electronics Engineers, the world's largest association of technical professionals whose objectives include the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering, and related disciplines.

23. I am a member of the IEEE Circuits and Systems Society, IEEE Solid State Circuits Society, IEEE Signal Processing Society, and IEEE Communication Society. I am also a member of the IEEE RF and Microwave committees, IEEE Low Power Symposium Committee, and IEEE Fellow Selection Committee. I was one of the key organizers establishing the IEEE Radio Frequency Integrated Circuits (RFIC) symposium in 1995, and I have been on the executive and technical committees of RFIC for the last 16 years.

24. I have received several awards including the Carter Best Teacher Award, the IEEE Darlington Award (which is given for the best technical paper on circuits and systems in the IEEE Circuits and Systems Society), and the Motorola 10X Rapid Design Cycle Reduction Award.

III. MATERIALS CONSIDERED

25. In formulating my opinion, I reviewed and considered U.S. Pat. No. 9,866,438 (Ex. 1101).

26. In preparing this declaration, I also reviewed and considered the Petition and the file history (Ex. 1104) of the '438 patent as well as the following references:

- Ex. 1105: U.S. Patent Application Publication No. 2007/0223512 (“Cooper”)
- Ex. 1111: U.S. Patent Application Publication No. 2012/0269242 (“Prodan”)
- Ex. 1112: U.S. Patent No. 10,084,538 (“Nielsen-538”)
- Ex. 1113: U.S. Patent Application Publication No. 2013/0004179 (“Nielsen-179”)
- Ex. 1114: U.S. Patent No. 6,952,454 (“Jalali”)
- Ex. 1115: U.S. Patent No. 7,573,822 (“Monk”)
- Ex. 1116: U.S. Patent No. 6,772,437 (“Cooper-437”)
- Ex. 1117: Claim Construction Memorandum Opinion and Order, *Entropic Comms., LLC v. Charter Comms., Inc.*, Case No. 2:22-CV-00125-JRG
- Ex. 1118: Rebuttal Expert Report of John Holobinko Regarding Validity of U.S. Patent Nos. 8,284,690 and 10,135,682
- Ex. 1119: Exhibit F, U.S. Patent No. 10,135,682 Exemplary Infringement Chart

- Ex. 1120: U.S. Patent Application Publication No. 2010/0061235 (“Pai”)
- Ex. 1121: Data-Over-Cable Interface Specifications, Radio Frequency Interface Specification, SP-RFII01-970326 (“DOCSIS 1.0”)
- Ex. 1122: Data-Over-Cable Service Interface Specifications, DOCSIS 1.1, Radio Frequency Interface Specification, CM-SP-RFIV1.1-C01-050907 (“DOCSIS 1.1”)
- Ex. 1123: Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIV2.0-C02-090422 (“DOCSIS 2.0”)
- Ex. 1124: U.S. Patent Application Publication No. 2007/0171994 (“Parker”)
- Ex. 1125: U.S. Patent No. 8,503,546 (“Ashrafi”)
- Ex. 1126: Tanenbaum, “Computer Networks,” 4th ed. (2003)
- Ex. 1127: Driscoll, “Next Generation IPTV Services and Technologies” (2008)
- Ex. 1128: U.S. Patent Application Publication No. 2005/0097617 (“Currivan”)
- Ex. 1129: U.S. Patent No. 10,135,682 (“the ’682 patent”)

- Ex. 1130: U.S. Patent Application Publication No. 2008/0291840 (“Cooper840”)
- Ex. 1131: U.S. Patent Application Publication No. 2005/0122996 (“Azenkot”)
- Ex. 1133: ITU-T J.222.1, *Series J: Cable Networks and Transmission of Television, Sound Programme and Other Multimedia Signals* (Jul. 2007)
- Ex. 1134: “[Tentative] Claim Construction Order,” *Entropic Communications, LLC v. Comcast Corporation*, No. 2:23-cv-01050 (C.D. Cal. filed Feb. 10, 2023) and *Entropic Communications, LLC v. Cox Communications, Inc.*, No. 2-23-cv-01049 (C.D. Cal. filed Feb. 10, 2023) (collectively, “CA litigation”)

IV. UNDERSTANDING OF APPLICABLE LEGAL STANDARDS

27. Although I am not an attorney, I have a general understanding of the applicable legal standards pertaining to the patentability issues presented in this proceeding.

28. I understand that, in this *inter partes* review (IPR), Petitioner is challenging the patentability of the claims of the ’438 patent. I understand that Petitioner has the burden of proving that each challenged claim is unpatentable by a preponderance of the evidence.

29. I understand that to be valid, a patent claim must be “novel,” and is invalid if “anticipated” by a single prior art reference. I further understand that a reference anticipates if it discloses each and every element as arranged in the claim, so as to enable a person of ordinary skill in the art (“POSITA”) to make and use the claimed invention without undue experimentation.

30. I understand that a patent claim is unpatentable if, at the time of the invention, it would have been obvious to a POSITA to combine the teachings of the prior art to yield the patent claim. I also understand that it is not required (although it is acceptable) that each element/limitation of a patent claim be found in a single reference in order to find a patent claim obvious. For a patent claim to be found obvious, all the elements/limitations of the patent claim may be found in a combination of references at which a person of ordinary skill in the art would have been reasonably expected to arrive. I understand that a proper analysis of whether an invention is unpatentable for obviousness includes a review of the scope and content of the prior art, the differences between the patent claims at issue and the prior art, the level of ordinary skill in the field of the invention at the time of the invention, and other objective considerations identified below.

31. It is my understanding that the prior art and claimed invention should be viewed through the knowledge and understanding of a person of ordinary skill in the art—one should not use his or her own insight or hindsight in deciding whether

a claim would have been obvious. I further understand that a claim may be rendered obvious if a person of ordinary skill in the art can implement the claimed invention as a predictable variation of a known product. I also understand that a person of ordinary skill in the art is presumed to have knowledge of the relevant prior art at the time of the claimed invention, which comprises any prior art that was reasonably pertinent to the particular problems the inventor faced.

32. I understand that a showing of obviousness requires some articulated reasoning with a rational underpinning to support the combination of the references. I understand that in consideration of the issue of obviousness it is important to identify whether a reason existed at the time of the invention that would have led a POSITA to combine elements of the references in a way that yields the claimed invention.

33. I understand that a claim may be considered unpatentable for obviousness for various reasons. I have been informed that the following exemplary rationales may support a finding of obviousness:

- (A) combining prior art elements according to known methods to yield predictable results;
- (B) simply substituting one known element for another to obtain predictable results;
- (C) use of a known technique to improve similar devices in the same way;

- (D) applying a known technique to a known device or method ready for improvement to yield predictable results;
- (E) choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- (F) known work in a field that prompts variations in the work in the same or a different field that leads to predictable results; and
- (G) some teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill in the art to modify a prior art reference or combine multiple prior art references or teachings to arrive at the claimed invention.

34. I understand that various objective or “real world” factors, also referred to as secondary considerations, may be indicative of non-obviousness. I understand that such factors/considerations include:

- (A) the commercial success of the claimed invention;
- (B) the existence of a long-felt, unresolved need for a solution to the problem solved by the claimed invention;
- (C) failed attempts to solve the problem solved by the claimed invention;
- (D) copying of the claimed invention;
- (E) unexpected results of the claimed invention;
- (F) praise for the claimed invention by others in the relevant field; and

(G) willingness of others to accept a license under the patent because of the merits of the claimed invention.

35. It is my understanding that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the link may be common sense. I further understand that the obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that is sufficient motivation to combine references.

36. It is my understanding that a particular combination may be proven obvious merely by showing that it was obvious to try the combination. For example, common sense is a good reason for a person of ordinary skill to pursue known options when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions.

37. I further understand that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, it is my understanding that any need or problem known in the field at the time of invention and addressed by the patent can provide a reason for combining the limitations in the manner claimed.

V. THE RELEVANT ART AND LEVEL OF ORDINARY SKILL IN THE RELEVANT ART

38. In my opinion, the relevant field of art for the '438 patent is cable television networks. Ex. 1101, Abstract, 1:47-50.

39. I understand that obviousness is determined from the vantage point of a hypothetical person having ordinary skill in the art (POSITA) at the time of the alleged invention, which, for purposes of this declaration, I have assumed is the earliest claimed priority date of July 23, 2012.

40. I understand that the following four factors may be considered when identifying the appropriate level of a POSITA: (i) the types of problems encountered by those working in the field and prior art solutions thereto; (ii) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (iii) the educational level of active workers in the field; and (iv) the educational level of the inventor. I understand that a POSITA is one who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

41. It is my opinion that, for the '438 patent, a person of ordinary skill in the art (a "POSITA") at the time of the alleged invention would have had at least a degree in computer or electrical engineering, computer science, information systems, or a similar discipline, along with at least three-to-four years of experience with the design and/or implementation of network-based content delivery systems, such as cable systems and Internet video streaming. It is also my opinion that additional education may substitute for professional experience, and significant work experience may substitute for formal education.

42. I worked in the relevant field with persons meeting this definition of a POSITA at, and leading up to, the time of the alleged invention of the '438 patent (*i.e.*, July 23, 2012). Therefore, I am familiar with the knowledge and skills that would have been possessed by a hypothetical person of ordinary skill in the art at the time of the alleged invention. In addition, I believe that my extensive industry experience and educational background qualify me as an expert in the relevant field.

43. In this Declaration, wherever I refer to a POSITA, it should be understood that I am referring to a hypothetical person at the time of the alleged invention of the '438 patent (*i.e.*, July 23, 2012) meeting the description I have provided in this section.

VI. CLAIM CONSTRUCTION

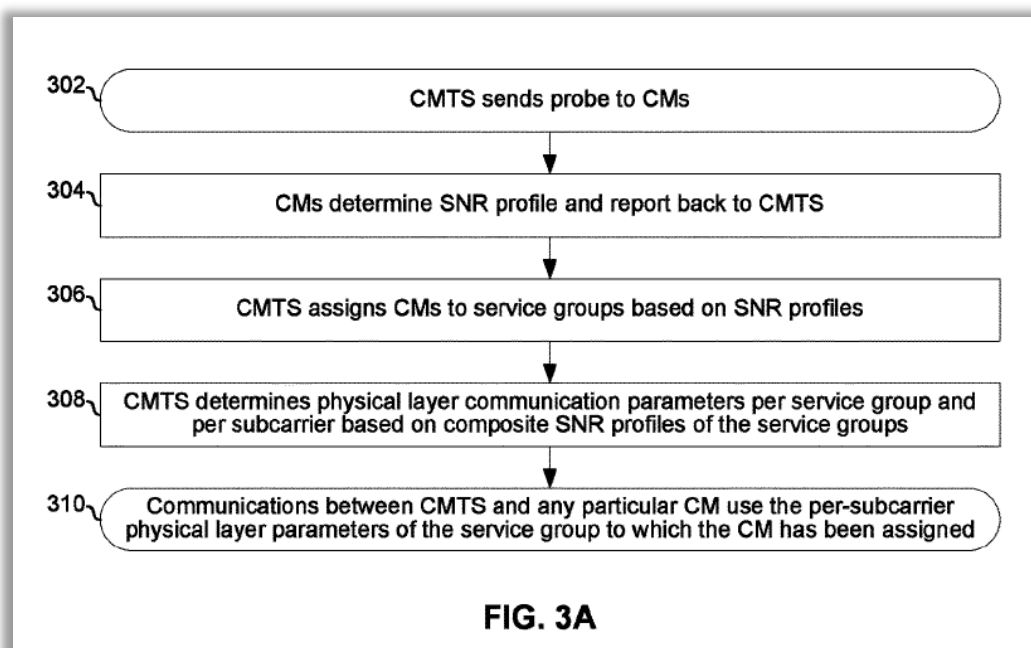
44. I understand that all claim terms herein should be given their ordinary and customary meaning to a POSITA, consistent with the prosecution history. I further understand that, with regard to the claim term “CMTS”, the District Court in the CA litigation issued a “[Tentative] Claim Construction Order” construing “CMTS” as “hardware and accompanying software, with the hardware located at the point at which the cable modem’s connection to the hybrid-fiber coaxial network terminates.” Ex. 1134, pp. 17-21, 25. I have considered this construction when forming my opinions below. I also understand that the Petitioner does not contend that the claims include any means-plus-function limitations.

VII. OVERVIEW OF THE '438 PATENT

A. '438 Patent

45. The '438 patent relates to service group management in a cable television network. Ex. 1101, 1:48-50. "A cable modem termination system (CMTS) may determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics. The CMTS may assign[] the modems among a plurality of service groups based on the SNR-related metrics." Ex. 1101, Abstract.

46. An exemplary process for grouping cable modems (CMs) in accordance with the alleged invention is shown in Figure 3A below.



Ex. 1101, Fig. 3A

47. As illustrated, a plurality of cable modems each determine a signal-to-noise ratio (SNR) profile and report the profile back to a cable modem termination

system (CMTS). Ex. 1101, 4:22-27, 5:32-35. The '438 patent describes an SNR profile as “SNR at a particular frequency or SNR over a range of frequencies.” *Id.*, 3:52-56; *see also id.* 3:61-63 (noting that message 202 “may”—but is not required to—span multiple frequencies), 4:40-43. This is consistent with the ordinary understanding of the term that a POSITA would have. The CMTS then assigns the cable modems to service groups based on the SNR profiles. Ex. 1101, Abstract, 4:49-53, 5:35-37, 6:44-7:4. A service group is simply a group of cable modems serviced by a CMTS. *Id.*, 6:44-46, 6:60-62, Fig. 4A (Elements 402 and 404), Fig. 4B (elements 406 and 408). A composite SNR profile based on the worst-case SNR profile for each service group is used to determine physical layer communication parameters used for communication between the CMTS and cable modems. Ex. 1101, Abstract, 4:37-53, 5:38-48. Physical layer communication parameters include encoding and modulation parameters, such as modulation type and modulation order. Ex. 1101, Abstract, 4:53-64.

B. Prosecution History

48. The application that led to the '438 patent, U.S. Application No. 15/434,673, was filed on February 16, 2017. Ex. 1101, 1-2.

49. All claims were rejected in an Office Action dated April 10, 2017, on the ground of nonstatutory double patenting as being unpatentable over claims 1-18

of U.S. Patent No. 9,577,886 to Ling *et al.* and claims 1-18 of U.S. Patent No. 9,419,858 to Ling *et al.* Ex. 1104, 56-74.

50. The claims were also rejected as obvious over combinations of prior art references that included U.S. Patent No. 8,743,933 to Prodan in view of U.S. Patent Publication 2009/0219856 to Richardson. Ex. 1104, 75-93. According to the Examiner, Prodan discloses nearly all of the features of claims 1 and 10, including a CMTS that selects “physical layer communication parameters” (*i.e.*, a modulation scheme and frequency spectrum) to be used for communicating with groups of CMs. Ex. 1104, 76. The Applicant responded to the rejections by filing a Terminal Disclaimer and amending both independent claims to require that the composite SNR-related metric is based “at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups.” Ex. 1104, 105, 107-108 (emphasis in original). The Examiner then issued a Notice of Allowance on September 7, 2017. *Id.*, 147-154.

51. The ’438 patent issued on January 9, 2018. Ex. 1101, 1-2.

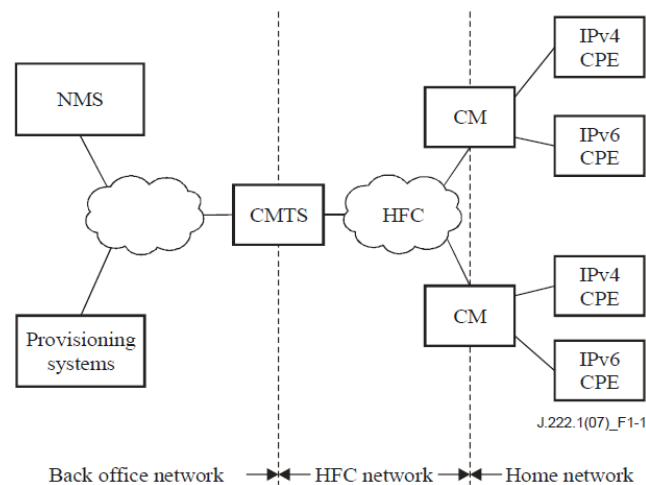
C. Priority Date

52. I understand that the earliest possible priority date for the ’438 patent claims is July 23, 2012, which is the filing date of U.S. Provisional Application No. 61/674,742 to which the ’438 patent claims priority.

VIII. TECHNICAL BACKGROUND

A. Cable Systems

53. At the time of the earliest possible priority date for the '438 patent, cable systems allowed the transmission of data between a cable operator's headend and customer locations over all-coaxial or hybrid-fiber/coax (HFC) cable networks. Ex. 1133, 2-4. A simplified version of this is shown below, which includes a cable modem termination system (CMTS) at the headend, cable modems, and customer premises equipment (CPE). Examples of CPEs include home routers, set-top devices, and personal computers. Ex. 1133, 2.



Ex. 1133, Fig. 1-1

54. A CMTS connects a cable operator's back office network at the headend with the HFC network. Ex. 1133, 2. Using the HFC network, the CMTS transmits data to cable modems on downstream channels and receives data from cable modems on upstream channels. *Id.*

55. The CMTS also configures the physical layer parameters (*e.g.*, modulation scheme) of each channel used to communicate data to and from the cable modems. Ex. 1131, ¶¶7, 13, 26-34; Ex. 1133, 15-17, 88-91. For example, a CMTS may send a plurality of cable modems an Upstream Channel Descriptor Message (UCD) that includes, among other things, modulation scheme, frequency, preamble pattern, and burst parameters. Ex. 1131, ¶¶26, 72-75. In response, a cable modem transmits an initial training burst that includes identification information, from which the CMTS may calculate the SNR and upstream equalization coefficients. Ex. 1131, ¶102. The CMTS then sends a downstream message to the cable modem to make certain adjustments to its transmission. Ex. 1131, ¶102.

56. Further, at the time of the '438 patent, it was common for a cable network to have hundreds or thousands of cable modems, each of which could have different throughput capabilities. Ex. 1131, ¶1. Because the throughput of a channel would be determined by the cable modem with the lowest throughput, a CMTS would group cable modems into channels by modem type (*e.g.*, DOCSIS type) and/or throughput ability as measured by performance characteristics (*e.g.*, SNR, bit error rate, packet error rate). Ex. 1131, ¶¶2-13, 37-46. By grouping cable modems, those cable modems with higher throughput capabilities would not be penalized by having cable modems on the same channel with lower throughput capabilities. Ex. 1131, ¶2.

57. Therefore, after the CMTS sends the UCD, receives the initial training bursts from the various cable modems on its cable network, and calculates the SNR for each cable modem, the CMTS is able to group different cable modems based on modem type and SNR. By grouping cable modems, newer DOCSIS modems (*e.g.*, DOCSIS 2.0) with higher SNRs can transmit using more complex modulation techniques that allow higher throughput (*e.g.*, Quadrature Amplitude Modulation (QAM)), while older DOCSIS modems (*e.g.*, DOCSIS 1.0, DOCSIS 1.1) and others with lower SNRs can transmit using less complex modulation techniques with lower throughput (*e.g.*, Quadrature Phase Shift Keying (QPSK)).

B. Orthogonal Frequency Division Multiplexing (OFDM)

58. OFDM is a modulation method for efficiently transmitting large amounts of data over a signal processing network. Ex. 1124, ¶2. The bandwidth (channel), reserved for data traffic, is divided into multiple and narrower sub-bands (sub-channels). Ex. 1124, ¶2. The data is also divided into lower data rate channels, each encoded on different subcarrier frequencies for transmission over the network. Ex. 1124, ¶2. The subcarrier frequencies are mutually orthogonal so that the frequencies are simultaneously transported to and accurately retrieved at the receiver. Ex. 1124, ¶2. The subcarriers maintain orthogonality by being spaced at frequency intervals $1/T$, where T represents the OFDM symbol period. Ex. 1124,

¶2. This approach reduces intersymbol interferences (ISI) by extending the symbol duration relative to the channel's delay spread. Ex. 1124, ¶¶2, 5.

59. In OFDM, the data bits are grouped as symbols based on the number of bits per symbol. The group of symbols are then modulated by the inverse Fourier transform. The OFDM output signal is generated by calculating an Inverse Fast Fourier Transform (IFFT) on a set of symbols. Ex. 1124, ¶3. Each symbol of the set of symbols defining the OFDM symbol represents a specific plurality of data bits and may be retrieved by performing the Fourier transform on the OFDM symbol. Ex. 1124, ¶3. In this way, only one symbol will be generated for any subcarrier frequency. Ex. 1124, ¶3. Further, because transmitted data is divided over multiple carrier sub-bands (sub-channels), the symbol intervals become longer, proportional to the number of sub-bands than if transmitting data over a single band (channel). Ex. 1124, ¶5. Longer symbol intervals reduce ISI when the symbol period overtakes the channel spread, as any ISI is then spread over fewer symbols. Ex. 1124, ¶5.

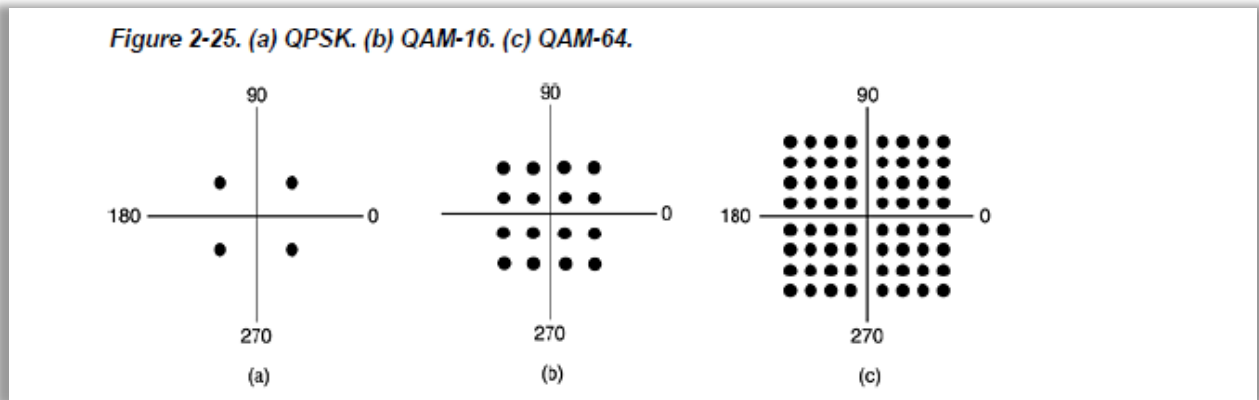
60. Similarly, OFDMA (Orthogonal Frequency-Division Multiple Access) transmits data over several sub-bands with different carrier frequencies. Ex. 1124, ¶¶60, 90-91. With OFDMA, multiple users are assigned a subset of subcarriers that are orthogonal to each other. Ex. 1124, ¶¶60, 90-91.

C. Quadrature Amplitude Modulation (QAM)

61. Transmitting data over a cable network requires encoding the data onto a carrier wave by modulation. Ex. 1125, Abstract, 1:10-43; Ex. 1126, 89-90, 98-101. Modulation entails changing the carrier wave's amplitude, frequency, and/or phase according to the desired transmitted data. Ex. 1126, 98-99. After transmitting the encoded carrier wave over the network, the data is extracted from the carrier wave by demodulation at the receiver. Ex. 1125, 1:44-53; Ex. 1126, 89-90, 98-99. One modulation technique is called Quadrature Amplitude Modulation (QAM). Ex. 1125, 1:10-43.

62. QAM employs two carrier signals within the same frequency band that are orthogonal to each other. Ex. 1125, 1:10-43. The two carrier signals are called an in-phase signal (I) and quadrature signal (Q). Ex. 1125, 1:10-43. The carrier signals are modulated and then combined for network transmission. Ex. 1125, 1:10-43. During modulation, the data bits are divided into groups called symbols. Ex. 1126, 98-99. For example, in 16-QAM, each symbol represents four bits. Ex. 1126, 98-99. As each bit is either a zero or a one, grouping four bits together results in 16 combinations of zeros and ones (*e.g.*, 0001, 0011, 0111, 1111, 1000, 1001, etc.). Ex. 1126, 98-99. Each group is represented by a symbol encoded on the carrier wave with a unique amplitude and phase shift modulation. Ex. 1126, 98-99. Constellation diagrams map all the possible modulation options to each of the 16 symbols within

the particular modulation scheme, which includes both modulation type and modulation order, as shown below. Ex. 1126, 98-99.



Ex. 1126, Fig. 2-25.

63. Each point in the constellation diagram represents a unique amplitude and phase used to encode the signal onto the carrier wave. Ex. 1126, 98-99. During demodulation, each symbol's amplitude and modulation are detected and looked up on the constellation diagram, resulting in decoding the original bits. Ex. 1126, 98-99; Ex. 1125, 5:10-33. A timing feature is employed to determine the start of each new symbol. Ex. 1125, 1:25-55.

D. Quadrature Phase Shift Keying (QPSK)

64. QPSK is another modulation technique. Ex. 1127, 64, 79, 237. Like QAM, QPSK employs two identical carrier signal waves orthogonal to each other. Ex. 1127, 237. However, QPSK modulation employs four different points in the constellation diagram, as indicated above. Ex. 1126, Fig. 2-25. Therefore, each symbol modulated using QPSK represents two bites of data. Ex. 1127, 237. QPSK

effectively doubles the bandwidth of the network and allows for efficient use of the frequency spectrum. Ex. 1127, 237.

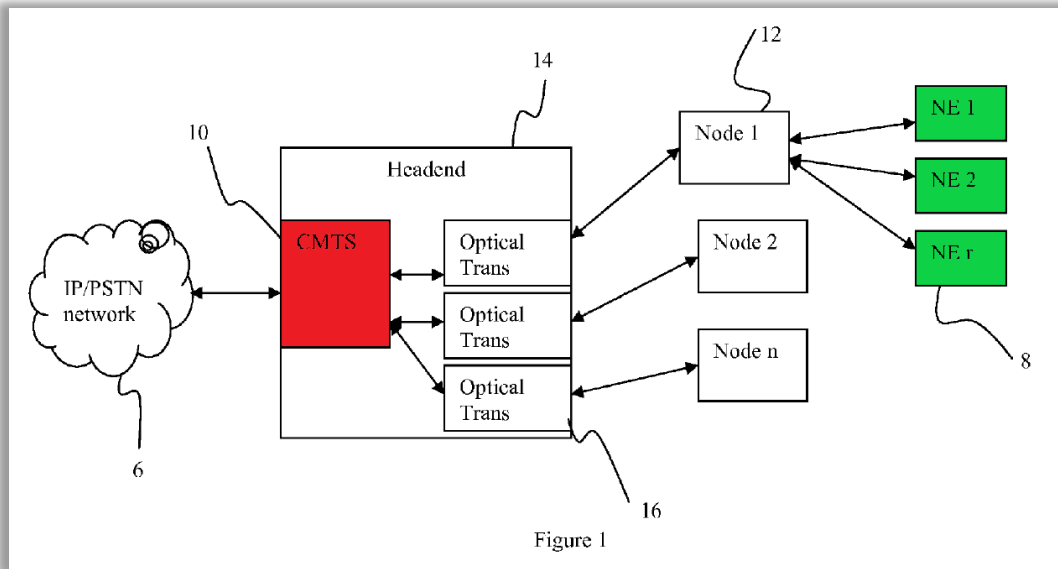
IX. OVERVIEW OF THE PRIOR ART

A. Cooper

65. Cooper (Ex. 1105) is a U.S. Published Application published September 27, 2007. Cooper is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

66. Cooper shows that it was known to group cable modems by location in a cable network when selecting common physical layer communication parameters for use by all cable modems within the group. Ex. 1105, ¶¶2, 7, 10, 19, 26-27, 30-33, 39-40, 43. Cooper's CMTS determines the locations of cable modems in a cable network and assigns the cable modems to service groups based at least in part on the location of the cable modem (*e.g.*, its distance from the CMTS or from an upstream amplifier). Ex. 1105, Abstract, ¶¶8, 21, 27-28, 37.

67. Cooper describes a “process for reconfiguring logical channels” in a network. Ex. 1105, ¶¶2, 17, 30-31. As illustrated below in Figure 1, Cooper discloses a network in which multiple network elements 8 such as cable modems (**green**) connect to a CMTS 10 (**red**). Ex. 1105, ¶22, Fig. 1.



Ex. 1105, Fig. 1 (annotated)

68. Cooper explains that CMTS 10 resides at a headend 14, which includes transceivers that communicate with the network elements by receiving upstream communications from the network elements and sending downstream communications to the network elements. Ex. 1105, ¶22; *see id.*, ¶3. The measured network parameters are determined in cooperation with the network elements without interruption of active communication services. The network parameters include upstream or downstream modulation error ratio (MER), upstream or downstream signal to noise ratio (SNR), upstream or downstream microreflections, upstream transmit level, downstream receive power level. Ex. 1105, Abstract. Cooper further describes a process that allows a network operator to easily group cable modems based upon common parametrics and performance similarities. Ex. 1105, ¶19. Cooper's groupings of cable modems may then be used to configure

logical channels and subsequently the assignment of cable modems to logical channels. Ex. 1105, ¶19.

B. Cooper840

69. Cooper840 (Ex. 1130) is a U.S. Published Application published November 27, 2008. Cooper840 is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

70. Cooper840 shows that it was known to use the lowest SNR for a group of cable modems when selecting a common modulation profile for use by all cable modems within the group. Ex. 1130, ¶¶28, 31, 34. Cooper840 specifically discloses determining a network element to be used to communicate with a network controller to measure and monitor parameters of a network. Ex. 1130, ¶1. In one embodiment, Cooper840 discloses a network that includes a CMTS 10 (**red**) and a multiple cable modems 8 (**green**). Ex. 1130, ¶20, Fig. 1 (reproduced below).

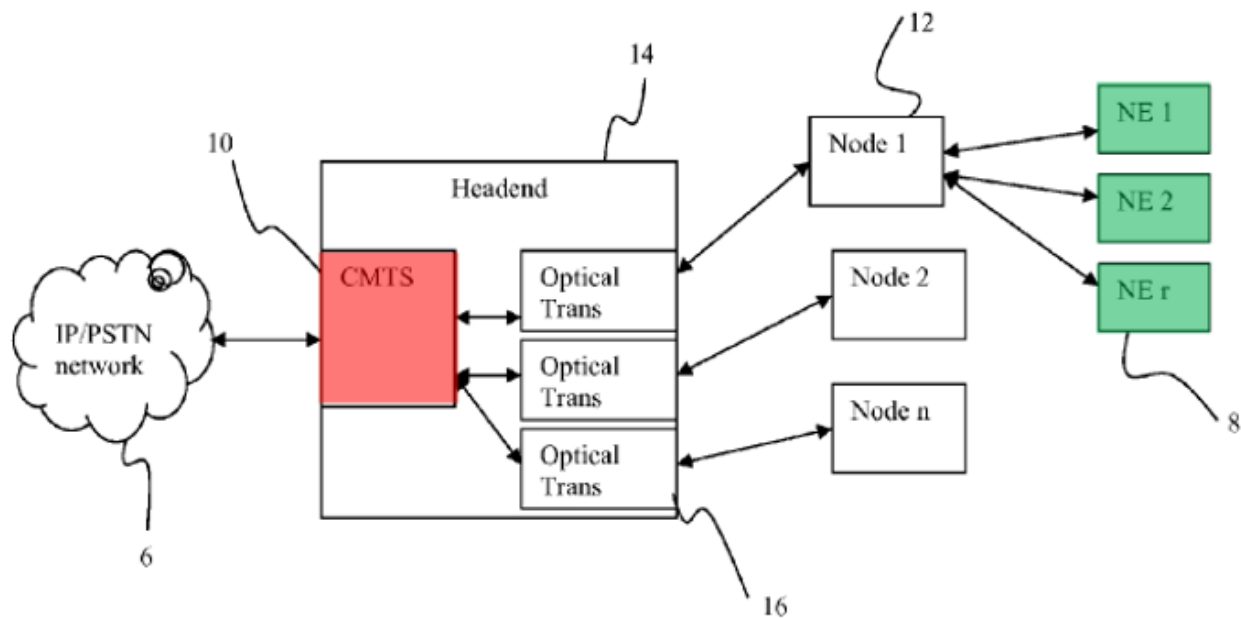


Figure 1
Ex. 1130, Fig. 1

71. Cooper840 further discloses a process for controlling modulation parameters, such as modulation order. Ex. 1130, ¶¶20, 28. Cable modems are sorted based on SNR. Ex. 1130, ¶¶9-11, 29-30, Fig. 5 (element S3). According to Cooper840, “[i]deally, we want to set the modulation profile as a function of the lowest MER in the network element pool” when describing the MER embodiment. Ex. 1130, ¶31. Cooper840 teaches that cable modems can be grouped by either MER or SNR. Ex. 1130, ¶¶9-11, 20, 28-30, Fig. 5 (element S3). Cooper840 explains that the modulation parameters include modulation order. Ex. 1130, ¶¶6, 28, 32.

C. Azenkot

72. Azenkot (Ex. 1131) is a U.S. Published Application published June 9, 2005. Azenkot is prior art under pre-AIA 35 U.S.C. § 102(b). Azenkot was cited

during prosecution, but not applied in any rejection during prosecution. Ex. 1101, 1-2.

73. Azenkot shows that it was known to set parameters of a common burst profile used for communications by multiple cable modems based on the least capable cable modem. Ex. 1131, ¶¶1, 7, 68. As I describe below, a POSITA would have understood that the least capable cable modem is the cable modem with the lowest SNR.

74. Azenkot specifically discloses a process for grouping cable modems by type/modulation profile and/or throughput ability into different logical groups. Ex. 1131, Abstract, ¶7. Each logical group is commanded to transmit upstream with a burst profile set to effectively use the throughput ability of the cable modem. *Id.* In one embodiment, Azenkot specifically teaches grouping cable modems by SNR using multiple logical channels. Ex. 1131, ¶¶7, 13, 16, 40-41, 92. Burst profiles used for communications are selected for a group based on SNR. Ex. 1131, ¶¶16, 40-41, 92-94.

D. Prodan

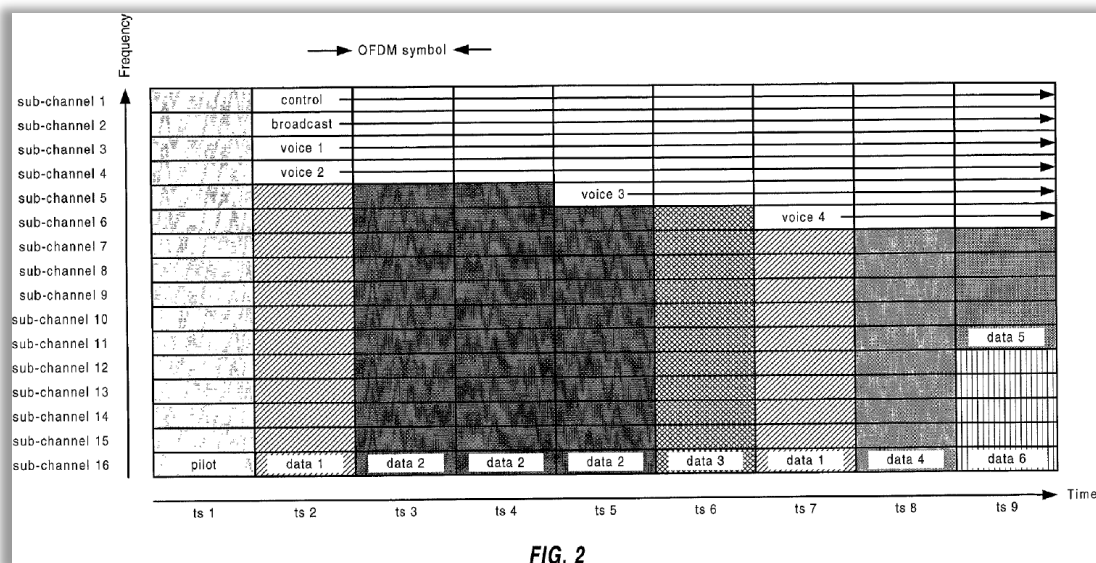
75. Prodan (Ex. 1111) is a U.S. Patent Application Publication published October 25, 2012. Prodan is prior art under pre-AIA 35 U.S.C. § 102(e). Prodan was considered during prosecution. Ex. 1101, 1-2.

76. Prodan discloses a cable TV system in which cable modems are assigned to groups and all of the cable modems within a group use a common modulation scheme. Ex. 1111, ¶44. In particular, Prodan describes frequency spectrum and modulation scheme allocation techniques that optimize power utilization and enable similar upstream transmission power by cable modems and signal-to-noise ratio (SNR) at the headend. Ex. 1111, Abstract, ¶7. One of these techniques describes a method and system for measuring SNR data and grouping cable modems into multiple categories for use in transmission based on a measured parameter. Ex. 1111, ¶44. The method may be performed at the headend or at a cable modem termination system (CMTS). Ex. 1111, ¶44. The signal strength versus frequency profiles of cable modems are measured. Ex. 1111, ¶44. These profiles are then used to group cable modems into service group categories. Ex. 1111, ¶44. Additionally, Prodan's CMTS assigns each of the cable modems a respective frequency allocation and/or modulation scheme based on the determined profiles of the cable modems. Ex. 1111, ¶45.

E. Jalali

77. Jalali (Ex. 1114) is a U.S. Patent filed July 12, 2000 and granted on October 4, 2005. Jalali is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

78. Jalali discloses a method of transmitting and receiving multiple types of services (*e.g.*, video, voice) along multiple carriers using OFDM. Ex. 1114, Abstract, 3:1-4, 3:29-49, 5:41-6:13, 25:62-26:17, Fig. 1. For example, Jalali's Figure 2 (below) shows a diagram of a transmission channel where the x-axis is time and the y-axis is frequency (divided into 16 sub-channels). Ex. 1114, 13:49-58.



Ex. 1114, Fig. 2

79. Jalali's Figure 2 also shows a TDM structure where data transmission is partitioned into nine different timeslots, which correspond to the duration of the OFDM modulation symbol. Ex. 1114, 13:58-63. In the given example, the first timeslot is used for pilot data (*e.g.*, data to help synchronize with receivers and perform channel estimation), while the other slots can be used for sub-carriers of other various types of data. Ex. 1114, 13:64-14:13. Jalali discloses that its communication system provides the flexibility for data to be transmitted through

multiple sub-channels and/or multiple time slots, achieving both a high performance and a high efficiency. Ex. 1114, 14:20-60, 15:26-35.

80. Jalali also discloses that “[f]lexibility, performance, and efficiency are further achieved by allowing for independence among the modulation symbols ... [to] be generated from a modulation scheme (*e.g.*, M-PSK, M-QAM, and others) that results in the best use of the resource at that particular time, frequency, and space.” Ex. 1114, 15:36-42, 11:51-12:9, 17:21-34, 22:19-24, 23:54-65, 32:34-44. Jalali further discloses that alternatively, “each ... sub-channel may be restricted to a particular modulation scheme (*e.g.*, M-PSK, M-QAM) for the duration of the transmission or until such time as a new modulation scheme is assigned.” Ex. 1114, 15:54-61, 12:45-48.

F. Monk

81. Monk (Ex. 1115) is a U.S. Patent filed November 12, 2007 and granted on August 11, 2009. Monk is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

82. Monk shows that it was known to use probe messages sent to cable modems when determining the SNR of channel and corresponding modulation schemes. Ex. 1115, Abstract, 4:44-59, 9:28-41. A cable modem in the Monk system analyzes the probe message and sends raw data back to the sending device for analysis. Ex. 1115, Abstract, 4:44-59, 9:28-50.

83. Monk discloses a method of communication that applies different modulation schemes based on a communication channel's SNR. Ex. 1115, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. Monk describes higher SNR channels supporting higher modulation orders through bit loading (*e.g.*, 16-QAM, 64-QAM and 256-QAM), while lower SNR channels may use a different modulation scheme such as QPSK. Ex. 1115, 4:55-59, 8:1-11, 9:9-11, 10:58-62. Monk discloses a sending node transmitting a probe message having a predetermined data sequence to a receiving device, which then analyzes the probe message for impairment at each frequency to determine the SNR of a channel. Ex. 1115, Abstract, 4:44-59, 9:28-41. Monk further discloses that the receiving device then sends the results of the analysis back to the sending device, as either raw data or a bit loading profile for the sending device to modify the transmission parameters. Ex. 1115, 9:42-50.

G. Cooper-437

84. Cooper-437 (Ex. 1116) is a U.S. Patent filed July 28, 1999 and granted on August 3, 2004. Cooper-437 is prior art under pre-AIA U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

85. The system in Cooper-437 uses cable modem probe messages that include instructions for measuring noise and reporting the noise to a CMTS. Ex. 1116, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1. Cooper-437 discloses a method by which a CMTS requests and receives specific noise signal power measurements

from cable modems in its network. Ex. 1116, Abstract, 1:62-65, 3:47-50, Fig. 1. For example, Cooper-437 describes a CMTS initiating noise signal power measurements by transmitting to cable modems in the network a message that defines the measurement techniques to be used and how to report the measurements. Ex. 1116, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1.

86. Cooper-437 further discloses that, after a cable modem receives the message, the cable modem performs the noise signal power measurements specified in the message, and then sends a report of the measurements (which may be provided as raw measured data) to the CMTS. Ex. 1116, 10:56-11:28, Table 1.

H. Pai

87. Pai (Ex. 1120) is a U.S. Published Application published March 11, 2010. Pai is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2.

88. Pai shows that it was known for CMTSs to include a processor and a network interface to control operations of the CMTS and to communicate with other network devices. Ex. 1120, ¶¶179-181, Fig. 6.

89. Pai discloses methods for managing traffic flow for transport over a plurality of communication channels of a hybrid fiber/coaxial (“HFC”) cable network that may be implemented by a CMTS. Ex. 1120, Abstract, ¶¶28-31. The CMTS in Pai includes a CPU 62 having one or more processors 63 that may receive

data, such as programming instructions, from memory 61. Ex. 1120, ¶¶179-180. The CMTS also includes interfaces 68 that control the sending and receiving of data packets over the network. Ex. 1120, ¶181. Interfaces 68 may be implemented with Ethernet interfaces, DSL interfaces, or similar interfaces. Ex. 1120, ¶181.

I. Currivan

90. Currivan (Ex. 1128) is a U.S. Patent Application Publication published May 5, 2005. Currivan is prior art under pre-AIA U.S.C. § 102(b) and was considered, but not applied, during prosecution. Ex. 1101, 1-2.

91. Currivan discloses a cable modem system that includes a CMTS configured to segregate cable modems into groups and select physical layer communication parameters for each group. Ex. 1128, ¶¶17, 26. The physical layer communication parameters are determined based on an SNR metric and include transmit power for a service group, transmit power per code word, strength of forward error correction and length of preambles. Ex. 1128, ¶¶17, 26, 65-68, 156-157, Fig. 14A.

X. OPINIONS WITH RESPECT TO THE '438 PATENT

A. Prodan in View of Cooper840 Renders Claims 1-2 and 6 Obvious

1. Independent Claim 1

a. Element [1A]: “A method comprising:”

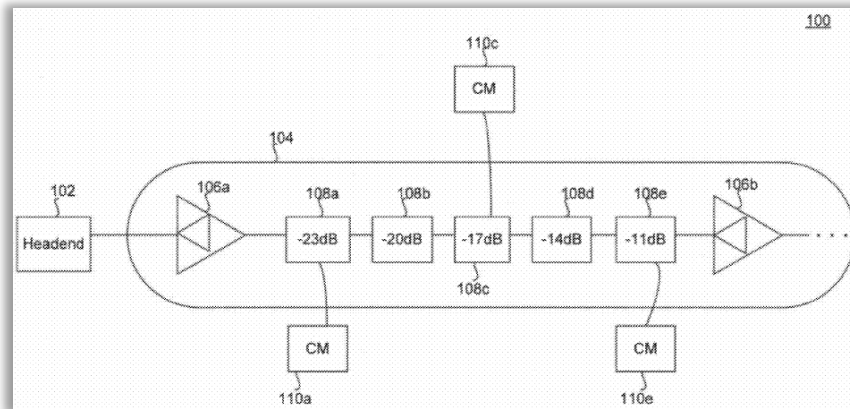
92. If the preamble [1A] limits the claim, it is my opinion that Prodan-Cooper840 teaches the claimed method for the reasons I provide below. As I

describe below, Cooper840 teaches the only feature the Examiner found missing from Prodan (*see* Ex. 1104, 105, 107-108, 128-130, 134, 153-154), and Prodan-Cooper840 renders claims 1-2 and 6 obvious.

b. Element [1B]: “determining, by a cable modem termination system (CMTS), for a plurality of cable modems served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;”

93. As shown below in Figure 1, Prodan describes a network of cable modems 110a, 110c, and 110e connected to headend 102. Ex. 1111, ¶16, Fig. 1. I note that Prodan shows headend 102 at a point of where a hybrid-fiber coaxial (HFC) network 104 that connects cable modems 110a, 110c and 110e terminates. Ex. 1111, ¶¶16-17, Fig. 6. Prodan also describes a CMTS (the claimed “cable modem termination system”) as being positioned between the headend 102 and the CMs. Ex. 1111, ¶¶32, 43-44, claim 4. In my opinion, a POSITA would have understood Prodan as disclosing a CMTS located between headend 102 and HFC network 104, as the name CMTS suggests. The CMTS in Prodan performs various processes. Ex. 1111, ¶¶32, 48, Fig 6. It is my opinion that a POSITA would have understood that the CMTS in Prodan includes hardware and accompanying software for performing the disclosed processes. This opinion is consistent with the CMTSs that existed at the time of the invention. Ex. 1130, ¶¶21, 40, Fig 2.; Ex. 1120, ¶¶179, 182; Ex. 1131, ¶150, Fig. 6. Therefore, it is my opinion that Prodan’s CMTS meets

the District Court’s tentative construction of “CMTS” in the CA litigation because it comprises hardware and accompanying software, with the hardware located at the point at which the CMs’ connection to a hybrid-fiber coaxial network terminates.



Ex. 1111, Fig. 1

94. In addition, Prodan discloses that the CMTS measures the signal strength versus frequency profiles of the cable modems. Ex. 1111, ¶¶25, 32, 44. Prodan explains that different measures are associated with the signal strength, including SNR. Ex. 1111, ¶32. Prodan’s signal strength versus frequency profiles, therefore, represent SNR versus frequency profiles (the claimed “signal-to-noise ratio (SNR) related metric”). Ex. 1111, ¶32, claim 5 (“The method of claim 1, wherein said signal strength versus frequency profiles represent signal-to-noise ratio (SNR) versus frequency profiles.”). Accordingly, it is my opinion that Prodan discloses that its CMTS measures the SNR for each of the cable modems connected to and in communication with its CMTS (the claimed “determining, by a [CMTS],

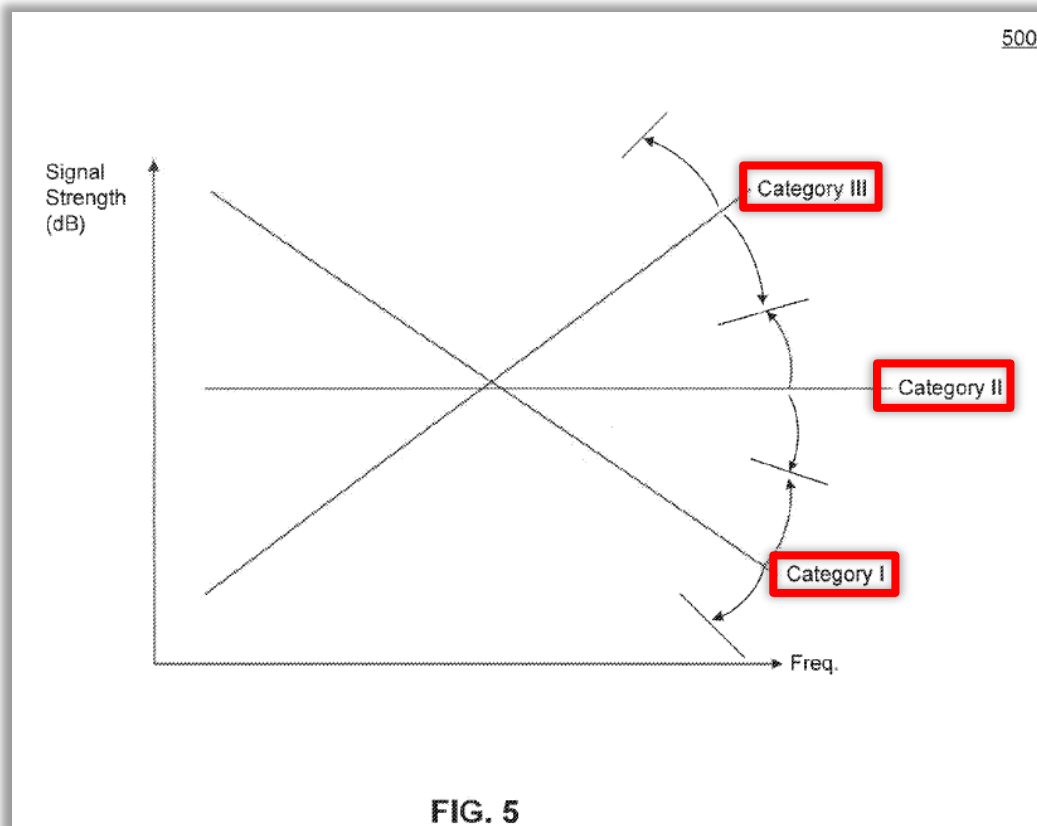
for a plurality of cable modems served by said CMTS, a corresponding plurality of [SNR] related metrics”). Prodan therefore discloses Element [1B].

95. If it is argued that Prodan does not disclose a CMTS comprising hardware and accompanying software, then it is my opinion that Cooper840 discloses this feature and a POSITA would have found it obvious to implement Prodan to include this feature. Specifically, similar to Prodan, Cooper840 discloses a network that includes a CMTS and multiple cable modems that are grouped based on SNR. Ex. 1130, ¶¶9-11, 20, 28-30, Fig. 1, Fig. 2, Fig. 5 (step S3). Cooper840 teaches that the CMTS comprises hardware and accompanying software. *Id.*, ¶¶21, 40, Fig. 2. In my opinion, a POSITA would have been motivated to implement Prodan’s CMTS with hardware and accompanying software because it would allow for efficient modification of the processes performed by the CMTS by simply modifying the software. It therefore would have been obvious to implement Prodan’s CMTS with hardware and accompanying software to allow for efficient modification of the processes performed by the CMTS. It is my further opinion that it also would have been obvious to implement Prodan’s CMTS with hardware and accompanying software, as taught by Cooper840, because implementing a CMTS with hardware and accompanying software would have simply involved choosing from a finite number of identified, predictable solutions (a CMTS implemented with

hardware, software, or hardware and accompanying software), with a reasonable expectation of success. *See, e.g.*, Ex. 1130, ¶¶21, 40.

- c. **Element [1C]: “assigning, by said CMTS, said plurality of cable modems among a plurality of service groups based on said plurality of SNR-related metrics;”**

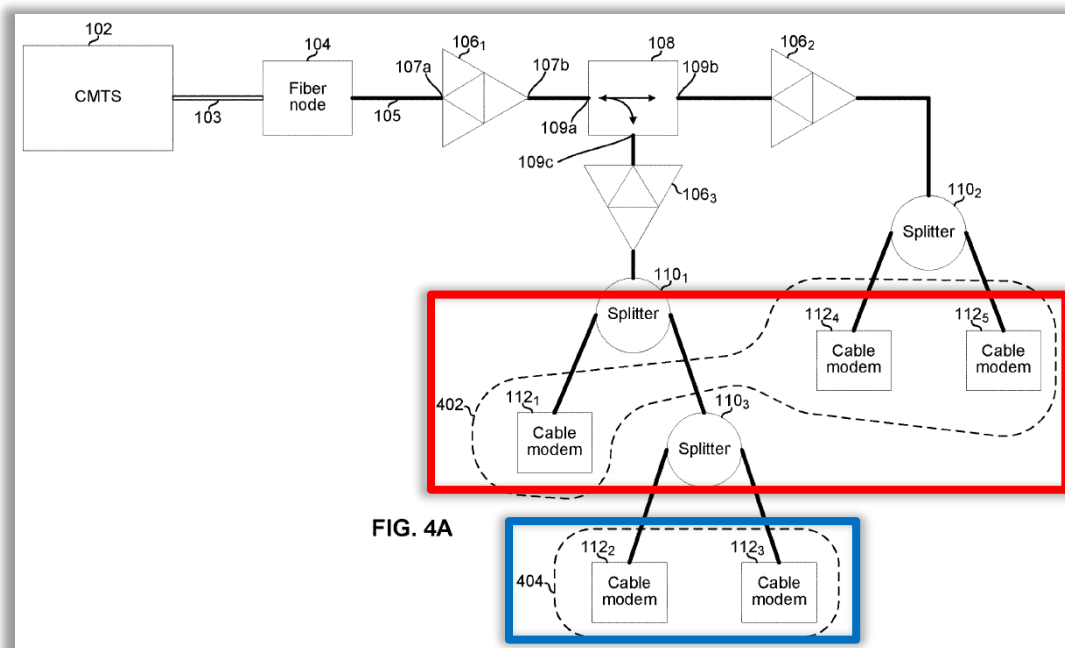
96. Prodan discloses that each of the cable modems are assigned to multiple categories based on the SNR versus frequency profile of each cable modem. Ex. 1111, ¶¶32, 34, 44-45. While Prodan does not expressly state the assignment is done by the CMTS, a POSITA would understand Prodan as disclosing that this assignment is done at either the headend or the CMTS. Specifically, as I illustrate below in Figure 5, Prodan discloses grouping the cable modems by assigning them to respective categories I, II, and III based on the slope of each respective signal strength versus frequency profile curve of the cable modems. Ex. 1111, Fig. 5.



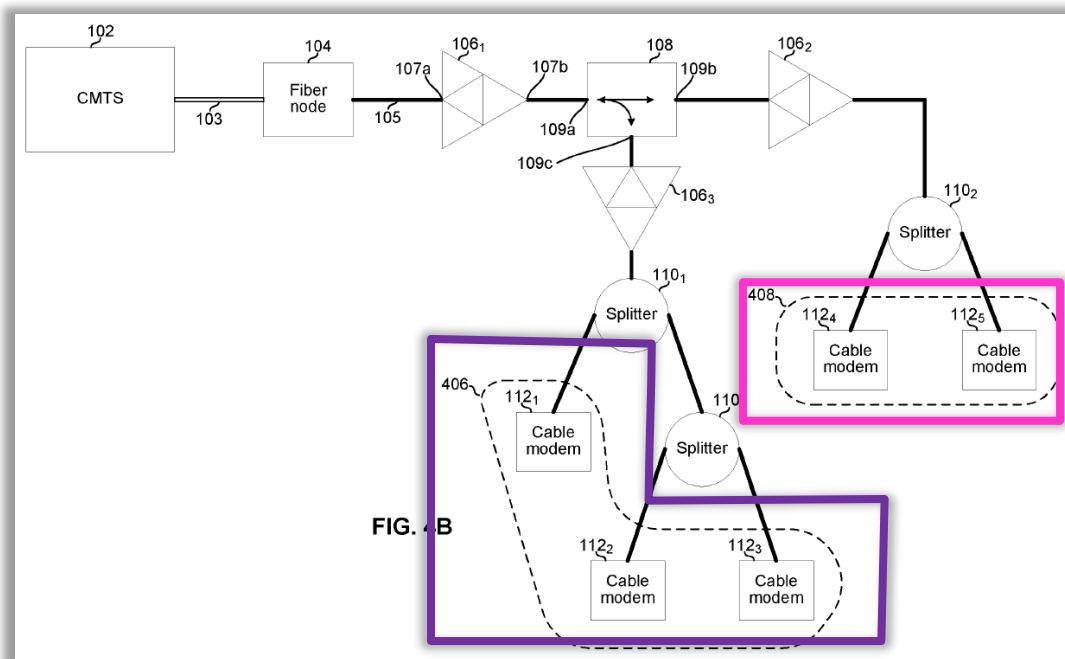
Ex. 1111, Fig. 5 (annotated)

97. According to Prodan, its process analyzes the SNR versus frequency profile measured for each of the cable modems connected to the CMTS and then assigns each of the cable modems to one of three groups (*i.e.*, Category I, II, or III) based on each respective cable modem’s SNR versus frequency profile (the claimed “assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric”). Ex. 1111, ¶34 (“the signal strength versus frequency space may be partitioned into three categories I, II, and III. Each CM is associated with one of the categories based on the tilt (or slope) of its signal strength versus frequency profile curve.”).

98. Such disclosures in Prodan for the claimed “plurality of service groups” are very similar to the ’438 patent’s disclosure for this claim term. In particular, the ’438 patent discloses “service groups” as groupings that arise from some shared characteristic between the cable modems of a respective group. For example, the ’438 patent illustrates service groups in Figures 4A and 4B in which the groupings are based on performance characteristics measured for the cable modems or their location in the cable network. Ex. 1101, 2:22-25, 5:35-37 (assigning cable modems to service groups based on SNR profile), 6:19-21 (assigning cable modems to service groups based on their location), 6:40-7:20 (generally discussing assigning cable modems to service groups), Figs. 3A-3B, 4A-4B.



Ex. 1101, Fig. 4A (service group 402 includes cable modems 112₁, 112₄, 112₅ (**red**); service group 404 includes cable modems 112₂, 112₃ (**blue**)) (annotated)



Ex. 1101, Fig. 4B (service group 406 includes cable modems 112₁, 112₂, 112₃ (**purple**); service group 408 includes cable modems 112₄, 112₅ (**pink**)) (annotated)

99. In addition, Prodan’s disclosure of “service groups” is also consistent with the plain meaning of that term as it is used in the specification of the ’438 patent. The ’438 patent is a parent of U.S. Pat. No. 10,135,682 (the “’682 patent”), which issued from a continuation application that claims priority to the ’438 patent. Ex. 1129, 1. Similar to the ’438 patent, claim 1 of the ’682 patent includes the claim term “service groups.” Ex. 1129, 8:8. In prior litigation involving the ’682 patent, a District Court construed the claim term “service group[s]” as having its plain meaning based on the ’682 patent’s reference to grouping cable modems when using this term. Ex. 1117, 55-57 (citing the ’682 patent at 2:24-27, 6:39-41, which corresponds to identical disclosure in the ’438 patent at 2:22-25, 6:37-39); *see also*

Ex. 1118, ¶¶145 (Patent Owner’s expert explaining that the ’682 patent defines “service group” to include “groupings of cable modems”), 146 (Patent Owner’s expert explaining that “a ‘service group’ is a group or cluster of cable modems” with reference to Patent Owner’s infringement contentions), 148 (Patent Owner’s expert describing a “service group” as a “conceptual” grouping of cable modems); Ex. 1119, 6-7 (Patent Owner’s infringement contentions alleging infringement based on organizing cable modems into groups). Here, the cable modems assigned to one of Prodan’s categories constitutes a group of cable modems, and such a group is consistent with the plain meaning of “service group” as that term is used in the ’438 patent. Prodan further explains that the category information is used to make frequency allocation decisions and/or modulation scheme assignment decisions. Ex. 1111, ¶34.

100. It is therefore my opinion that the categories of cable modems that result from Prodan’s assignment of each cable modem according to its SNR-frequency profile satisfies the plain and ordinary meaning of “service group” as recited in Element [1C]. Accordingly, by assigning the cable modems to the different categories based on SNR-frequency profile, Prodan discloses “assigning, by said CMTS, said plurality of cable modems among a plurality of service groups based on said plurality of SNR-related metric.”

- d. Element [1D]: “generating, by said CMTS for each one of said plurality of service groups, a composite SNR-**

related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;”

101. Prodan-Cooper840 teaches Element [1D]. As I show above for Element [1B], Prodan discloses determining the SNR versus frequency profile of the cable modems (the claimed “determining ... a corresponding ... signal-to-noise ratio (SNR) related metric[.]”). Section X.A.1.b, *supra*; Ex. 1111, ¶¶25, 32, 44, Fig. 3. As I also show above for Element [1C], Prodan discloses that its CMTS assigns each of the cable modems into a service group category based on the respective SNR versus frequency profiles of the cable modems. Section X.A.1.c, *supra*; Ex. 1111, ¶¶34, 44. To the extent that Patent Owner argues that Prodan does not teach “generating ... *a composite SNR-related metric based at least in part on a worst-case SNR profile*,” Prodan-Cooper840 does.

102. As I describe above for Element [1B], Cooper840 describes a network that includes cable modems and a CMTS. Ex. 1130, ¶20, Fig. 1. Cooper840 further discloses a process for selecting a network element (*e.g.*, a cable modem) to evaluate a service group and control modulation parameters (*e.g.*, modulation order). Ex. 1130, ¶¶20, 28. Cooper840 teaches that cable modems are sorted based on SNR. Ex. 1130, ¶¶9-11, 29-30, Fig. 5 (step S3). According to Cooper840, “[i]deally, we want to set the modulation profile as a function of the lowest MER in the network element pool” when describing the MER embodiment. Ex. 1130, ¶31. Cooper840

teaches that cable modems can be grouped by either modulation error ratio (MER) or SNR. Ex. 1130, ¶¶9-11, 20, 28-30, Fig. 5 (element S3). Modulation error ratio is a measurement that considers noise and distortion effects and indicates signal quality. Ex 1130, ¶4. Modulation error ratio and SNR are both ratios that consider noise and indicate signal quality and in my opinion are each independently an SNR related metric. Ex. 1130, ¶4. Cooper840 further teaches that the modulation parameters include modulation order. Ex. 1130, ¶¶6, 28, 32. I note that what Cooper840 refers to as a “modulation type” corresponds to what the ’438 patent refers to as “modulation order”. *See* Ex. 1130, ¶6. It is my opinion that a POSITA would have understood from Cooper840 that setting the modulation profile as a function of the lowest MER or SNR is ideal because such a setting ensures that all of the network elements can pass data on the channel, *i.e.*, no cable modem in a group has an SNR too low for the modulation order selected for that group. Ex. 1130, ¶¶5-6, 31-32.

103. Cooper840 thus teaches a POSITA to determine the lowest SNR or MER for cable modems in a service group (the claimed “composite SNR-related metric based on a worst-case SNR profile ...”) and to use that to select modulation parameters (such as modulation order) for the service group. In my opinion, a POSITA would have been motivated to apply this teaching to the process used by Prodan’s CMTS to assign each CM into different categories, thus ensuring that all

of the cable modems can pass data on the channel. Ex. 1130, ¶¶5-6, 32. This is consistent with and supportive of Prodan's teaching that its CMTS may optimize modulation schemes, which would include a modulation order, according to a "minimum required SNR." Ex. 1111, ¶47 (emphasis added); *see also id.*, ¶¶28, 34, 39, Fig. 5 (illustrating that each cable modem service group category has a corresponding lower bound, i.e., the claimed "worst-case SNR profile"); Ex. 1113, ¶51.

104. Prodan further describes that the process of its CMTS grouping cable modems into service group categories "address[es] the problem of allocation of frequency bands to [cable modems] in a cable network as an optimization problem having known fixed constraints (e.g., maximum cable modem transmit power, minimum required signal strength at headend, etc.) and an objective function (e.g., overall power utilization in the network, variance in signal strength among CMs at the headend, etc.) to minimize/maximize." Ex. 1111, ¶29. According to Prodan, its process "makes optimizing frequency allocation more tractable as an optimization problem and more manageable by a flow scheduler." Ex. 1111, ¶34.

105. Applying Cooper840's teachings as set forth above furthers these goals of Prodan. Specifically, it is my opinion that a POSITA, aware of Cooper840's teachings of determining the lowest MER or SNR of a cable modem in a service group in order to select modulation parameters for the service group, would have

appreciated that configuring Prodan's modulation schemes based on the worst-case SNR determined for each of the cable modem service group categories would have furthered Prodan's goals of optimizing "one or more performance parameters (e.g., power utilization, SNR levels, transmit powers, throughput network load, etc.)" in a cable modem network. Ex. 1111, ¶¶28, 39, 47.

106. Further, it is my opinion that a POSITA would have recognized that applying Cooper840's teachings to Prodan would have been nothing more than the combination of prior art elements according to known methods to yield predictable results. The prior art elements include Prodan's CMTS that applies frequency allocation and modulation order parameters to cable modems that are grouped based on their SNR characteristics, and Cooper840's teaching of determining the lowest MER or SNR of a cable modem in a service group to select modulation parameters for the service group. The known methods include programming a CMTS. The predictable results include a CMTS that generates a worst-case SNR metric for a cable modem service group that is based on the measured individual SNRs of the cable modems in that group.

107. The proposed combination also represents the application of a known technique to a known system ready for improvement to yield predictable results. The known technique includes Cooper840's use of the lowest SNR of a cable modem in a service group to select modulation parameters for the service group.

The known system comprises Prodan's system that that applies frequency allocation and modulation order parameters to cable modems that are grouped based on a comparison of their SNR characteristics. The predictable results include an improved system that furthers Prodan's goals of optimizing "one or more performance parameters (e.g., power utilization, SNR levels, transmit powers, throughput network load, etc.)" in a cable modem network and ensures that each CM in a service group can pass data. Moreover, Prodan's modified CMTS would have been improved because, as explained above, by determining the worst-case SNR measurement for a cable modem service group category, Prodan's modified CMTS would have been able to select a modulation scheme that was sufficiently tolerant of all SNRs measured for the cable modems in the category. In my opinion, applying Cooper840's teachings to Prodan's CMTS would have been well within the capabilities of a POSITA because it would have involved only straightforward modifications to the programming of Prodan's CMTS. Ex. 1111, ¶47.

108. Prodan-Cooper840's CMTS therefore teaches the claimed "generating ... for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups." The use by Prodan-Cooper840 of the lowest SNR or MER within a cable modem group to select the physical layer parameters for that group is a "composite" SNR-related metric

because it is applied to all of the cable modems within a service group. It is also my opinion that Prodan-Cooper⁸⁴⁰'s teaching of the claimed "composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics" is consistent with what the '438 patent discloses for the limitation. The '438 patent, for example, teaches that a worst-case SNR profile simply includes multiple performance metric measurements (such as SNR) for the cable modems of a particular service group. Ex. 1101, 4:7-17, Fig. 2B. In addition, the '438 patent discloses that physical layer parameters are determined based on the singular worst-case SNR for a service group. Ex. 1101, 5:4-18, 5:38-44.

109. I also understand that, in prior litigation, a District Court construed a nearly identical phrase in the claims of the '682 patent (which as I discuss above issued from a continuation that claims priority to the '438 patent) as having its plain meaning based on the '682 patent's disclosure. *See* Ex. 1117, 53-55 (citing disclosure in the '682 patent at 4:9-20, 5:7-12, 5:42-57, Fig. 2C, which corresponds to identical disclosure in the '438 patent at 4:7-17, 5:4-9, 5:40-55, Fig. 2C); *see also id.*, 54 (noting Patent Owner's position that "'composite' means that something is **for** more than one cable modem" and that a POSITA "would understand that the term 'composite SNR-related metric' **relates to** multiple cable modems") (emphasis added); Ex. 1118, ¶187 (Patent Owner's expert explaining that the '682 patent's "specification describes that examples of a 'worst-case SNR profile' is the SNR

profile related to a cable modem or group of cable modems, indicating their worst-case performance metrics” and citing the ’682 patent at 4:9-20, 5:7-12, Fig. 2C); Ex. 1119, 8-10 (Patent Owner’s infringement contentions alleging infringement of the claimed “composite SNR-related metric” based on a “worst case noise that is expected on” upstream and downstream channels).

110. It is therefore my opinion that Prodan-Cooper840 teaches Element [1D].

- e. **Element [1E]: “selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and”**

111. It is my opinion that Prodan-Cooper840 teaches Element [1E]. As I describe above for Element [1D], Cooper840’s CMTS teaches using the worst-case SNR determined for a group of carriers (subchannel) to select a network communication parameter for that carrier group. Section X.A.1.d, *supra*.

112. As I also show, Prodan’s CMTS assigns/selects a “frequency allocation scheme” and a “modulation scheme” (which a POSITA would recognize comprises a modulation order) for each service group based on the composite SNR profile. Ex. 1111, ¶¶34, 44-45 (“[A] multiplicity of modulation schemes may be determined for each CM ...”), 47, Fig. 4 (illustrating the method by which each cable modem is assigned a respective modulation scheme based on SNR versus frequency profiles

of the cable modems); Ex. 1130, ¶¶28, 32; Ex. 1113, ¶51; Section VI.A.1.d, *supra*. In my opinion, the “modulation scheme” (e.g., modulation order) and “frequency allocation scheme” parameters disclose the claimed “physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric.” See Ex. 1104, 76; Section X.A.1.d, *supra*. I noted that such teachings in Prodan (as modified by Cooper840) are similar to the ’438 patent’s disclosure for this limitation. The ’438 patent, for example, explains that “physical layer communication parameters” comprises multiple parameters, including “modulation type,” “modulation order,” “modulation parameters” and “timeslot duration.” Ex. 1101, Abstract, 4:53-64, claims 2 and 5. And during prosecution the Examiner found that Prodan’s “modulation scheme” and “frequency spectrum”/“frequency allocation scheme” parameters were “physical layer communication parameters” as described in the ’438 patent (I note that Applicant did not specifically dispute this finding). Ex. 1104, 76, 128-130. In my opinion, the Examiner’s finding is consistent with a POSITA’s understanding that Prodan’s “modulation scheme” and “frequency allocation scheme” parameters were examples of “physical layer communication parameters” as described in the ’438 patent. Ex. 1111, ¶¶34, 44-45, 47, Fig. 4.

113. In addition, while Prodan does not expressly state the selection of the modulation scheme is done by the CMTS, a POSITA would understand Prodan as

disclosing that the selection of the modulation scheme is done at either the headend or the CMTS. The modulation scheme that Prodan's CMTS assigns each cable modem thus discloses the claimed "selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups."

114. Prodan further discloses that its CMTS may automatically perform frequency allocation scheme and modulation scheme assignments. Ex. 1111, ¶¶45-46. Prodan explains that its CMTS automates frequency allocation and modulation scheme assignments "dynamically (i.e., in real time), at fixed intervals, when the network topology changes, or only once for each CM when the CM connects to the network." Ex. 1111, ¶46. Prodan thus teaches that automating the configuration of its cable modems would enable its CMTS to dynamically respond to deteriorating SNR measurements and ensure that each cable modem employed the optimal modulation scheme based on current SNR conditions. Ex. 1111, ¶46.

115. Prodan (as modified by Cooper840) therefore teaches automating the selection of the frequency allocation schemes and modulation schemes based on a worst-case SNR metric determined for a group of cable modems as part of its cable modem configuration. Specifically, Prodan-Cooper840's CMTS automatically: (i) selects the frequency allocation and modulation schemes for Prodan's cable modems after measuring the SNR versus frequency profiles for each cable modem (Ex. 1111,

Fig. 4, step 402); (ii) assigns those cable modems to service group categories based on their measured SNR versus frequency profiles (Ex. 1111, Fig. 5); and (iii) determines the worst-case SNR (as taught by Cooper840) for each cable modem service group category. Prodan-Cooper840's CMTS also automatically selects the frequency allocation scheme and modulation scheme based on the worst-case SNR determined for the cable modem service group category (the claimed "selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric"). *See* Section X.A.1.d, *supra*.

116. It is therefore my opinion that Prodan-Cooper840 teaches Element [1E].

- f. Element [1F]: "communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said selected physical layer communication parameters."**

117. As I show above for Element [1E], Prodan's CMTS (as modified by Cooper840) selects/assigns frequency allocations and a modulation scheme for each category of cable modems based on the worst-case SNR versus frequency profiles respectively determined for each of the category assignments. Section X.A.1.e, *supra*; Ex. 1111, ¶¶45-47. In my opinion, a POSITA would have understood that Prodan's modified CMTS communicates with the cable modems connected to it

using the selected frequency allocation and modulation schemes (the claimed “communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said selected physical layer communication parameters.”).

118. Specifically, Prodan’s disclosure encompasses both upstream and downstream communications. *See, e.g.*, Ex. 1111, ¶¶17-18. Prodan, therefore, teaches using the selected frequency allocation and modulation scheme for communications. Ex. 1111, ¶¶17-19, 41, 45. Prodan-Cooper840’s communications thus disclose the “communicating” step in Element [1F], which encompasses both upstream and downstream communications as I explain below.

119. Indeed, such disclosures in Prodan are similar to the ’438 patent’s disclosure for the limitation “communicating, by said CMTS...” In particular, the ’438 patent discloses that “communicating, by a CMTS” broadly encompasses both upstream and downstream communications. For example, dependent claim 5, which indirectly depends from claim 1, recites “[t]he method of claim 4, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use *for [upstream] transmission to said CMTS*, and which of said OFDM subcarriers to use *for [downstream] reception of information from said CMTS*.” Ex. 1101, claims 4-5 (emphasis added).

120. Prodan’s disclosure of “communicating, by said CMTS ...” is also consistent with the scope Patent Owner accorded to the same term in the related ’682 patent in a District Court litigation. Specifically, I understand that in prior litigation, Patent Owner asserted that the accused products satisfied a similar claim element in the ’682 patent because the accused products “communicate, via CMTSs and/or CCAPs, messages that include parameters that control the Accused Set Top Products and Accused Cable Modem Products in each of said plurality of service groups *in the applicable upstream and downstream channels*. These communications utilize the selected one or more physical layer communication parameters.” Ex. 1119, 14 (emphasis added). Thus, Patent Owner contended that the scope of the term “communicating, by said CMTS ...” in the related ’682 patent encompasses both downstream communications (*i.e.*, from the CMTS to the connected cable modems) and upstream communications (*i.e.*, from the connected cable modems and received at the CMTS). *Id.*

121. It is therefore my opinion that Prodan-Cooper840 teaches Element [1F] and renders claim 1 invalid as obvious.

2. **Dependent Claim 2: “The method of claim 1, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order,**

forward error correction (FEC) type, and FEC code rate.”

122. It is my opinion that Prodan-Cooper840 teaches dependent claim 2. As I show above for Element [1E], Prodan-Cooper840’s CMTS selects a modulation scheme, which includes a modulation order, for each cable modem service group category. Ex. 1111, ¶45, Fig. 4; *see also*, Section X.A.1.e, *supra*. A POSITA would have understood that Prodan-Cooper840’s “modulation scheme” includes the modulation order. *See* Ex. 1113, ¶51 (“Two common digital modulation schemes employed in conventional cable communication systems and based on the foregoing concepts include quadrature phase shift keying (QPSK) and different orders of quadrature amplitude modulation (QAM)”). Prodan-Cooper840’s modulation scheme thus teaches the claimed “physical layer communication parameter ...” as that term is used in the ’438 patent. Ex. 1101, 4:40-43.

3. Dependent Claim 6

- g. Element [6A]: “The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; and”**

123. As I show above, independent claim 1 is taught by Prodan-Cooper840. Section X.A.1, *supra*. Claim 6 depends from independent claim 1. Ex. 1101, claim 6.

124. As I describe above for Element [1C], Prodan assigns cable modems into at least three different service group categories based on comparing the cable modem's SNR versus frequency profile to a threshold. Ex. 1111, ¶¶34, 44, Fig. 5; Section X.A.1.c, *supra*. It is therefore my opinion that Prodan-Cooper840 teaches at least “a first service group and a second service group” and a “cable modem [with] a particular SNR versus frequency profile” as claimed. As I also describe above for Element [1D], Prodan-Cooper840 teaches generating a composite SNR profile for each cable modem service group based on the worst-case SNR profile of the service group (the claimed “first service group [having] a first composite SNR versus frequency profile, said second service group [having] a second composite SNR versus frequency profile.”). Section X.A.1.d, *supra*. Lastly, I show above for Element [1B] that Prodan discloses measuring an SNR versus frequency profile for each individual cable modem, which discloses a “third cable modem [with] a particular SNR versus frequency profile” as recited in Element [6A]. Section X.A.1.b, *supra*.

125. It is therefore my opinion that Prodan-Cooper840 teaches Element [6A].

- h. Element [6B]: “said assigning said plurality of cable modems among said plurality of service groups comprises: assigning said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second**

composite SNR versus frequency profile; and assigning said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.”

126. Element [6B] requires assigning the third cable modem to the service group whose composite SNR profile is more similar to the SNR profile of the third cable modem. A POSITA would have understood from the '438 patent that Element [6B] requires assigning the third cable modem to the service group that has a composite SNR versus frequency profile more similar to that of the third cable modem while still allowing that third modem to communicate with the CMTS as required by Element [1F]. Ex. 1101, 5:44-55, 8:2-23, 9:9-33. It is my opinion that Prodan-Cooper840 teaches Element [6B]. As I show above for Element [6A], Prodan-Cooper840 teaches at least a first and second cable modem service group having respective composite SNR versus frequency profiles. Section X.A.3.a, *supra*. Prodan-Cooper840 also teaches “a third cable modem has a particular SNR versus frequency profile.” *Id.* Prodan-Cooper840 further teaches assigning the third cable modem to a service group having a composite SNR versus frequency profile more similar to the particular SNR versus frequency profile of the third CM (as required by Element [6B]) because when a new cable modem connects to the network in Prodan, the CMTS measures its SNR versus frequency profile and assigns the new cable modem to the service group with the closest composite SNR

versus frequency profile in order to achieve Prodan's goal of optimizing network resources. Ex. 1111, ¶¶28-31, 34, 38-39, 41, 44-47, Figs. 4, 5.

127. In particular, Prodan-Cooper840 groups modems with similar SNR versus frequency profiles into service groups and selects communication parameters for each service group based on the worst case SNR-related profile of a CM in a service group so that the CMTS can communicate with each CM, as discussed for Elements [1D] and [1E]. Sections X.A.1.d-e. Thus, a POSITA would understand that because Prodan-Cooper840 groups CMs with similar SNR versus frequency profiles, Prodan-Cooper840 would also assign a third cable modem to a service group that has the most similar SNR versus frequency profile while still allowing communication with the CMTS. Indeed, under any reasonable construction, Prodan-Cooper840 teaches Element [6B]. For example, if the first service group has a worse composite SNR versus frequency profile than that of the second service group, and the third CM has an SNR versus frequency profile between the profiles of the first service group and the second service group, the third CM will be assigned to the first service group. The first service group's composite SNR is more similar to the third CM than that of the second service group.

128. Prodan-Cooper840, therefore, teaches Element [6B], and Prodan-Cooper840 renders claim 6 invalid as obvious.

B. Prodan in View of Azenkot Renders Claims 1-2 and 6 Obvious

1. Independent Claim 1

i. Elements [1A]-[1C]

129. For the reasons I describe above for independent claim 1, Prodan discloses Elements [1A]-[1C]. Sections X.A.1.a-c, *supra*. If it is argued that Prodan does not disclose a CMTS comprising hardware and accompanying software, it is my opinion that Azenkot discloses this feature and a POSITA would have found it obvious to implement Prodan to include this feature. Azenkot teaches a system that includes a CMTS and multiple cable modems that are grouped by SNR using multiple logical channels. Ex. 1131, ¶¶7, 13, 16, 40-41, 92. Azenkot teaches that the CMTS comprises hardware and accompanying software. Ex. 1131, ¶150, Fig. 6. In my opinion, a POSITA would have been motivated to implement Prodan's CMTS with hardware and accompanying software because it would allow for efficient modification of the processes performed by the CMTS by simply modifying the software. Therefore, it is my opinion that it would have been obvious to implement Prodan's CMTS with hardware and accompanying software to allow for efficient modification of the processes performed by the CMTS. It is my further opinion that it also would have been obvious to implement Prodan's CMTS with hardware and accompanying software, as taught by Azenkot, because implementing a CMTS with hardware and accompanying software would have simply involved choosing from a finite number of identified, predictable solutions (a CMTS

implemented with hardware, software, or hardware and accompanying software), with a reasonable expectation of success. *See, e.g.*, Ex. 1131, ¶150, Fig. 6.

j. Element [1D]

130. As I describe above for Element [1C], Prodan's CMTS assigns each of the cable modems into a service group category based on the respective SNR versus frequency profiles of the cable modems. Section X.A.1.c, *supra*. Prodan, however, does not explicitly disclose determining a "worst case" SNR for such groups of cable modems. In my opinion, a POSITA would have found it obvious to do so in view of the teachings in Azenkot.

131. As I describe above for Element [1B], Azenkot discloses grouping cable modems by SNR using multiple logical channels. Ex. 1131, ¶¶7, 13, 16, 40-41, 92. According to Azenkot, burst profiles used to communicate with each cable modem group are then selected such that cable modems with higher SNRs receive higher-throughput communications based on SNR. Ex. 1131, ¶¶16, 40-41, 92-94. In my opinion, a POSITA would have understood that there are trade-offs between the robustness of a burst profile and throughput. Specifically, relatively higher cable modem SNRs are required for burst profiles that support higher throughput, while more robust burst profiles that result in lower throughput are required for lower cable modem SNRs. Ex. 1131, ¶¶10, 68, 92-93, 111.

132. Azenkot further discloses setting a burst profile that all cable modems within a group must use that (i) is tailored to the throughput abilities of the modems in a group, and (ii) is based on the “least capable cable modem” in the group (thereby allowing for communications with the least capable cable modem). Ex. 1131, ¶¶1, 7, 13, 89. It is my opinion that a POSITA would have understood that the least capable cable modem described in Azenkot corresponds to the cable modem with the lowest SNR. Indeed, if, as a result of dynamic conditions, a cable modem in a group has an SNR that becomes too low for the burst profile being used with that group, the cable modem is moved to a different group, thus maintaining groupings so that the worst SNR in any group is still high enough to accommodate the burst profile being applied to that group. It is also my opinion that a POSITA would have understood that the least capable cable modem described in Azenkot corresponds to the cable modem with the lowest SNR because Azenkot is concerned with maximizing throughput—which is limited by the SNR of a cable modem. In addition, a POSITA would also have understood that Azenkot’s disclosure of setting a burst profile based on the least capable cable modem is also a disclosure of generating a value for lowest SNR for a group of cable modems (which is required to set the burst profile). Moreover, Azenkot teaches grouping by throughput capability or SNR. Ex. 1131, ¶¶2, 7. Azenkot further teaches that the burst profile

includes modulation order (QPSK, 64 QAM, 128 QAM, etc.). Ex. 1131, ¶¶13, 68, 74.

133. Azenkot therefore teaches that the CMTS should determine the lowest cable modem SNR for a group of cable modems (the claimed “composite SNR-related metric based at least in part on a worst-case SNR profile”) and to use that to select modulation parameters (*e.g.*, modulation order) for the service group. In my opinion, a POSITA would have been motivated to apply this teaching to Prodan’s selection of physical layer communication parameters (such as a frequency allocation scheme and a modulation scheme) so that optimal physical layer communication parameters can be selected for each group that allow for communications with all cable modems in the group. Prodan already discloses that its CMTS may optimize frequency allocation schemes and modulation schemes, which would include a modulation order, according to a “minimum required SNR.” Ex. 1111, ¶¶28-29, 34, 39, 47, Fig. 5; Ex. 1113, ¶51; Section X.A.1.d, *supra*.

134. It is also my opinion that such a combination would have been obvious because it would have only required the combination of prior art elements according to known methods to yield predictable results. The prior art elements include Prodan’s CMTS that applies frequency allocation and modulation parameters to cable modems that are grouped based on their SNR characteristics, and Azenkot’s teaching of determining the lowest cable modem SNR for a group of cable modems

to determine which physical layer parameters to apply to the group. The known methods include programming a CMTS. The predictable results include a CMTS that generates a worst-case SNR metric for a cable modem service group that is based on the individual SNRs of the cable modems in that group and that is used to select a frequency allocation scheme and a modulation scheme to communicate with the cable modem service group.

135. The proposed combination also represents the application of a known technique to a known system ready for improvement to yield predictable results. The known technique includes Azenkot's determination of the lowest cable modem SNR for a group of cable modems to determine which physical layer parameters to apply to the group. The known system includes Prodan's system that applies uniform modulation order parameters to cable modems that are grouped based on having similar SNRs. The predictable results include an improved system with optimal physical layer communication parameters selected that allow for communications with all cable modems in the group. Finally, Prodan already discloses that its CMTS may optimize frequency allocation schemes and modulation schemes, which would include a modulation order, according to a "minimum required SNR." Ex. 1111, ¶¶28-29, 34, 39, 47, Fig. 5; Ex. 1113, ¶51; Section VI.A.1.d, *supra*. Thus, applying Azenkot's teachings to Prodan's CMTS would

have been well within the capabilities of a POSITA as it would have involved only straightforward modifications to the programming of Prodan's CMTS.

136. Prodan-Azenkot thus teaches Element [1D].

k. Elements [1E]-[1F]

137. For reasons similar to those that I provide above for Prodan-Cooper⁸⁴⁰, Prodan-Azenkot teaches Elements [1E]-[1F]. Sections X.A.1.e-f, *supra*. Specifically, and as I discuss above, Prodan-Azenkot's CMTS would have similarly selected frequency allocation schemes and modulation schemes based on the worst-case SNR metrics determined for the groups of cable modems assigned to service group categories in order to ensure communication with all modems in the group—while also optimizing the network. Ex. 1111, ¶47; *see also* Section X.A.1.e, *supra*.

138. In addition, Prodan-Azenkot's CMTS would have communicated with the connected cable modems using the selected frequency allocation and modulation schemes. Ex. 1111, ¶¶45-47; *see also* Section X.A.1.e, *supra*. It is therefore my opinion that Prodan-Azenkot teaches Elements [1E]-[1F], and renders claim 1 obvious.

2. Dependent Claim 2

139. For reasons similar to those that I provide above for Prodan-Cooper⁸⁴⁰, it is my opinion that Prodan-Azenkot teaches dependent claim 2. Section X.A.2, *supra*. Specifically, Prodan-Azenkot's CMTS selects a modulation scheme (which

includes a modulation order) for each cable modem service group category. Ex. 1111, ¶45, Fig. 4; Ex. 1113, ¶51; *see also*, Sections X.A.2, X.B.1.b-c, *supra*. Prodan-Azenkot therefore teaches the claimed “physical layer communication parameter” as that term is used in claim 2 of the ’438 patent. Ex. 1101, 4:38-43.

3. Dependent Claim 6

I. Element [6A]

140. As I describe above, independent claim 1 is taught by Prodan-Azenkot. Section X.B.1, *supra*. Claim 6 depends from independent claim 1. Ex. 1101, claim 6.

141. As I also describe above for Element [1C], Prodan discloses assigning cable modems into at least three different service group categories based on comparing the cable modem’s SNR versus frequency profile to a threshold. Ex. 1111, ¶44, Fig. 5; Sections X.A.1.c and X.B.1.a, *supra*. Prodan, therefore, teaches at least “a first service group and a second service group” and a “third cable modem [with] a particular SNR versus frequency profile” as claimed.

142. In addition, as I show above for Element [1D], Prodan-Azenkot teaches generating a composite SNR profile for each cable modem service group based on the worst-case SNR profile of the service group (the claimed “first service group [having] a first composite SNR versus frequency profile, said second service group

[having] a second composite SNR versus frequency profile.”). *See* Section X.B.1.b, *supra*. It is therefore my opinion that Prodan-Azenkot teaches Element [6A].

m. Element [6B]

143. Element [6B] requires assigning the third CM to the service group whose composite SNR profile is more similar to the SNR profile of the third CM. A POSITA would have understood from the '438 patent that Element [6B] requires assigning the third cable modem to the service group that has a composite SNR versus frequency profile more similar to that of the third cable modem while still allowing that third modem to communicate with the CMTS as required by Element [1F]. Ex. 1101, 5:44-55, 8:2-23, 9:9-33. It is my opinion that Prodan-Azenkot teaches Element [6B]. As I show above for Element [6A], Prodan-Azenkot teaches at least a first and second cable modem service group that each have their own composite SNR versus frequency profile based on the cable modem with the worst-case SNR versus frequency profile. Section X.B.3.a, *supra*. Prodan-Azenkot also teaches assigning the third cable modem to a service group having a composite SNR versus frequency profile more similar to the particular SNR versus frequency profile of the third cable modem, as required by Element [6B], because when a new cable modem connects to the network in Prodan, the CMTS measures its SNR versus frequency profile and assigns the new cable modem to the service group with the closest composite SNR versus frequency profile in order to achieve Prodan's goal

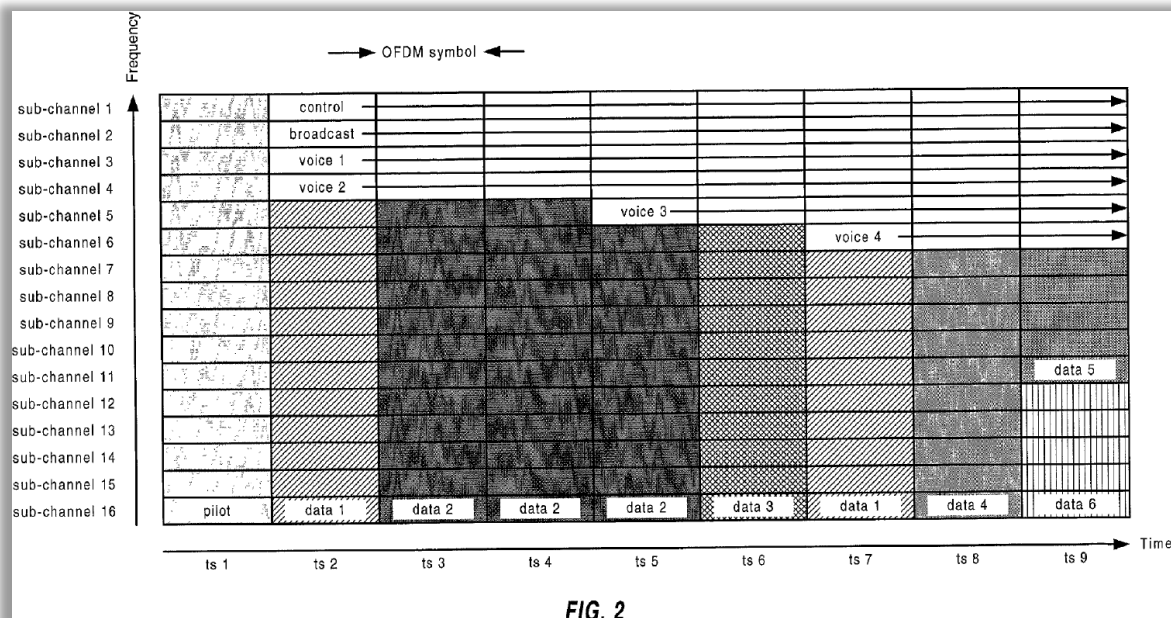
of optimizing network resources. Ex. 1111, ¶¶28-31, 34, 38-39, 41, 44-47, Figs. 4, 5.

144. In particular, Prodan-Azenkot groups modems with similar SNR versus frequency profiles into service groups and selects communication parameters for each service group based on the worst case SNR-related profile of a cable modem in a service group so that the CMTS can communicate with each cable modem, as discussed for Elements [1D] and [1E]. Sections X.A.1.d-e and X.B.1.b-c. It is therefore my opinion that a POSITA would understand that because Prodan-Azenkot groups cable modems with similar SNR versus frequency profiles, Prodan-Azenkot would also assign a third cable modem to a service group that has the most similar SNR versus frequency profile while still allowing communication with the CMTS. Indeed, it is my opinion that under any reasonable construction, Prodan-Azenkot teaches Element [6B]. For example, if the first service group has a worse composite SNR versus frequency profile than that of the second service group, and the third cable modem has an SNR versus frequency profile between the profiles of the first service group and the second service group, the third CM will be assigned to the first service group. The first service group's composite SNR is more similar to the third cable modem than that of the second service group. Accordingly, it is my opinion that Prodan-Azenkot teaches Element [6B], and renders claim 6 obvious.

C. Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali Render Dependent Claims 3-5 Obvious

1. Dependent Claim 3: “The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.”

145. As I show above, independent claim 1, from which claim 3 depends, is taught by Prodan-Cooper840 and Prodan-Azenkot. Sections X.A.1 and X.B.1, *supra*. In particular, as I discuss above for Elements [1D]-[1F], Prodan-Cooper840 and Prodan-Azenkot teach that the CMTS selects physical layer communication parameters and then, using the parameters, communicates with one or more cable modems. Sections X.A.1.d-f and X.B.1.b-c, *supra*. Although Prodan-Cooper840 and Prodan-Azenkot do not teach communicating using OFDM over a plurality of subcarriers, Jalali does as I explain below.



Ex. 1114, Fig. 2

146. Jalali describes a method of transmitting and receiving multiple types of services, such as video and voice, along multiple carriers using OFDM. Ex. 1114, Abstract, 3:1-4, 3:29-49, 5:41-6:13, 25:62-26:17, Fig. 1. Jalali's Figure 2 (reproduced above), for example, shows a diagram of a transmission channel where time is plotted on the x-axis and frequency is plotted on the y-axis (divided into 16 sub-channels). Ex. 1114, 13:49-58.

147. In addition, Jalali's Figure 2 shows data transmission that is partitioned into nine different timeslots that correspond to the duration of the OFDM modulation symbol. Ex. 1114, 13:58-63. According to Jalali, the first timeslot in this example is used for pilot data (*e.g.*, data to help synchronize with receivers and perform channel estimation), while during the other timeslots the sub-carriers transmit other various types of data. Ex. 1114, 13:64-14:13. Jalali teaches that the communication system flexibly transmits data through multiple sub-channels, which achieves both high performance and high efficiency. Ex. 1114, 14:20-60, 15:26-35.

148. Further, Jalali teaches that “[f]lexibility, performance, and efficiency are further achieved by allowing for independence among the modulation symbols ... [to] be generated from a modulation scheme (*e.g.*, M-PSK, M-QAM, and others) that results in the best use of the resource at that particular time, frequency, and space.” Ex. 1114, 15:36-42, 11:51-12:9, 17:21-34, 22:19-24, 23:54-65, 32:34-44.

According to Jalali, “each ... sub-channel may be restricted to a particular modulation scheme (*e.g.*, M-PSK, M-QAM) for the duration of the transmission or until such time as a new modulation scheme is assigned.” Ex. 1114, 15:54-61, 12:45-48. Jalali, therefore, teaches communicating data over a plurality of sub-carriers using OFDM, wherein each sub-carrier has an independently chosen modulation scheme.

149. In my opinion, a POSITA would have been motivated to combine the OFDM communication techniques taught by Jalali with the communication techniques taught by Prodan-Cooper840’s and Prodan-Azenkot’s CMTS, thus providing increased flexibility, performance, and efficiency in transmitting multiple types of services. As I describe above for Element [1E], Prodan-Cooper840’s and Prodan-Azenkot’s CMTS assigns services groups of cable modems to channels and selects different modulation schemes for those channels based on a composite worst-case SNR. Sections X.A.1.e and X.B.1.c, *supra*. As taught by the Prodan-Cooper840 and Prodan-Azenkot combinations and by Jalali, however, there are ever increasing capacity demands put on communication networks (*e.g.*, cable networks) to transmit higher quality and reliable services in expanding frequency spectrums. Ex. 1111, ¶¶5-7; Ex. 1114, 2:49-52. To address such issues, Jalali’s OFDM communication technique allows an increase in capacity by dividing the available bandwidth into subcarriers, while still selecting similar modulation schemes (*e.g.*,

QAM) for each subcarrier. Ex. 1114, 3:1-19. Utilizing OFDM, therefore, would allow Prodan-Cooper840's and Prodan-Azenkot's CMTS to communicate with CMs more efficiently and reliably using selected modulation schemes for each subcarrier.

150. It is also my opinion that such combinations would have been obvious because they would have been nothing more than application of a known technique to a known system ready for improvement to yield predictable results. The known technique includes Jalali's OFDM method. The known system comprises Prodan-Cooper840's and Prodan-Azenkot's CMTS and CM system. The predictable results include a CMTS that uses OFDM to communicate over a plurality of subcarriers that also use different modulation schemes.

151. Additionally, it is my opinion that combining Jalali's teachings with Prodan-Cooper840's and Prodan-Azenkot's CMTS would have been well within the capabilities of a POSITA and would have only required straightforward modifications to the programming of the CMTS. Moreover, a POSITA would have had a reasonable expectation of success in these programming modifications because OFDM methods, such as the one in Jalali, were widely used and would have been routine to implement in a CMTS, including the CMTS in Prodan-Cooper840's and Prodan-Azenkot's CMTS. Ex. 1111, ¶¶32, 44, 48; Ex. 1114, 33:44-49. It is therefore my opinion that, as modified by Jalali, Prodan-Cooper840's and Prodan-

Azenkot's CMTS teaches the claimed use of "[OFDM] over a plurality of subcarriers for said communicating."

152. Dependent claim 3 is therefore invalid as obvious over Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali.

2. Dependent Claim 4: "The method of claim 3, comprising selecting, by said CMTS, said physical layer communication parameters on a per-OFDM-subcarrier basis."

153. Dependent claim 3, from which claim 4 depends, is taught by Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali. Section X.C.1, *supra*. As I describe above for Element [1E], Prodan-Cooper840's and Prodan-Azenkot's CMTS selects physical layer communication parameters for different service groups. Sections X.A.1.e, X.B.1.c, X.C.1, *supra*. This selection process by Prodan-Cooper840's and Prodan-Azenkot's CMTS happens on a per-OFDM-subcarrier basis. Section X.C.1, *supra*.

154. As I described above for dependent claim 3, Prodan-Cooper840-Jalali's and Prodan-Azenkot-Jalali's CMTS uses OFDM where each sub-carrier has a particular modification scheme, such as M-PSK or M-QAM. Sections X.C.1, *supra*. According to Jalali, this improves "[f]lexibility, performance, and efficiency ...". Ex. 1114, 15:36-38.

155. Jalali also provides an example in which "each modulation symbol may be generated from a modulation scheme (*e.g.*, M-PSK, M-QAM, and others) that

results in the best use of the resource at that particular time, frequency, and space.” Ex. 1114, 15:36-42. Jalali further discloses encoding that includes error correction coding performed on a per channel or a partial channel basis. *Id.*, 16:35-58. In my opinion, a POSITA would have been motivated to further configure Prodan-Cooper840-Jalali’s and Prodan-Azenkot-Jalali’s CMTS to select physical layer communication parameters on a per-OFDM-subcarrier basis to optimize the best use of the resource at that particular time, frequency, and space as Jalali teaches doing on a per channel basis in order to make best use of the resource at that particular time, frequency, and space.

156. It is also my opinion that such combinations would have been obvious because they would have been nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Prodan-Cooper840-Jalali’s and Prodan-Azenkot-Jalali’s CMTS and Jalali’s method of assigning communication parameters on a per channel basis.

157. The known methods include programming a CMTS. The predictable results include a CMTS that uses OFDM to communicate over a plurality of subcarriers and selects physical layer communications parameters on a per-OFDM-subcarrier basis to optimize the best use of the resource at that particular time, frequency, and space.

158. In my opinion, combining the further teachings of Jalali with the CMTS of Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the CMTS. Moreover, a POSITA would have had a reasonable expectation of success in these programming modifications as Jalali's method is implemented with basic electronic circuits, and a POSITA would recognize such circuits would be included in Prodan-Cooper840-Jalali's and Prodan-Azenkot-Jalali's CMTS. Ex. 1111, ¶¶32, 44, 48; Ex. 1114, 33:44-49.

159. It is therefore my opinion that claim 4 is invalid as obvious over Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali.

3. Dependent Claim 5: “The method of claim 4, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.”

160. Claim 5 depends from dependent claim 4. Dependent claim 5 is taught by Prodan in view of Cooper840 and Jalali, and Prodan in view of Azenkot and Jalali. As I discuss above, Prodan-Cooper840-Jalali's and Prodan-Azenkot-Jalali's CMTS selects “physical layer communication parameters” on a per-OFDM-subcarrier basis based on a composite SNR-related metric. Section X.C.2, *supra*.

161. Prodan also teaches the use of DOCSIS modems, which transmit and receive in different, designated frequency bands, that determine which frequencies

of OFDM subcarriers are used for communication between equipment. Ex. 1111, ¶19; Ex. 1121, 17-19 (Figure 0-2 indicating different frequencies for transmitting and receiving at the headend), 23 (Section 2.2.1 describing a frequency plan for downstream and upstream signals), 24 (Table 0-1 indicating frequencies for downstream transmissions), 25 (Table 0-2 indicating frequencies for upstream transmissions); Ex. 1122, 15 (DOCSIS 1.1 standard), 18 (Figure 1-2), 21 (frequency plan), 22-23 (Table 2-1 indicating frequencies for downstream transmissions), 24 (Table 2-2 indicating frequencies for upstream transmissions); Ex. 1123, 19 (DOCSIS 2.0 standard), 21 (Figure 1-2), 43 (frequency plan), 45 (Table 4-1 indicating frequencies for downstream transmissions and Table 4-2 indicating frequencies for upstream transmissions). As I also discuss above for Element [1F], Prodan also acknowledges different requirements in addition to the different frequency bands used in upstream versus downstream communications. Section X.A.1.f, *supra*; Ex. 1111, ¶¶5, 17-19, 23.

162. Given that Prodan discloses using different frequency bands for upstream and downstream communication, Prodan-Cooper840-Jalali's and Prodan-Azenkot-Jalali's CMTS teaches selecting separate upstream and downstream "physical layer communication parameters" on a per-OFDM-subcarrier basis based on specific frequency bands and a composite upstream or downstream SNR-related metric. Prodan-Cooper840-Jalali's and Prodan-Azenkot-Jalali's CMTS, therefore,

teaches “physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS,” as claimed.

163. It is therefore my opinion that dependent claim 5 is invalid as obvious over Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali.

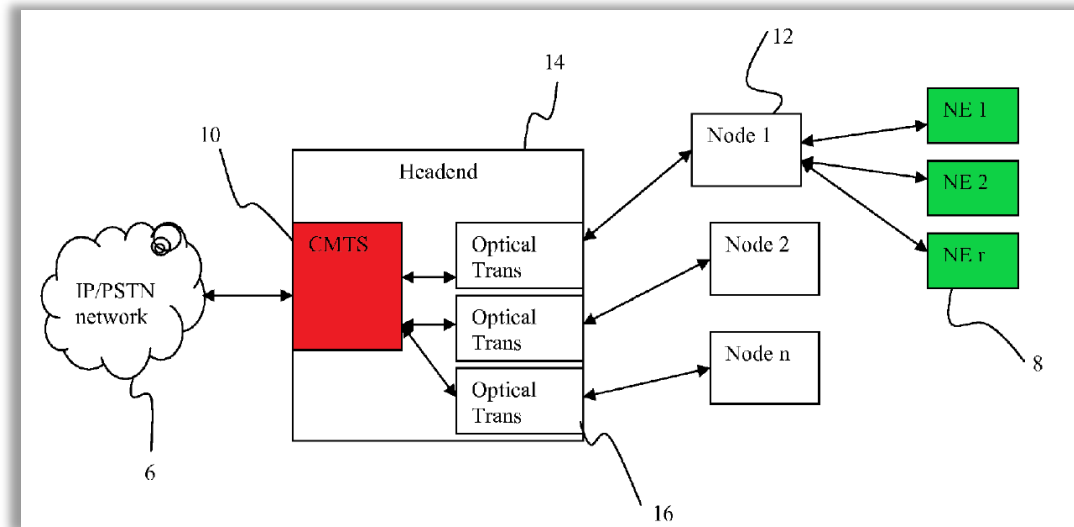
D. Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper Render Dependent Claims 7-8 Obvious

1. Dependent Claims 7-8

164. Independent claim 1 is taught by Prodan-Cooper840 and Prodan-Azenkot. Sections X.A.1 and X.B.1, *supra*. Claims 7-8 depend from independent claim 1 and require assigning cable modems to one of a plurality of service groups “based on distances between said CMTS and said plurality of cable modems” (claim 7), or “based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems” (claim 8). Ex. 1101, 8:60-67.

165. As I discuss above for Element [1C], Prodan’s process analyzes the SNR versus frequency profile measured for each of the cable modems connected to the CMTS and then assigns each of the cable modems to a service group based on each respective cable modem’s SNR versus frequency profile. Section X.A.1.c, *supra*. While Prodan acknowledges that the SNR profile of each cable modem is impacted by its location in a cable network (*e.g.*, distance from an amplifier), Prodan does not teach assigning each cable modem to a group based on its location in the

network (e.g., its distance from the CMTS or from an upstream amplifier). Ex. 1111, ¶27. Cooper, however, does.

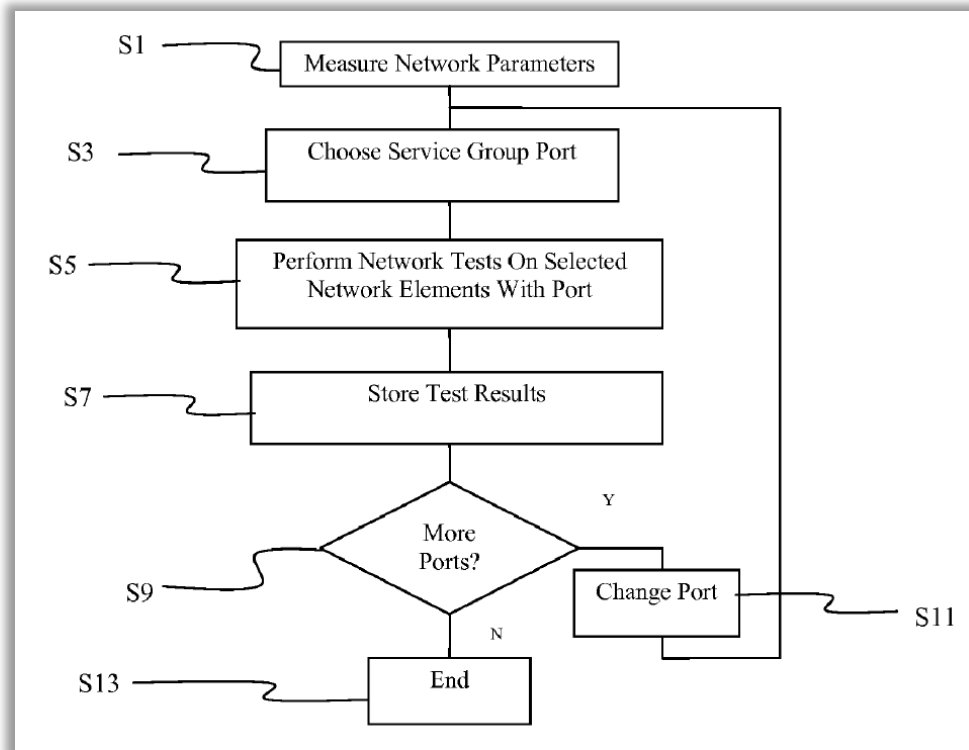


Ex. 1105, Fig. 1 (annotated)

166. Cooper discloses a network in which multiple network elements 8 (green), which include cable modems connected to CMTS 10 (red) via nodes 12. Ex. 1105, ¶22, Fig. 1. This is illustrated above in an annotated version of Figure 1 from Cooper. Cooper describes that CMTS 10 resides at headend 14, and that the headend includes transceivers that communicate with the network elements by receiving upstream communications from the network elements and sending (*i.e.*, serving) downstream communications to the network elements. *Id.*, ¶¶3, 22-25.

167. Cooper teaches optimizing network communications based on certain network parameter measurements, which can be performed at the CMTS or each cable modem. Ex. 1105, ¶¶8, 11. Referring to Figure 4 (reproduced below), Cooper

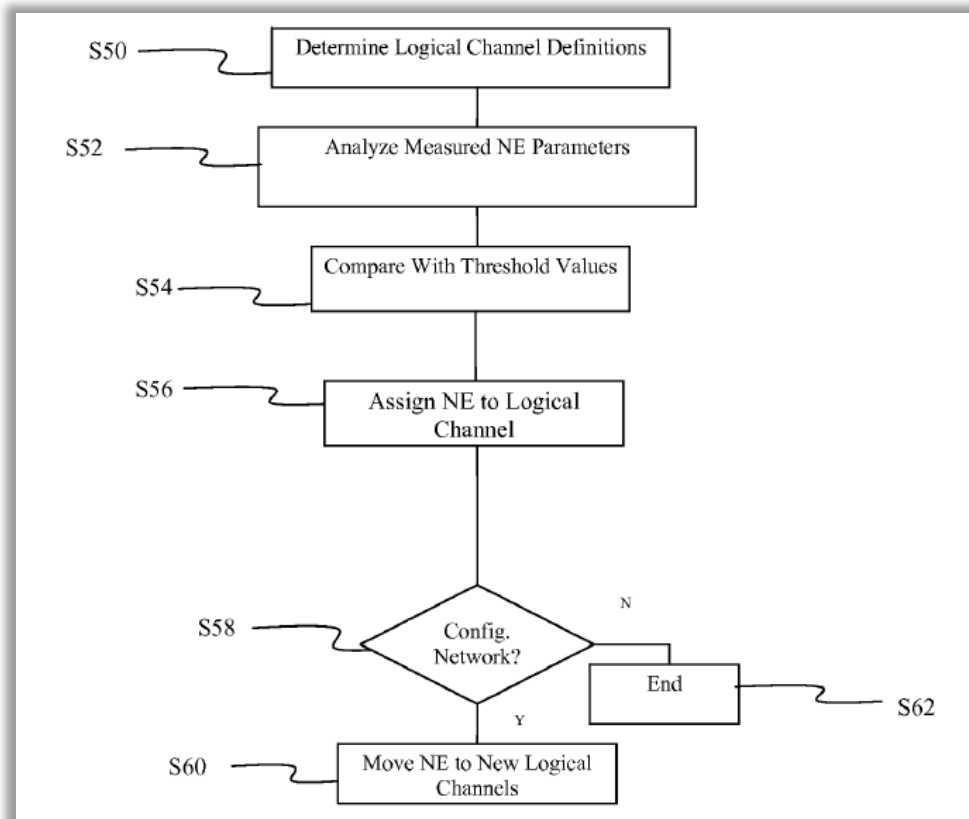
describes the CMTS initiating the measurement process (S1), which begins by choosing a “service group port” (e.g., a transceiver at the headend) (S3), and performing tests on the selected port (S5). Ex. 1105, ¶¶16, 22-23, 26-27, 29, Fig. 4. Cooper teaches that such testing involves the CMTS determining network parameters of the cable modems connected to the selected port. Ex. 1105, ¶¶26-28. In particular, such testing includes determining “upstream or downstream signal to noise ratio (SNR).” Ex. 1105, ¶¶7, 27.



Ex. 1105, Fig. 4

168. After the SNR of the cable modems is determined, Cooper teaches that its CMTS assigns them to logical channels based on a comparison with SNR thresholds, with the goal of increasing overall network through-put by optimizing

physical layer configuration parameters to each cable modem grouping. Ex. 1105, ¶¶2, 6-10, 19, 26-27, 30-33, 39-40, 43. Specifically, referring to Figure 5 (reproduced below), Cooper teaches analyzing the parameters measured for each cable modem and then assigning them to logical channels based on a comparison between their measured parameters and respective thresholds (which are predetermined or dynamically determined). Ex. 1105, ¶¶8, 30, Fig. 5.



Ex. 1105, Fig. 5 (annotated)

169. Cooper also discloses that, in addition to assigning cable modems to service groups based on SNR, a CMTS assigns network elements to service groups based on the additional factor of the location of cable modems in a cable network.

Ex. 1105, Abstract, ¶¶8, 21, 27-28, 37. In addition, Cooper teaches assigning a network element to a service group based at least in part on amplifier cascade depth. *Id.* According to Cooper, such a system enables a network operator to optimize the performance of the network by assigning network elements to groups cheaply and quickly at a central location. Ex. 1105, ¶43. In my opinion, a POSITA would have recognized that these various options of grouping cable modems among service groups according to (or at least in part according to) the location of the network elements in a cable network or according to amplifier cascade depth allows the identification and isolation of geographic areas in the network that are problematic and/or the identification and isolation of problematic network elements, which would support proactive maintenance activities. Ex. 1105, ¶19. It is therefore my opinion that it would have been obvious to modify Prodan-Cooper840's and Prodan-Azenkot's CMTS to also assign cable modems to service groups based (at least in part) on the location of cable modems in a cable network or amplifier cascade depth to allow for more proactive maintenance of the network. *Id.*

170. More specifically, it would have been obvious to configure Prodan-Cooper840's and Prodan-Azenkot's CMTS to determine the location of cable modems in a cable network, and then assign the cable modems among a plurality of service groups based at least in part on such a location in order to quickly identify and isolate problematic geographic regions in the network or network elements for

maintenance (thus meeting claim 7's requirement of "assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems"). In addition, it would have been obvious to configure Prodan-Cooper840's and Prodan-Azenkot's CMTS to also assign a cable modem to one of a plurality of service groups based at least in part on amplifier cascade depth also in order to quickly identify and isolate problematic geographic regions in the network or network elements for maintenance (thus meeting claim 8's requirement of "assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems").

171. It is my further opinion that such modifications also would have been obvious because they would have only required the combination of prior art elements according to known methods to yield predictable results. The prior art elements include Prodan-Cooper840's and Prodan-Azenkot's CMTS and cable modems as well as Cooper's methods of assigning cable modems to service groups based on each cable modems location in a cable network or cascade depth. The known methods include programming of a CMTS. The predictable results include a CMTS that is better able to identify and isolate problematic areas in the network or network elements. In my opinion, applying such teachings in Cooper to Prodan-Cooper840's

and Prodan-Azenkot's CMTS would have been well within the capabilities of a POSITA and would have involved straightforward modifications to the programming of Prodan-Cooper840's and Prodan-Azenkot's CMTS.

172. It is therefore my opinion that dependent claims 7-8 are invalid as obvious over Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper.

E. Prodan-Cooper840-Monk-Cooper-437 and Prodan-Azenkot-Monk-Cooper-437 Render Claim 9 Obvious

173. As I show above, independent claim 1 is taught by Prodan-Cooper840 and Prodan-Azenkot. Sections X.A.1 and X.B.1, *supra*. Claim 9 depends from independent claim 1. Ex. 1101, claim 9.

174. As I describe above for Element [1B], Prodan-Cooper840 and Prodan-Azenkot teach determining an SNR-related metric for each cable modem served by the CMTS based on a measurement at the CMTS. Section X.A.1.b and X.B.1.a, *supra*. While these combinations do not teach a probe message that initiates the measurement of the SNR-related metric at the cable modems or that includes instructions for measuring a metric and reporting said measured metric back to the CMTS (as required by claim 9), such a probe message is taught by Monk and Cooper-437.

175. Prodan describes a cable system that transmits data via upstream and downstream channels. Ex. 1111, ¶¶17-18, 23, 56; *see* Section X.A.1.f, *supra*. According to Prodan, in an upstream embodiment, the cable modem transmits a test

signal to the CMTS, and the CMTS measures the SNR of the cable modem in order to assign a modulation scheme to the cable modem. Ex. 1111, ¶¶32-34. Prodan does not expressly mention a downstream embodiment. However, Prodan teaches using a variety of algorithms to make modulation scheme assignments. Ex. 1111, ¶47.

176. Monk teaches a method of communication that relies on different modulation schemes based on the SNR of a communication channel. Ex. 1115, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. Monk discloses that higher SNR channels can support higher modulation orders through bit loading (e.g., 16-QAM/64-QAM/256-QAM), while lower SNR channels may use a different modulation scheme such as QPSK. Ex. 1115, 4:55-59, 8:1-10, 9:9-11, 10:58-62.

177. According to Monk, to determine the SNR of a channel, a sending node transmits a probe message having a predetermined data sequence to a receiving device, and the receiving device analyzes the probe message for impairment. Ex. 1115, Abstract, 4:44-59, 9:28-41. Monk discloses that the receiving device sends the results of the analysis back to the sending device as either raw data or a bit loading profile for the sending device to determine the transmission parameters. *Id.*, 9:41-50. Monk also teaches that for non-symmetrical channels, such as those described in Prodan, a sending node transmits a probe message to a receiving device, and the receiving device analyzes the probe message and sends the results of the analysis back to the sending device to characterize the communication channel and

determine the transmission parameters. Ex. 1115, Abstract, 4:44-59, 9:28-50. It is therefore my opinion that a POSITA would have found it obvious to implement the CMTS of Prodan-Cooper840 and Prodan-Azenkot (which measures SNR of CMs) so that it sends a probe message to the cable modems (the claimed “transmitting a probe message to each said plurality of cable modems”) in order to implement the measurement and reporting by the cable modem of the downstream channel’s SNR to further the goal of characterizing the communication channel (as taught by Monk and Prodan). Ex. 1115, Abstract. In my opinion, a POSITA would further have found it obvious to send probe messages to the cable modems to distribute processing requirements for measuring among the cable modems, thus limiting processing required by the CMTS.

178. It is my further opinion that incorporating Monk’s probe messages and reporting messages into Prodan-Cooper840 and Prodan-Azenkot also would have been obvious because such an implementation would be nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include the CMTS of Prodan-Cooper840 and Prodan-Azenkot that measures SNR and the probe messages and reporting messages of Monk used to measure SNR. The known methods include programming the CMTS to send probe messages and receive reporting messages that provide an analysis of

a downstream channel's SNR. The predictable results include a system that uses probe messages and reporting messages to determine a downstream channel's SNR.

179. In my opinion, applying Monk's teachings to the CMTS of Prodan-Cooper840 and Prodan-Azenkot would have been well within the capabilities of a POSITA as it would have only required straightforward modifications to the programming of the CMTS. Thus, a POSITA would have had a reasonable expectation of success applying Monk's teachings to Prodan-Cooper840's and Prodan-Azenkot's CMTS.

180. Although Prodan-Cooper840-Monk and Prodan-Azenkot-Monk teach a probe message, the combinations do not teach a probe message that includes instructions for measuring a metric and reporting said measured metric back to the CMTS. However, Cooper-437 does. Cooper-437 describes a method for a CMTS to ask for and receive specific noise signal power measurements from cable modems in its network. Ex. 1116, Abstract, 1:62-65, 3:47-50, Fig. 1. Cooper-437's CMTS initiates these measurements by transmitting to cable modems in the network a message that defines the measurement techniques to be used and how to report the measurements. *Id.*, 8:11-29, 8:60-9:5, 10:56-11:28, 11:30-60 (Table 1). Cooper-437 discloses that after receiving the probe message, a cable modem performs the specified measurements, and then sends back a report of the measurements (which may be raw measured data). *Id.*, 10:56-11:28, 11:30-60.

181. By including the measurement and reporting modes (*i.e.*, instructions) in the message, the method taught in Cooper-437 allows a CMTS to send customized probe messages to specific modems to conduct specific testing (*e.g.*, at specific frequencies or at specific noise thresholds), which can be adjusted as different noise sources connect or are active on the network. Ex. 1116, 8:9-64, 10:56-11:28, 11:30-60. In my opinion, a POSITA would have found it obvious to modify Monk's probe message (which already initiates the measurement of channel characteristics) to identify a measurement mode and reporting mode (as taught by Cooper-437) in order to allow the CMTS of Prodan-Cooper840-Monk and Prodan-Azenkot-Monk to send customized probe messages to specific cable modems or service groups to conduct specific testing to determine the SNR of specific service groups or at specific frequencies, resulting in a system that allows more robust communication between the CMTS and cable modems on the network. Ex. 1116, 8:9-64, 10:56-11:28, 11:30-60. Such a modification would allow a CMTS to more quickly identify groups of modems or frequencies that have had a change in their SNR, and would also allow more robust communication between the CMTS and cable modems on the network. Ex. 1116, 8:9-64, 10:53-11:60, Table 1.

182. It is my further opinion that modifying the probe message to identify a measurement mode (the claimed "instructions for measuring a metric") and a reporting mode (the claimed "instructions for ... reporting said measured metric")

would also have been obvious because it would have been nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Prodan-Cooper840-Monk's and Prodan-Azenkot-Monk's probe message and the measurement mode and reporting mode of Cooper-437. The known methods include modifying the contents of a probe messages. The predictable results include a CMTS that uses probe messages that include instructions for measurement and reporting of SNR-related metrics, which provides the benefits recited above.

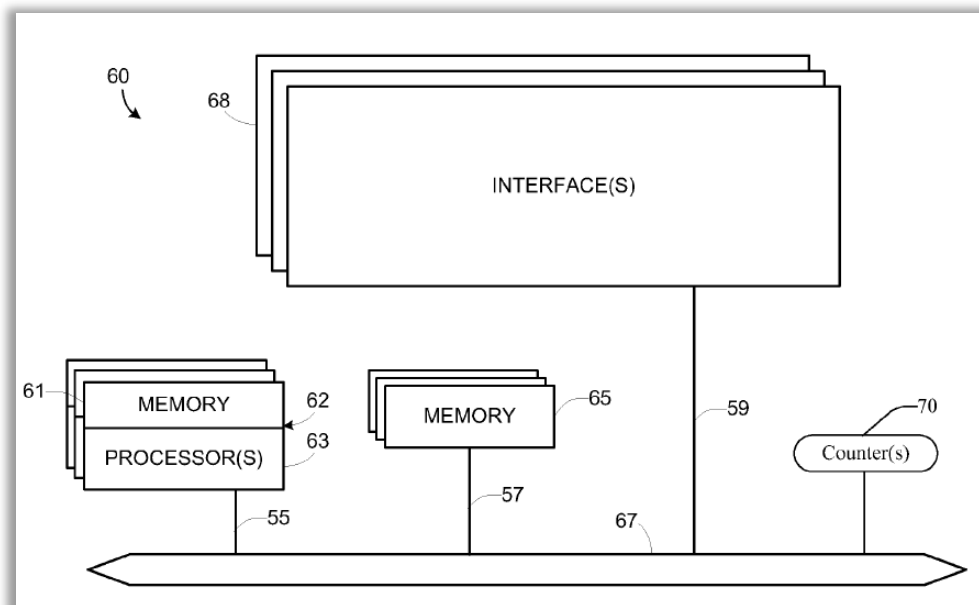
183. In addition, combining the teachings of Cooper-437 with the CMTS of Prodan-Cooper840-Monk and Prodan-Azenkot-Monk would have been well within the capabilities of a POSITA as it would have only required straightforward modifications to the programming of the CMTS. In my opinion, a POSITA would have a reasonable expectation of success in these programming modifications as Prodan-Cooper840-Monk and Prodan-Azenkot-Monk and Cooper-437 each teach using the DOCSIS standard for transfer of data over a cable system and rely on generic microprocessors or microcontrollers for execution of their methods. Ex. 1111, ¶19; Ex. 1116, 5:3-14, 7:6-22.

184. It is therefore my opinion that Prodan-Cooper840 in view of Monk and Cooper-437, as well as Prodan-Azenkot in view of Monk and Cooper-437 teach dependent claim 9.

F. Prodan-Cooper840-Pai and Prodan-Azenkot-Pai Render Claims 10-11 and 15 Obvious

- 1. Element [10A]: “A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:”**

185. Claim 10 is a system claim with limitations similar to that of method claim 1. The “network” in Prodan that I describe above in Section X.A.1.b discloses a system as it is recited in Element [10A]. Ex. 1111, ¶¶16-17, 32, Fig. 1. While Prodan broadly discloses the use of a CMTS that communicates with connected cable modems, Prodan does not explicitly disclose that the CMTS includes circuitry comprising a network interface and a processor (although a POSITA would have been well aware that a CMTS possesses a processor and interface). Pai, however, does. Ex. 1120, ¶¶179-181, Fig. 6.



Ex. 1120, Fig. 6

186. Pai shows that it was known to implement a CMTS with a processor and a network interface in order to control operations of a CMTS and to facilitate communication with other network devices. As shown above, Pai's Figure 6 illustrates that CMTS 60 comprises circuitry that includes: (i) processor(s) 63 (the claimed "circuitry ... comprising a ... processor") that implements programming instructions received from memory 61 for controlling operations of the CMTS, and (ii) interface(s) 68 (the claimed "circuitry comprising a network interface") that bidirectionally communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1120, ¶¶179-181, Fig. 6.

187. In my opinion, it would have been obvious for a POSITA to implement the CMTS of Prodan-Cooper840 and Prodan-Azenkot with the processor and network interface taught by Pai in order to control the operations of Prodan-Cooper840's and Prodan-Azenkot's CMTS and to communicate with other network devices, as taught by Pai and is required by Prodan. It is also my opinion that such combinations would have been obvious because they would have been nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Prodan-Cooper840's and Prodan-Azenkot's CMTS and the circuitry of Pai's CMTS. The predictable results include a CMTS that includes a processor for controlling operations of the CMTS and a network interface to communicate with other network devices.

188. Applying the teachings of Pai to the CMTS of Prodan-Cooper840 and Prodan-Azenkot also would have been well within the capabilities of a POSITA as it would have only required basic knowledge of hardware design and/or programming. A POSITA would have a reasonable expectation of success because Pai's method is implemented with basic electronic circuits, which a POSITA would recognize would be included in Prodan-Cooper840's and Prodan-Azenkot's CMTS. Ex. 1111, ¶¶32, 44, 48; Ex. 1120, ¶¶134, 190, 198, Figs. 2, 4, 7. It is therefore my opinion that Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach Element [10A].

2. Elements [10B]-[10F]

189. I note that Elements [10B]-[10E] are nearly identical to Elements [1B]-[1E], except Elements [10B]-[10E] recite that the "processor" in the CMTS "is configured to" perform the limitations recited in Elements [1B]-[1E].

190. Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach that processor(s) 63 in CMTS 60 is configured to perform the limitations described above in Elements [1B]-[1E]. See Sections X.A.1.b-e, and X.B.1.a-c, *supra*; Ex. 1120, ¶¶179-181. Thus, for the reasons I describe above with respect to Elements [1B]-[1E], Prodan-Cooper840-Pai's and Prodan-Azenkot-Pai's processor(s) 63 teaches and is configured to perform the limitations recited in Elements [10B]-[10E]. *Id.*

191. I note that Element [10F] is nearly identical to Element [1F], except that Element [10F] recites that the claimed "network interface" is configured to

perform the limitations recited in Element [1F]. Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach that interface(s) 68 communicates bidirectionally with network devices and control the sending and receiving of data packets over the network. Ex. 1120, ¶181, Fig. 6. Therefore, for the reasons I describe above with respect to Element [1F], Prodan-Cooper840-Pai's and Prodan-Azenkot-Pai's interface(s) 68 comprises a network interface that teaches and is configured to perform the limitations recited in Element [10F]. *Id.*; see Sections X.A.1.f and X.B.1.c, *supra*.

3. **Dependent Claim 11: “The system of claim 10, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.”**

192. As I show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. Claim 11 depends from independent claim 10, and the language of dependent claim 11 is nearly identical to the language of claim 2. Therefore, it is my opinion that Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach dependent claim 11 for the same reasons as dependent claim 2. See Sections X.A.2 and X.B.2, *supra*.

4. **Dependent Claim 15: [15A] “The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus**

frequency profile;” [15B] “said assignment of said plurality of cable modems among said plurality of service groups comprises: assignment of said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.”

193. Independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. Claim 15 depends from independent claim 10, and the language of dependent claim 15 is nearly identical to the language of dependent claim 6. It is therefore my opinion that Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach dependent claim 15 for the same reasons as dependent claim 6. *See* Sections X.A.3 and X.B.3, *supra*.

**G. Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali
Render Claims 12-14 Obvious**

- 1. Dependent Claim 12: “The system of claim 10, wherein said network interface and said plurality of cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.”**

194. As I show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. Dependent claim 12 depends from independent claim 10 and is nearly identical to dependent claim 3, except dependent claim 12 recites that the claimed “network interface” is

configured to perform the limitations recited in dependent claim 3. As I discuss above for Element [10A], Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach interface(s) 68 that communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1120, ¶¶179-181, Fig. 6; Sections X.F.1-2, *supra*.

195. As I also discuss above for dependent claim 3, applying Jalali's teachings of OFDM to Prodan-Cooper840 and Prodan-Azenkot teach the limitations of dependent claim 3. Section X.C.1, *supra*. In my opinion, Jalali's teachings are equally applicable to Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. For the same reasons I provide above in Section X.C.1, it is my opinion that a POSITA would have found it obvious and been motivated to apply Jalali's teachings regarding OFDM communication techniques to the CMTS of Prodan-Cooper840-Pai and Prodan-Azenkot-Pai.

196. It is also my opinion that a POSITA would have had a reasonable expectation of success applying the teachings of Jalali to the CMTS of Prodan-Cooper840-Pai and Prodan-Azenkot-Pai because it would have only required straightforward modifications to the programming of the CMTS's processor (which would have been well within the capabilities of a POSITA) that would then communicate through the network interface. Ex. 1120, ¶¶179-181, Fig. 6; Ex. 1114, 33:44-49. Therefore, for the reasons set forth above with respect to dependent claim

3, the Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali combinations comprise a network interface that teaches and is configured to perform the limitations recited in claim 12. *See* Sections X.C.1 and X.F.1-2, *supra*.

2. Dependent Claim 13: “The system of claim 12, wherein said network interface is configured such that said physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.”

197. As I show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. Claim 13 depends from dependent claim 12, which depends from independent claim 10.

198. I note that dependent claim 13 is nearly identical to dependent claim 4, except dependent claim 13 recites that the claimed “network interface” is configured to perform the limitations recited in dependent claim 4. As I describe in Sections X.C.2 and X.G.1, Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali teach a network interface that communicates using OFDM over a plurality of subcarriers, each of which is configurable on a per-OFDM subcarrier basis. It is therefore my opinion that Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali comprise a network interface that teaches and is configured to perform the limitations recited in dependent claim 13. *See* Sections X.C.2, X.F.1, X.G.1, *supra*.

3. Dependent Claim 14: “The system of claim 12, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said

**OFDM subcarriers to use for reception of information
from said CMTS.”**

199. As I show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. As I also show above, dependent claim 12 is taught by Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali. Section X.G.1, *supra*. Claim 14 depends from dependent claim 12, which depends from independent claim 10. I note that the language of dependent claim 14 is nearly identical to the language of dependent claim 5. It is therefore my opinion that Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali teach dependent claim 14 for the same reasons as dependent claim 5. *See* Sections X.C.3 and X.F.1-2, *supra*.

**H. Prodan-Cooper840-Pai-Cooper and Prodan-Azenkot-Pai-Cooper
Render Claims 16 and 17 Obvious**

**1. Dependent Claim 16: “The system of claim 10, wherein
said processor is configured to assign said plurality of
cable modems among said plurality of service groups
based on distances between said CMTS and said
plurality of cable modems.”**

200. As I show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. Claim 16 depends from independent claim 10 and is nearly identical to dependent claim 7, except dependent claim 16 recites that the claimed “processor” is configured to perform the limitations recited in dependent claim 7. As I discuss above for Element [10A], Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach a CMTS that includes

a processor 63 configured to implement Prodan-Cooper840's and Prodan-Azenkot's methods. Ex. 1120, ¶¶179-181, Fig. 6; Section X.F.1, *supra*. As I further discuss above for dependent claim 7, Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper teach the limitations of dependent claim 7. Section X.D.1, *supra*.

201. For the reasons I provide above in Section X.D.1, it is my opinion that a POSITA would have found it obvious and been motivated to apply Cooper's method of assigning cable modems to service groups based on geographic distances from a CMTS to Prodan-Cooper840-Pai's and Prodan-Azenkot-Pai's CMTS. Section X.D.1. As described above in Section X.D.1, such combinations would allow more proactive maintenance of the network. *Id.* It is also my opinion that a POSITA would have had a reasonable expectation of success combining the teachings of Cooper, which are performed by a microprocessor, to the CMTS of Prodan-Cooper840-Pai and Prodan-Azenkot-Pai because it would have only required straightforward modifications to the programming of the CMTS's processor, which would have been well within a POSITA's capabilities. Ex. 1120, ¶¶179-181, Fig. 6; Ex. 1105, ¶¶8, 23-24.

202. It is therefore my opinion that, for the reasons set forth above with respect to dependent claim 7, Prodan-Cooper840-Pai-Cooper and Prodan-Azenkot-Pai-Cooper comprise a processor that teaches and is configured to perform the limitations recited in dependent claim 16. *See* Sections X.D.1 and X.F.1-2, *supra*.

2. Dependent Claim 17: “The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on a branch further branch amplifier that serves each of said plurality of cable modems.”

203. As I show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. Dependent claim 17 depends from independent claim 10 and is nearly identical to dependent claim 8, except dependent claim 17 recites that the claimed “processor” is configured to perform the limitations recited in dependent claim 8.

204. As I discuss above for Element [10A], Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach a CMTS that includes a processor 63 configured to implement Prodan-Cooper840’s and Prodan-Azenkot’s methods. Ex. 1120, ¶¶179-181, Fig. 6; Section X.F.1, *supra*. As I further discuss above for dependent claim 8, Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper teach the limitations of dependent claim 8. Section X.D.1, *supra*.

205. For the same reasons I provide above in Section X.D.1, it is my opinion that a POSITA would have found it obvious and been motivated to apply Cooper’s method of assigning cable modems to service groups based on amplifier cascade depth to Prodan-Cooper840-Pai’s and Prodan-Azenkot-Pai’s CMTS. Section X.D.1. As described above in Section VI.D.1, such combinations would allow more proactive maintenance of the network. *Id.* It is also my opinion that a POSITA

would have had a reasonable expectation of success combining the teachings of Cooper, which are performed by a microprocessor, to the CMTS of Prodan-Cooper840-Pai and Prodan-Azenkot-Pai because it would have only required straightforward modifications to the programming of the CMTS's processor, which would have been well within a POSITA's capabilities. Ex. 1120, ¶¶179-181, Fig. 6; Ex. 1105, ¶¶8, 23-24.

206. It is therefore my opinion that, for the reasons set forth above with respect to dependent claim 8, Prodan-Cooper840-Pai-Cooper and Prodan-Azenkot-Pai-Cooper comprise a processor that teaches and is configured to perform the limitations recited in claim 17. Sections X.D.1 and X.F.1-2, *supra*.

I. Prodan-Cooper840-Pai-Monk-Cooper-437 and Prodan-Azenkot-Pai-Monk-Cooper-437 Render Claim 18 Obvious

207. Dependent claim 18 depends from dependent claim 10 and is nearly identical to dependent claim 9, except dependent claim 18 recites that the claimed “network interface” is configured to perform the limitations recited in dependent claim 9. As I describe above for Element [10A], Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach an interface(s) 68 that communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1120, ¶¶179-181, Fig. 6; Section X.F.1, *supra*. As I also discuss above for dependent claim 9, Prodan-Cooper840-Monk-Cooper-437 and Prodan-Azenkot-Monk-Cooper-437 teach the limitations of dependent claim 9. Section X.E, *supra*.

208. As I further show above, independent claim 10 is taught by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Sections X.F.1-2, *supra*. In my opinion, Monk and Cooper-437 are equally applicable to Prodan-Cooper840-Pai and Prodan-Azenkot-Pai because the limitations added to the combinations by Pai do not change the motivations I recited above for combining Monk and Cooper-437 to the Prodan-Cooper840 and Prodan-Azenkot combinations. Section X.E, *supra*.

209. It is therefore my opinion that, for the reasons set forth above with respect to dependent claim 9, Prodan-Cooper840-Pai-Monk-Cooper-437 and Prodan-Azenkot-Pai-Monk-Cooper-437 comprise a network interface that teaches and is configured to perform the limitations recited in claim 18. *See* Sections X.E and X.F.1-2, *supra*.

J. Prodan-Cooper840, Prodan-Azenkot, Prodan-Cooper840-Jalali, Prodan-Azenkot-Jalali, Prodan-Cooper840-Cooper, Prodan-Azenkot-Cooper, Prodan-Cooper840-Monk-Cooper-437, Prodan-Azenkot-Monk-Cooper-437, Prodan-Cooper840-Pai, Prodan-Azenkot-Pai, Prodan-Cooper840-Pai-Jalali, Prodan-Azenkot-Pai-Jalali, Prodan-Cooper840-Pai-Cooper, Prodan-Azenkot-Pai-Cooper, Prodan-Cooper840-Pai-Monk-Cooper-437, Prodan-Azenkot-Pai-Monk-Cooper-437, in further view of Currivan Render Claims 1-18 Obvious

210. With regard to each of the combinations I describe above in Sections X.A-I, each teaches Elements [1E] and [10E] by teaching a CMTS selecting network communication parameters for a group of modems based on a worst-case SNR metric for a service group of modems. *See* Sections X.A-I, *supra*. The network

communication parameters include a frequency allocation scheme and a modulation scheme. In the event it is asserted that the combinations described above do not teach selecting “physical layer communication parameters” as recited in Elements [1E] and [10E], it is my opinion that Currivan discloses this limitation and that a POSITA would have found it obvious to further modify the combinations based on the additional teachings in Currivan.

211. As I describe above, Prodan (as modified by Cooper840 or Azenkot) discloses the CMTS using the composite SNR-related metric to select the frequency allocation scheme and modulation scheme. Sections X.A.1.d-e and X.B.1.b-c. In my opinion, Currivan similarly discloses a cable modem system in which a CMTS segregates cable modems into multiple groups. Ex. 1128, ¶¶26, 161, 192, claim 1, claim 16. In Currivan, the CMTS selects a modulation order (also referred to in Currivan as modulation density) for each group based on a measured SNR. Ex. 1128, ¶¶34, 79, 157, 182. In addition, Currivan describes the relationships between SNR and the physical layer communication parameters (modulation order and transmit power). Ex. 1128, ¶¶67, 157-158. Currivan specifically teaches increasing SNR by increasing transmit power to support a higher modulation order. Ex. 1128, ¶¶20, 151, 157-158, 177, 200. It was known in the art that higher modulation orders require higher SNRs and have higher throughput. Ex. 1128, ¶¶18, 65, 158, 170, 182.

212. In view of the teachings in Currivan, it is my opinion that a POSITA would have found it obvious to configure Prodan-Cooper840's and Prodan-Azenkot's CMTS to further select a higher transmit power for a service group based on the composite SNR-related metric to support a higher modulation order to increase the throughput for that service group (as taught by Currivan). Ex. 1128, ¶¶18, 20, 65, 151, 157-158, 170, 177, 182, 200; Sections X.A.1.d-e and X.B.1.b-c.

213. In my opinion, these combinations also would have been obvious because they would have merely been a combination of prior art elements according to known methods to yield predictable results. The prior art elements are Prodan-Cooper840's and Prodan-Azenkot's CMTS and Currivan's method of increasing cable modem transmit power for a service group. The known method is programming a CMTS to instruct a cable modem service group to increase transmit power level. The predictable results are a system that supports a higher modulation order and increased throughput.

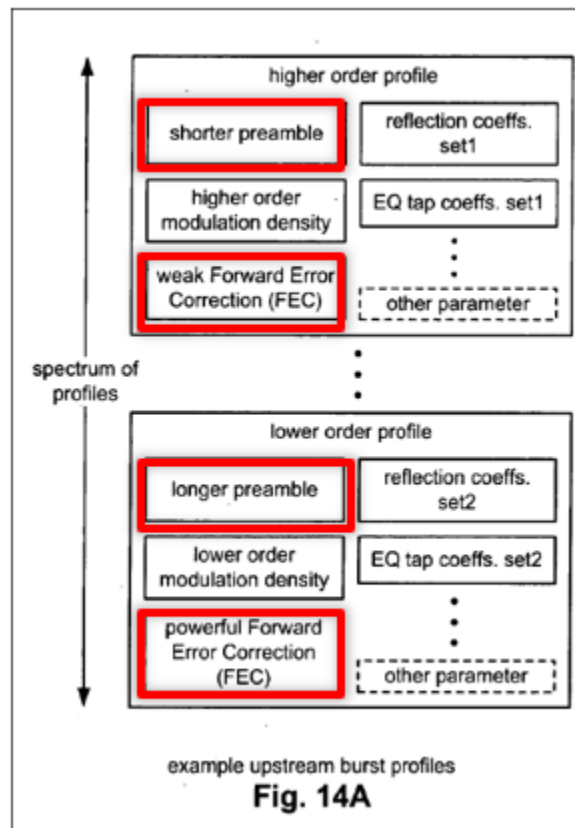
214. It is also my opinion that it would have been well within the capabilities of a POSITA to apply Currivan's teachings to Prodan-Cooper840's and Prodan-Azenkot's CMTS because it would have involved straightforward modifications to the programming of the CMTS. I note that Prodan describes using a wide range of transmission power levels which is consistent with my understanding that

programming a CMTS to instruct a cable modem to use a particular power level was well within the skill level of someone skilled in the art. Ex. 1128, ¶19.

215. In addition, Currivan teaches another power modification procedure. The additional power modification procedure includes increasing the transmit power per code word while reducing the number of codes transmitted to increase the SNR to support a higher modulation order. Ex. 1128, ¶¶67-69, 142, 151-152, 157, 169, 176-177, 182. In light of such additional teachings in Currivan, it is my opinion that a POSITA also would have found it obvious to configure Prodan-Cooper840's and Prodan-Azenkot's CMTS to increase the transmit power per code word—while reducing the number of codes transmitted for a service group—in order to increase the SNR and allow one of the service groups to communicate at a higher modulation order.

216. It is my further opinion that such combinations also would have been obvious because they would have merely been a combination of prior art elements according to known methods to yield predictable results. The prior art elements are Prodan-Cooper840's and Prodan-Azenkot's CMTS and Currivan's method of increasing the transmit power per code word while reducing the number of codes transmitted. The known method is programming a CMTS to instruct a cable modem service group to increase transmit power per code word while reducing the number of codes transmitted for a service group. The predictable results are a system that

includes a service group that supports a higher modulation order to reduce the number of modulation orders that the CMTS is required to support. In my opinion, applying Currivan's teachings to Prodan-Cooper840's and Prodan-Azenkot's CMTS would have been well within the capabilities of a POSITA because it would have involved straightforward modifications to the programming of the CMTS to select a modulation scheme and instruct a cable modem service group accordingly.



Ex. 1128, Fig. 14A (annotated)

217. I note that Currivan also teaches selecting the additional physical layer communication parameters of forward error correction and preamble length. Ex. 1128, ¶¶155-156, 161-162, 175, Fig. 14A. Currivan's Figure 14A, which is

reproduced above, illustrates a spectrum of burst profiles that include such physical layer communication parameters. Ex. 1128, ¶¶161-163.

218. Currivan teaches that the burst profiles are selected by the CMTS and assigned to cable modems based on the SNR of the communication channel from the cable modems to the CMTS. Ex. 1128, ¶¶34, 79, 176, 182, 192. The lower order profile that is shown in Figure 14A is used when a channel may be corrupted to ensure that communication take place. Ex. 1128, ¶163. Figure 14A shows higher order profile utilizing shorter preambles and weaker FEC. Ex. 1128, ¶¶161-162, Fig. 14A. In my opinion, a POSITA would have recognized that there were trade-offs between the amount of processing required and robustness of the communications and preamble lengths and FEC strengths that are selected to ensure communication in view of the SNR of the communication channel from the cable modems to the CMTS. Ex. 1128, ¶¶153-157, 162-163, claim 9.

219. In view of these additional teachings in Currivan, it is my opinion that a POSITA would have found it obvious to configure Prodan-Cooper840's and Prodan-Azenkot's CMTS to further select the physical layer communication parameters of preamble length and FEC strength for a service group based on the composite SNR-related metric to optimize processing required and robustness of the communications.

220. It is my further opinion that such combinations also would have been obvious because they would have merely been a combination of prior art elements according to known methods to yield predictable results. The prior art elements are Prodan-Cooper840's and Prodan-Azenkot's CMTS and Currivan's method of selecting preamble length and FEC strength based on a channel's SNR. The known method is programming a CMTS to instruct a cable modem service group to use a preamble length and FEC strength based on a channel's SNR. The predictable results are a system that optimizes the processing required and robustness of the communications in view of various SNR levels. It is also my opinion that applying Currivan's teachings to Prodan-Cooper840's and Prodan-Azenkot's CMTS would have been well within the capabilities of a POSITA because it would have involved straightforward modifications to the programming of the CMTS to select preamble lengths and FEC strengths and to accordingly instruct a cable modem service group.

XI. CONCLUSION

221. All of the statements made in this declaration of my own knowledge are true. All statements made based on information and belief are believed to be true. Further, these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code.



Date: December 6, 2024

Sayfe Kiaei

XII. CLAIM LISTING APPENDIX

U.S. Pat. No. 9,866,438

Designation	Claim Language
Claim 1	
[1A]	1. A method comprising:
[1B]	determining, by a cable modem termination system (CMTS), for a plurality of cable modems served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;
[1C]	assigning, by said CMTS, said plurality of cable modems among a plurality of service groups based on said plurality of SNR-related metrics;
[1D]	generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
[1E]	selecting, by said CMTS, physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
[1F]	communicating, by said CMTS, with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using said selected physical layer communication parameters.
Claim 2	
2	2. The method of claim 1, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 3	
3	3. The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.
Claim 4	

Designation	Claim Language
4	4. The method of claim 3, comprising selecting, by said CMTS, said physical layer communication parameters on a per-OFDM-subcarrier basis.
Claim 5	
5	5. The method of claim 4, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 6	
[6A]	6. The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile; and
[6B]	said assigning said plurality of cable modems among said plurality of service groups comprises: assigning said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assigning said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 7	
7	7. The method of claim 1, comprising assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 8	
8	8. The method of claim 1, comprising assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more

Designation	Claim Language
	of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.
Claim 9	
[9A]	9. The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises:
[9B]	transmitting a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and
[9C]	receiving a metric reporting message from each of said plurality of cable modems.
Claim 10	
[10A]	10. A system comprising: circuitry for use in a cable modem termination system (CMTS), said circuitry comprising a network interface and a processor wherein:
[10B]	said processor is configured to determine, for a plurality of cable modems served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics;
[10C]	said processor is configured to assign said plurality of cable modems among a plurality of service groups based on said plurality of SNR-related metrics;
[10D]	said processor is configured to generate, for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;
[10E]	said processor is configured to select physical layer communication parameters to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric; and
[10F]	said network interface is configured to communicate with a portion of said plurality of cable modems corresponding to said one of said plurality of service groups using the selected physical layer communication parameters.
Claim 11	
11	11. The system of claim 10, wherein said physical layer communication parameters include one or more of: transmit power, receive sensitivity, timeslot duration, modulation

Designation	Claim Language
	type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 12	
12	12. The system of claim 10, wherein said network interface and said plurality of cable modems are configured to communicate using orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers.
Claim 13	
13	13. The system of claim 12, wherein said network interface is configured such that said physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.
Claim 14	
14	14. The system of claim 12, wherein said physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS.
Claim 15	
[15A]	15. The system of claim 10, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile, and a third cable modem has a particular SNR versus frequency profile;
[15B]	said assignment of said plurality of cable modems among said plurality of service groups comprises: assignment of said third cable modem to said first service group if said particular SNR versus frequency profile is more similar to said first composite SNR versus frequency profile than to said second composite SNR versus frequency profile; and assignment of said third cable modem to said second service group if said particular SNR versus frequency profile is more similar to said second composite SNR versus frequency profile than to said first composite SNR versus frequency profile.
Claim 16	

Designation	Claim Language
16	16. The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems.
Claim 17	
17	17. The system of claim 10, wherein said processor is configured to assign said plurality of cable modems among said plurality of service groups based on a branch further branch amplifier that serves each of said plurality of cable modems.
Claim 18	
[18A]	18. The system of claim 10, wherein said determination of said plurality of SNR-related metrics comprises:
[18B]	transmission, via said network interface, of a probe message to each said plurality of cable modems, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and
[18C]	reception, via said network interface of said CMTS, of a metric reporting message from each of said plurality of cable modems.