

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. 10,135,682

Filing Date: January 9, 2018

Issue Date: November 20, 2018

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

Inter Partes Review No.: IPR2024-00444

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 1 of 2

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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. 10,135,682 (“the ’682 patent”) (Ex. 1001) and the unpatentability grounds set forth in the Petition for this proceeding. I understand the ’682 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

A. 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 1003. 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 1993-2002, 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. 10,135,682.

26. In preparing this declaration, I also reviewed and considered the Petition and the file history (Ex. 1004) of the '682 patent (Ex. 1001) as well as the following references:

- Ex. 1005: U.S. Patent Application Publication No. 2007/0223512
("Cooper")
- Ex. 1006: U.S. Provisional Patent Application No. 60/785,647
("Cooper Provisional")
- Ex. 1007: U.S. Patent Application Publication No. 2005/0111535
("Saey")
- Ex. 1008: U.S. Patent Application Publication No. 2004/0085987
("Gross")
- Ex. 1011: U.S. Patent Application Publication No. 2012/0269242
("Prodan")
- Ex. 1012: U.S. Patent No. 10,084,538 ("Nielsen-538")
- Ex. 1013: U.S. Patent Application Publication No. 2013/0004179
("Nielsen-179")
- Ex. 1014: U.S. Patent No. 6,952,454 ("Jalali")
- Ex. 1015: U.S. Patent No. 7,573,822 ("Monk")
- Ex. 1016: U.S. Patent No. 6,772,437 ("Cooper-437")

- Ex. 1017: Claim Construction Memorandum Opinion and Order, *Entropic Comms., LLC v. Charter Comms., Inc.*, Case No. 2:22-CV-00125-JRG
- Ex. 1018: Rebuttal Expert Report of John Holobinko Regarding Validity of U.S. Patent Nos. 8,284,690 and 10,135,682
- Ex. 1019: Exhibit F, U.S. Patent No. 10,135,682 Exemplary Infringement Chart
- Ex. 1020: U.S. Patent Application Publication No. 2010/0061235 (“Pai”)
- Ex. 1021: Data-Over-Cable Interface Specifications, Radio Frequency Interface Specification, SP-RFII01-970326 (“DOCSIS 1.0”)
- Ex. 1022: Data-Over-Cable Service Interface Specifications, DOCSIS 1.1, Radio Frequency Interface Specification, CM-SP-RFIV1.1-C01-050907 (“DOCSIS 1.1”)
- Ex. 1023: Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIV2.0-C02-090422 (“DOCSIS 2.0”)
- Ex. 1024: U.S. Patent Application Publication No. 2007/0171994 (“Parker”)
- Ex. 1025: U.S. Patent App. No. 8,503,546 (“Ashrafi”)

- Ex. 1026: Tanenbaum, “Computer Networks,” 4th ed. (2003).
- Ex. 1027: Driscoll, “Next Generation IPTV Services and Technologies” (2008)

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 '682 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 is 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 '682 patent is a method of operating a cable television network. Ex. 1001, Abstract, 1:49-52.

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 '682 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 video-on-demand cable systems and Internet video streaming.

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 '682 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 '682 patent (*i.e.*, July 23, 2012) meeting the description I have provided in this section.

VI. CLAIM CONSTRUCTION

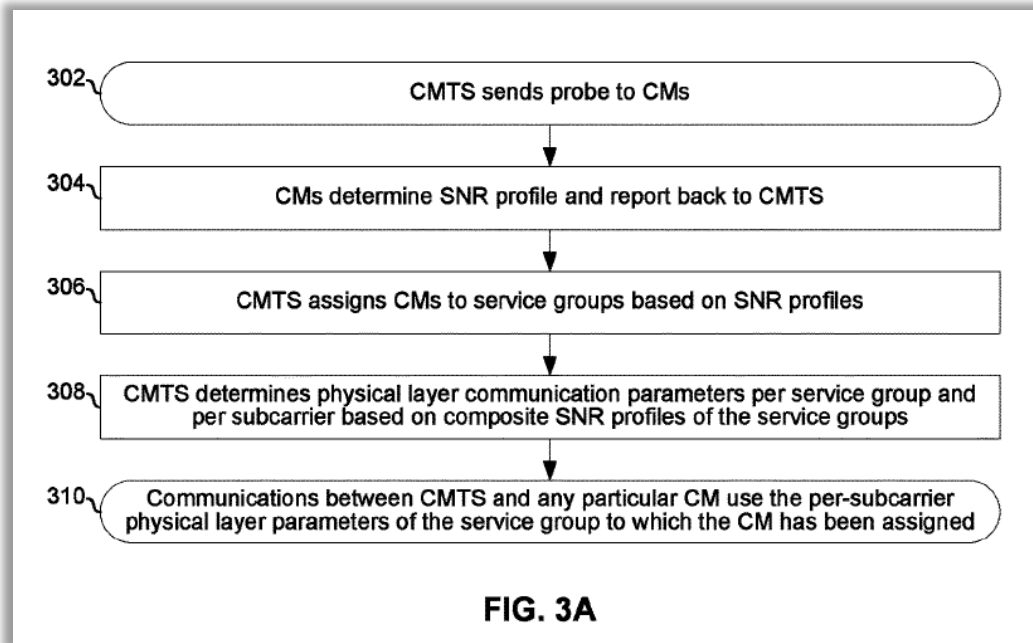
44. I understand that all claim terms herein should be given their ordinary and customary meaning to a POSITA, consistent with the prosecution history. I understand that the Petitioner does not contend that the claims include any means-plus-function limitations.

VII. OVERVIEW OF THE '682 PATENT

A. '682 Patent

45. The '682 patent relates to service group management in a cable television network. Ex. 1001, 1:50-52. "A cable modem termination system (CMTS) may determine, for a plurality of cable modems (CMs) 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. 1001, Abstract.

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



Ex. 1001, 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. 1001, 4:25-30, 5:34-37. The CMTS then assigns the cable modems to groups based on the SNR profiles. Ex. 1001, Abstract, 4:52-56, 5:37-39, 6:46-7:6. A composite SNR profile for each service group is used to determine a physical layer communication parameter used for communication between the CMTS and cable modems. Ex. 1001, Abstract, 4:40-56, 5:40-50. Physical layer communication parameters include encoding and modulation parameters, such as modulation type and modulation order. Ex. 1001, Abstract, 4:56-67.

B. Prosecution History

48. The application that led to the '682 patent, U.S. Application No. 15/866,106, was filed on January 9, 2018. Ex. 1004, 8-37, 52-54; Ex. 1001, 1-2.

49. All claims were rejected in an Office Action dated April 3, 2018, 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.*, claims 1-18 of U.S. Patent No. 9,419,858 to Ling *et al.* and claims 1-18 of U.S. Patent No. 9,866,438 to Ling *et al.* *Id.*, 61-89. The Examiner also indicated that claims 1 and 10 contained allowable subject matter because the prior art failed to disclose or render obvious:

“... 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 ... in combination with other limitations recited in the claims.”

Id., 85 (emphasis original).

50. The Applicant filed a Terminal Disclaimer on June 21, 2018 and the Examiner issued a Notice of Allowance on August 1, 2018. *Id.*, 104, 122-123, 130-136.

51. The '682 patent issued on November 20, 2018. Ex. 1001, 1-2.

C. Priority Date

52. I understand that the earliest possible priority date for the '682 patent claims is July 23, 2012, which is the filing date of U.S. Provisional Application No. 61/674,742.

VIII. TECHNICAL BACKGROUND

A. Orthogonal Frequency Division Multiplexing (OFDM)

53. OFDM is a modulation method for efficiently transmitting large amounts of data over a signal processing network. Ex. 1024, ¶2. The bandwidth (channel), reserved for data traffic, is divided into multiple and narrower sub-bands (sub-channels). Ex. 1024, ¶2. The data is also divided into lower data rate channels, each encoded on different subcarrier frequencies for transmission over the network. Ex. 1024, ¶2. The subcarrier frequencies are mutually orthogonal so that the frequencies are simultaneously transported to and accurately retrieved at the receiver. Ex. 1024, ¶2. The subcarriers maintain orthogonality by being spaced at frequency intervals $1/T$, where T represents the OFDM symbol period. Ex. 1024, ¶2. This approach reduces intersymbol interferences (ISI) by extending the symbol duration relative to the channel's delay spread. Ex. 1024, ¶¶2, 5.

54. 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. 1024, ¶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. 1024, ¶3. In this way, only one symbol will be generated for any subcarrier frequency. Ex. 1024, ¶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. 1024, ¶5. Longer symbol intervals reduce ISI when the symbol period overtakes the channel spread, as any ISI is then spread over fewer symbols. Ex. 1024, ¶5.

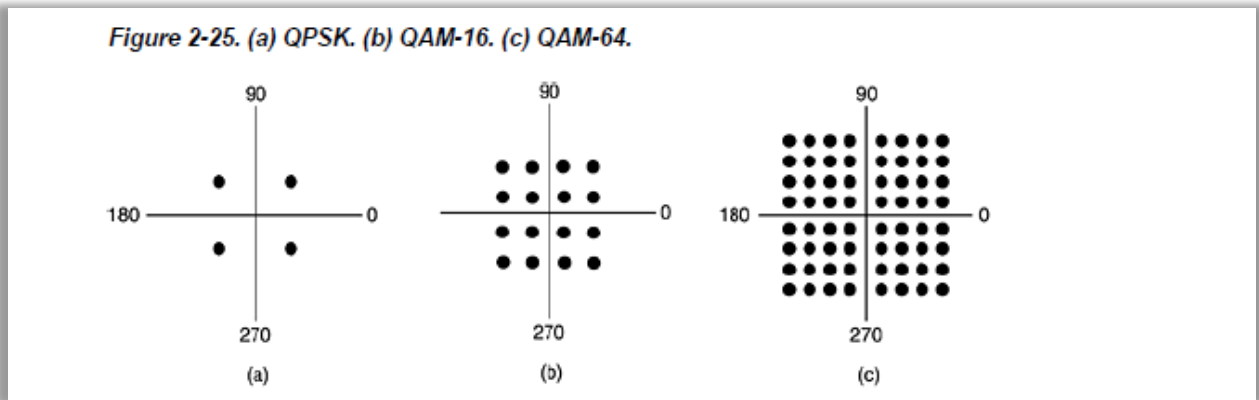
55. Similarly, OFDMA (Orthogonal Frequency-Division Multiple Access) transmits data over several sub-bands with different carrier frequencies. Ex. 1024, ¶¶60, 90-91. With OFDMA, multiple users are assigned a subset of subcarriers that are orthogonal to each other. Ex. 1024, ¶¶60, 90-91.

B. Quadrature Amplitude Modulation (QAM)

56. Transmitting data over a cable network requires encoding the data onto a carrier wave by modulation. Ex. 1025, Abstract, 1:10-43; Ex. 1026, 89-90, 98-101. Modulation entails changing the carrier wave's amplitude, frequency, and/or phase according to the desired transmitted data. Ex. 1026, 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. 1025, 1:44-53; Ex. 1026, 89-90, 98-99.

One modulation technique is called Quadrature Amplitude Modulation (QAM). Ex. 1025, 1:10-43.

57. QAM employs two carrier signals within the same frequency band that are orthogonal to each other. Ex. 1025, 1:10-43. The two carrier signals are called an in-phase signal (I) and quadrature signal (Q). Ex. 1025, 1:10-43. The carrier signals are modulated and then combined for network transmission. Ex. 1025, 1:10-43. During modulation, the data bits are divided into groups called symbols. Ex. 1026, 98-99. For example, in 16-QAM, each symbol represents four bits. Ex. 1026, 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. 1026, 98-99. Each group is represented by a symbol encoded on the carrier wave with a unique amplitude and phase shift modulation. Ex. 1026, 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. 1026, 98-99.



Ex. 1026, Fig. 2-25.

58. Each point in the constellation diagram represents a unique amplitude and phase used to encode the signal onto the carrier wave. Ex. 1026, 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. 1026, 98-99; Ex. 1025, 5:10-33. A timing feature is employed to determine the start of each new symbol. Ex. 1025, 1:25-55.

C. Quadrature Phase Shift Keying (QPSK)

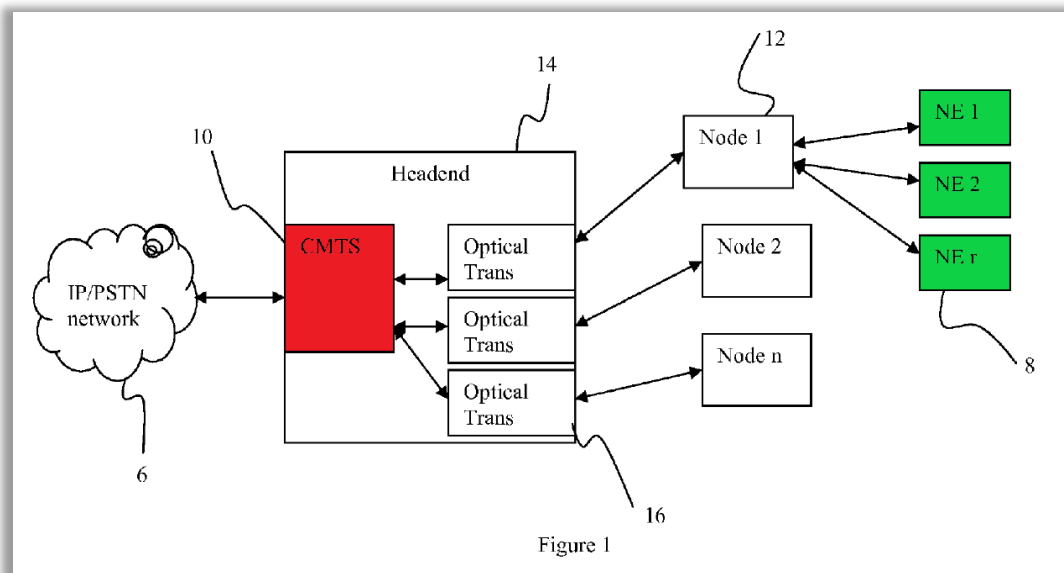
59. QPSK is another modulation technique. Ex. 1027, 64, 79, 237. Like QAM, QPSK employs two identical carrier signal waves orthogonal to each other. Ex. 1027, 237. However, QPSK modulation employs four different points in the constellation diagram, as indicated above. Ex. 1026, Fig. 2-25. Therefore, each symbol modulated using QPSK represents two bites of data. Ex. 1027, 237. QPSK effectively doubles the bandwidth of the network and allows for efficient use of the frequency spectrum. Ex. 1027, 237.

IX. OVERVIEW OF THE PRIOR ART

A. Cooper

60. Cooper (Ex. 1005) 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. 1001, 1-2.

61. Cooper describes a “process for reconfiguring logical channels” in a network. Ex. 1005, ¶¶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. 1005, ¶22, Fig. 1.



Ex. 1005, Fig. 1 (annotated)

62. 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

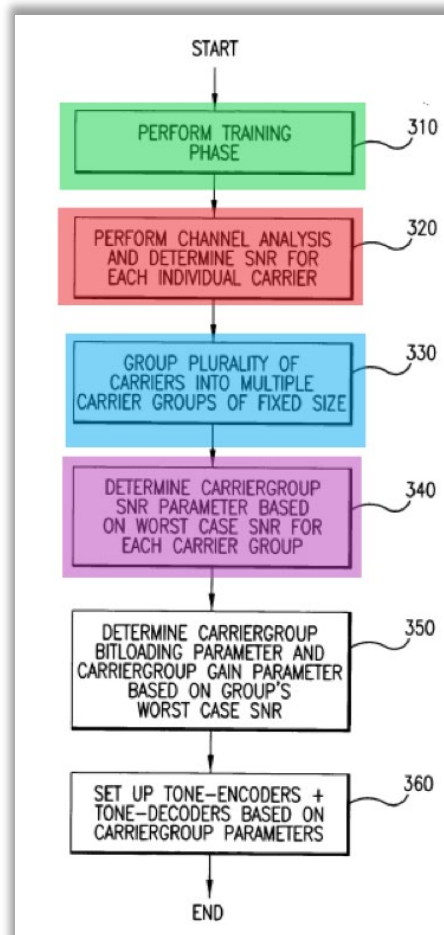
communications to the network elements. Ex. 1005, ¶22; *see id.*, ¶3. The measured network parameters are determined in cooperation with the network elements without interruption of active communication services. The network parameters include upstream or downstream modulation error ratio (MER), upstream or downstream signal to noise ratio (SNR), upstream or downstream microreflections, upstream transmit level, downstream receive power level. Ex. 1005, Abstract. Cooper further describes a process that allows a network operator to easily group cable modems based upon common parametrics and performance similarities. Ex. 1005, ¶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. 1005, ¶19.

B. Saey

63. Saey (Ex. 1007) is a U.S. Published Application published May 26, 2005. Saey is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1001, 1-2.

64. Saey describes a method and system of grouping one or multiple carrier groups based at least in part on a worst-case SNR. Ex. 1007, Abstract, ¶10. In one embodiment, a training phase 310 (**green**) is performed. Modems negotiate about parameters to be used. Ex. 1007, ¶29. A channel analysis step 320 (**red**) determines an SNR for each individual carrier. Ex. 1007, ¶30. At step 330, the plurality of

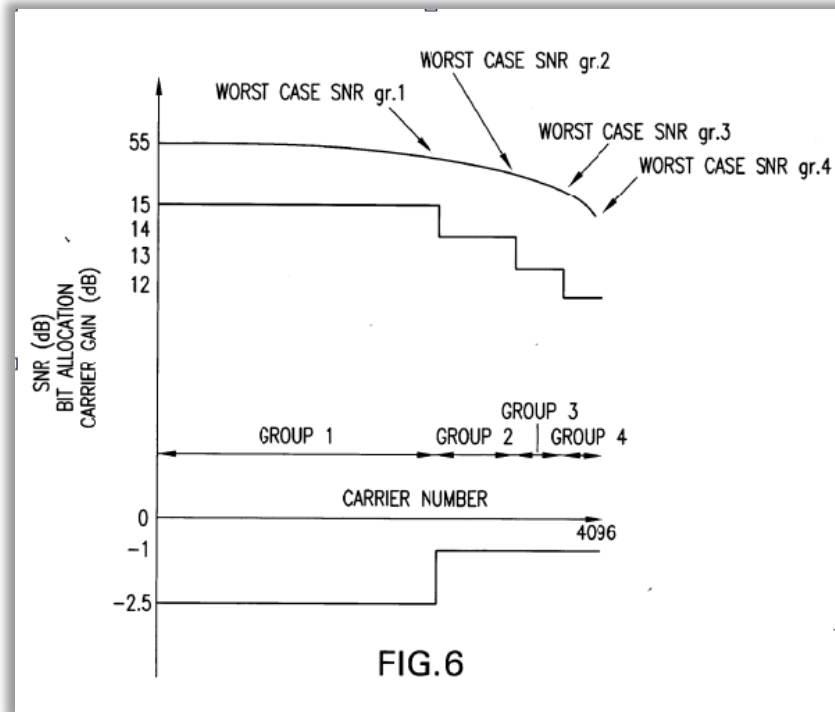
carriers is grouped into multiple carrier groups of fixed size (**blue**). Ex. 1007, ¶31. At step 340 (**purple**), the worst-case SNR for each fixed size carrier group is determined and used to define a “carriergroup SNR parameter” for that specific carrier group. Ex. 1007, ¶32.



Ex. 1007, Fig. 3 (annotated)

65. Figure 6 also illustrates the SNR for each of the individual carriers as a continuous curve. The worst-case SNR for each group is determined and used to calculate the worst-case bit loading and the worst case carrier gain for each group. Thus, each carrier group has a carrier group SNR parameter based on the worst-case

SNR for the carriers in the group, a carrier group bitloading parameter and a carrier group gain parameter based on the worst-case carrier group SNR parameter for that particular group. Ex. 1007, ¶43.



Ex. 1007, Fig. 6.

C. Gross

66. Gross (Ex. 1008) is a U.S. Published Application published May 6, 2004. Gross is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1001, 1-2.

67. Gross describes enhancing the accuracy and reliability of communications in systems using discrete multitone technology to communicate data over digital subscriber lines. Ex. 1008, ¶24. Gross uses special data modems

that carry voice and data communications simultaneously and can operate without special filtering provided by “plain old telephone service” (POTS) splitters. Ex. 1008, ¶25. In the event there is a disturbance on the communication channel, the modem changes the bit allocation and the subchannel gains among the subchannels. Ex. 1008, ¶25. Channel control parameter sets are used to achieve this goal. Ex. 1008, ¶30. A key parameter used is known as the “bit allocation” for respective subchannels and is calculated based on the channel SNR. Ex. 1008, ¶32. Gross describes parameter sets representing a “worst case” condition which would be based at least in part on a worst-case SNR. Ex. 1008, ¶100.

D. Prodan

68. Prodan (Ex. 1011) is a U.S. Published Application published October 25, 2012. Prodan is prior art under pre-AIA 35 U.S.C. § 102(e). Prodan was considered during prosecution. Ex. 1001, cover.

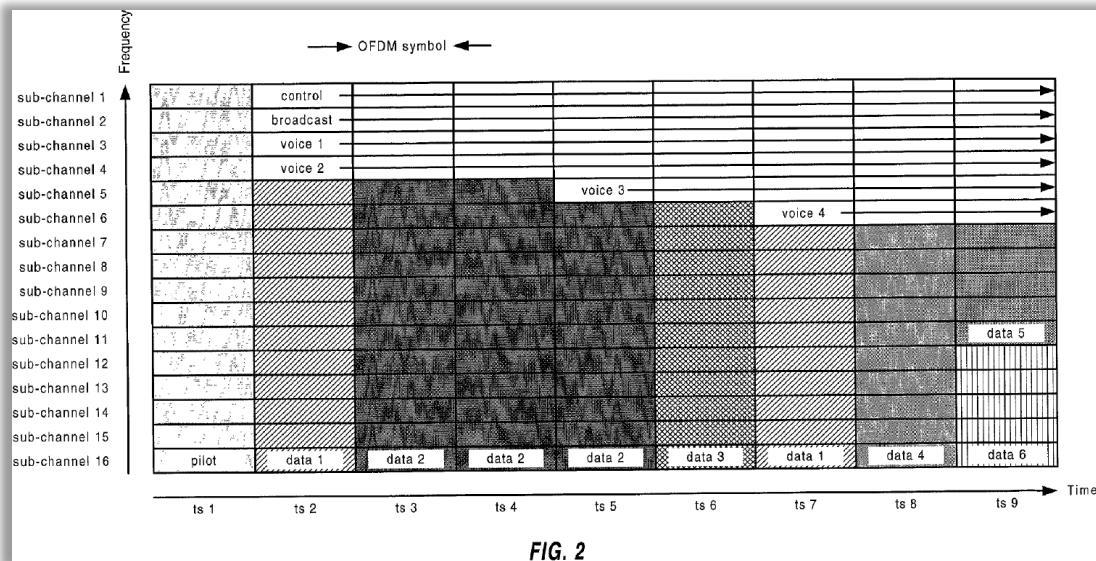
69. Prodan describes frequency spectrum and modulation scheme allocation techniques that optimize power utilization and enable similar upstream transmission power by cable modems and signal-to-noise ratio (SNR) at the headend. Ex. 1011, Abstract, ¶7. One of these techniques describes a method and system for measuring SNR data and grouping cable modems into multiple categories for use in transmission based on a measured parameter. Ex. 1011, ¶44. The method may be performed at the headend or at a cable modem termination system (CMTS).

Ex. 1011, ¶44. The signal strength versus frequency profiles of cable modems are measured. Ex. 1011, ¶44. These profiles are then used to group cable modems into service group categories. Ex. 1011, ¶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. 1011, ¶45.

E. Jalali

70. Jalali (Ex. 1014) 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. 1001, 1-2.

71. Jalali discloses a method of transmitting and receiving multiple types of services (*e.g.*, video, voice) along multiple carriers using OFDM. Ex. 1014, 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. 1014, 13:49-58.



Ex. 1014, Fig. 2

72. Jalali 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. 1014, 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. 1014, 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. 1014, 14:20-60, 15:26-36.

73. 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. 1014, 15:36-42, 11:51-12:9, 17:21-34, 22:19-24, 23:54-65, 32:34-46. 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. 1014, 15:54-61, 12:45-48.

F. Monk

74. Monk (Ex. 1015) 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. 1001, 1-2.

75. Monk discloses a method of communication that relies on different modulation schemes based on a communication channel’s SNR. Ex. 1015, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. For example, Monk teaches that higher SNR channels can support 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. 1015, 4:55-59, 8:1-11, 9:9-11, 10:58-62. To determine the SNR of a channel, 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. Ex. 1015, 4:44-59, 9:28-41, Abstract. 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. 1015, 9:42-50.

G. Cooper-437

76. Cooper-437 (Ex. 1016) 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. 1001, 1-2.

77. Cooper-437 discloses a method by which a CMTS requests and receives specific noise signal power measurements from cable modems in its network. Ex. 1016, 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. 1016, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1.

78. Cooper 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. 1016, 10:56-11:28, Table 1.

H. Pai

79. Pai (Ex. 1020) 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. 1001, 1-2.

80. 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. 1020, Abstract, ¶¶28-31. Pai discloses that its CMTS includes a CPU 62 having one or more processors 63 that may receive data, such as programming instructions, from memory 61. Ex. 1020, ¶¶179-180. Pai further discloses that its CMTS also includes interfaces 68 that control the sending and receiving of data packets over the network. Ex. 1020, ¶181. Interfaces 68 may include Ethernet interfaces, DSL interfaces, and the like. Ex. 1020, ¶181.

X. OPINIONS WITH RESPECT TO THE '682 PATENT

A. Cooper in View of Saey Renders Claims 1-2, 7-8, 10-11, and 16-17 Obvious

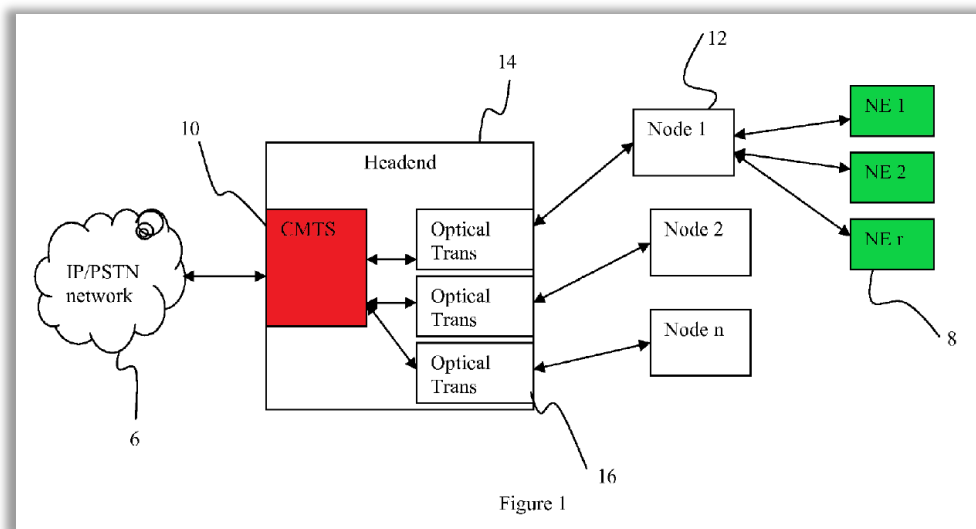
1. Independent Claim 1

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

81. If the preamble [1A] is limiting, then it is disclosed by Cooper. Specifically, Cooper discloses a method for configuring logical channels in a network. Ex. 1005, Title, Abstract, ¶¶2, 5-11, 17, 19-21, 30-33, 36-41.

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

82. Cooper discloses Element [1B]. As I show below in Figure 1, Cooper discloses a network in which multiple network elements 8 (**green**) connect to a CMTS 10 (**red**) via nodes 12. Ex. 1005, ¶22, Fig. 1. Cooper’s network elements 8 include cable modems (CMs). Ex. 1005, ¶22.



Ex. 1005, Fig. 1 (annotated).

83. Cooper explains that CMTS 10 resides at a headend 14, which includes transceivers that communicate with the network elements by receiving upstream communications for the network elements and sending downstream communications to the network elements (the claimed “each cable modem served by said CMTS”). Ex. 1005, ¶22, Fig. 2; *see id.*, ¶¶3 (“network elements communicate to the CMTS via upstream communications on a dedicated band of frequency and receive

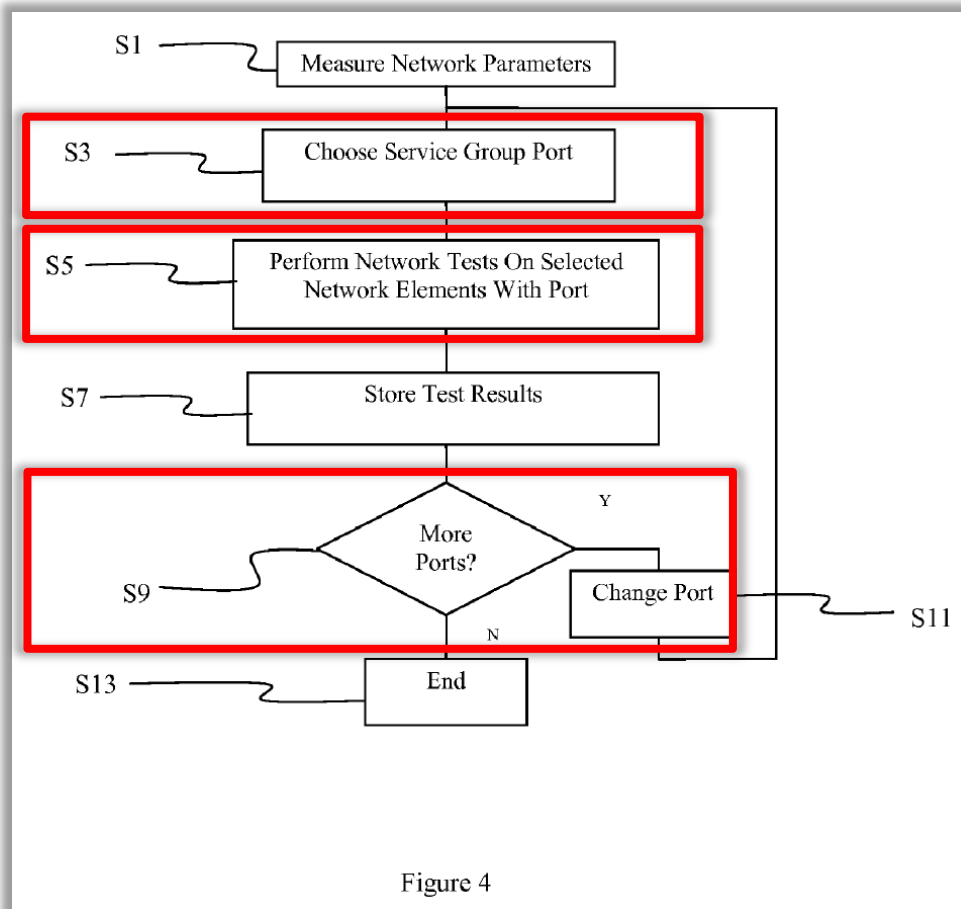
information from the CMTS via downstream communications”), 23 (“CTMS [] may contain a processing unit 100 which ... may control the operation of the CMTS [] and RF communication signals to be sent/received to/from the network elements”), 24 (“RF transceiver (transmitter/receiver) unit preferably contains a plurality of transmitters [] and receivers [] to provide bi-directional communication with a plurality of network elements”), 25 (“[n]etwork element [] also contains a transceiver ... which provides bidirectional RF communication with [the] CMTS”). By sending the network elements downstream communications, the CMTS serves those network elements. In other words, the network elements are served by the CMTS when they receive the downstream communications.

84. Cooper also discloses optimizing network communications based on measuring various network parameters at the CMTS or each cable modem. Ex. 1005, ¶¶8, 11. Referring to Figure 4 below, Cooper further discloses a process of measuring network parameters for the cable modems connected to the CMTS. Ex. 1005, ¶¶16 (describing Cooper’s Figure 4 as a “process for measuring network parameters), 26 (describing Cooper’s Figure 4 as a “process for automatically measuring network element parameters in a service group”).² According to Cooper,

² Cooper refers to network elements associated with associated with a particular “service group port” (*e.g.*, a receiver at the headend) as a “service group.” Ex. 1005,

its network parameter measurement process measures parameters for each network element (*e.g.*, cable modem) connected to a “service group port” (*e.g.*, a transceiver at the headend), and this measurement process may be performed at each port or at each cable modem. Ex. 1005, ¶¶11, 22-23, 26-27, 29. Cooper discloses the CMTS initiating the measurement process (step S1) at the CMTS, which begins by choosing a “service group port” (*e.g.*, a transceiver at the headend) (step S3), and performing tests on the selected port (step S5). Ex. 1005, ¶¶16, 22-23, 26-27, 29, Fig. 4. This testing involves the CMTS determining network parameters of the CMs connected to the selected port. Ex. 1005, ¶¶26-28. The results of the testing are stored (step S7), and the process is repeated until all ports have been exhausted (steps S9 and S11). Ex. 1005, ¶29.

¶¶26-27. As explained below, a group of Cooper’s network elements assigned to a logical channel satisfy the plain and ordinary meaning of “service group” as recited in Element [1C]. *See* Section X.A.1.c, *infra*.



Ex. 1005, Fig. 4 (annotated).

85. Cooper’s CMTS performs the testing, which includes testing “upstream or downstream signal to noise ratio (SNR).” Ex. 1005, ¶¶7, 27. Cooper thus discloses testing the SNR for each network element (*e.g.*, cable modem) connected to and in communication with a CMTS.

86. Therefore, Cooper discloses Element [1B].

c. Element [1C]: “assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;”

87. Cooper discloses Element [1C]. Cooper explains that its process is “directed toward grouping network elements according to certain parameters to configure logical channels in a network.” Ex. 1005, ¶2. Cooper further explains that its process seeks to address perceived deficiencies in “[e]xisting technologies within CMTSs or network management applications,” including the lack of any “mechanism to differentiate modems and reassign[] them to leverage any grouping benefits” and any “product offering that provides [an] operator a mechanism for grouping [the] modems.” Ex. 1005, ¶6.

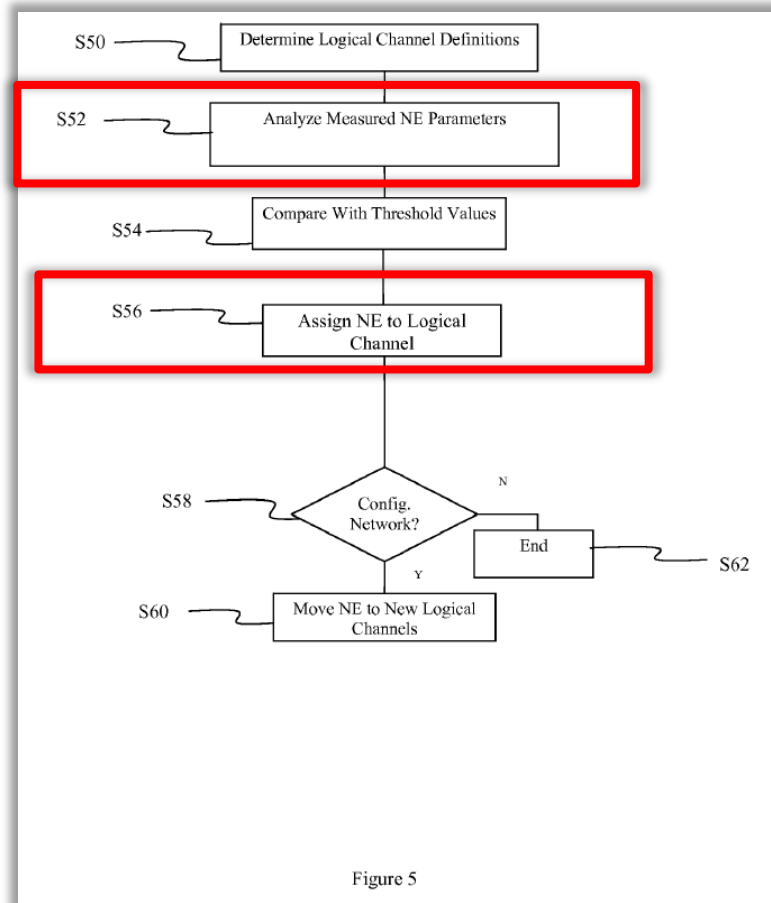
88. To that end, Cooper teaches a method that includes “determining network parameters (*e.g.*, SNR) associated with a selected network element based on communications with the selected network element” and “assigning network elements to logical channels based on the network parameters.” Ex. 1005, ¶9; *see also id.*, ¶¶8, 10 (similar determining and assigning language).

89. More specifically, Cooper describes “a CMTS supporting application ... and a process which allows the network operator to easily group network elements (*e.g.*, cable modems ...) based upon common parametrics and performance similarities.” Ex. 1005, ¶19. Cooper’s “groupings [of network elements] may then be used to configure logical channels and subsequently the assignment of the

network elements to [the] logical channels.” Ex. 1005, ¶19. Cooper explains that the “grouping [of its network elements] by logical channels provides the operator with many advantages including: the ability to take advantage of unique features common to only a subset of the network elements [and] increase overall network through-put by optimizing physical layer configuration parameters to [the] network elements grouping” among others. Ex. 1005, ¶19; *see also id.*, ¶20 (“network operator may differentiate groups of these network elements based upon thresholds for these parameters [and] configure the CMTS with the appropriate logical channels matching these groups”). Figure 4 in Cooper illustrates the process for measuring network element parameters in the service group. Ex. 1005, ¶¶26-27. In Cooper’s Figure 4, the tests are performed on the headend receiver for measuring SNR and other parameters of a cable modem. Furthermore, Cooper teaches that the CMTS can automate these processes. Ex. 1005, Abstract (“Logical channels in a network are automatically [] configured by using measured network parameters.”), ¶¶7 (“This disclosure explains an automated process to determine logical channels using network elements (such as ... cable modems) in conjunction with measurements made at the headend, via a CMTS device”), 26 (“exemplary process for automatically measuring network element parameters in a service group”), 30 (“process for reassigning network elements to logical channels in the network ... may be implemented as an automated process”), 33 (“thresholds and number of

thresholds used may also be automatically assigned to best fit the network elements into logical channels based on a network parameter, such as evenly segmenting the network elements based on SNR”), 39 (“automatically determine the optimum value for the threshold settings”), 40 (“automatically rerun the logical channel optimization process at regular intervals”), 41 (“modems which are configured with the automatic threshold process”); *see also* Section X.A.1.d, *infra* (discussing automation for Element [1D]).

90. Figure 5 in Cooper illustrates this process of grouping its network elements (*e.g.*, cable modems) by assigning them to respective logical channels. Ex. 1005, ¶30 (explaining Figure 5 “illustrates an exemplary process for reassigning network elements to logical channels in the network” that “selects the optical grouping of modems to be assigned to each of multiple logical channels”), Fig. 5. As I show below, Cooper’s process analyzes the parameters (*e.g.*, SNR) measured for each cable modem connected to the CMTS. Ex. 1005, ¶¶8, 30 (“measured network element parameters from the process illustrated in FIG. 4 are analyzed in step S52”). Cooper’s process then assigns the cable modems to logical channels based on a comparison between their measured network parameters and parameter thresholds. Ex. 1005, ¶¶8, 31 (“network elements are assigned to logical channels based on the comparison of their individual test parameter value with the threshold values in step S54”).



Ex. 1005, Fig. 5 (annotated)

91. Cooper further illustrates how its cable modems would be grouped by comparing their measured network parameters (*e.g.*, SNR) to parameter thresholds (*e.g.*, SNR thresholds). Ex. 1005, ¶¶32 (illustrating “an example of a channel configuration screen”), 33 (“operator may quickly decipher what proportion of the modems [] possess a network element parameter greater than THRESHOLD1 and less than THRESHOLD2” which “is useful in allowing the operator to identify which parameters should be utilized as a basis for grouping network elements into various logical channels” and, for example, “segmenting the network elements based

on SNR”), 41 (“system preferably provides a mechanism for the operator to view the lists of modems categorized by logical channel”), Fig. 6. This is shown in the figure below from Cooper.³ As I show, Cooper’s figure includes a list of modems (**red**) identified by their respective MAC addresses, a list of corresponding SNR measurements (**orange**), and a list of three SNR thresholds (**blue**) used to delineate four logical channels (**purple**) numbered 0-3. Ex. 1006, 11 (Fig. 3); Ex. 1005, Fig. 6.

³ Figure 3 in U.S. Provisional Patent Application No. 60/785,647, which Cooper incorporates by reference, is a higher-quality version of Cooper’s Figure 6. Ex. 1005, ¶1. Cooper’s Figure 6 and Figure 3 in Cooper’s provisional are otherwise identical.

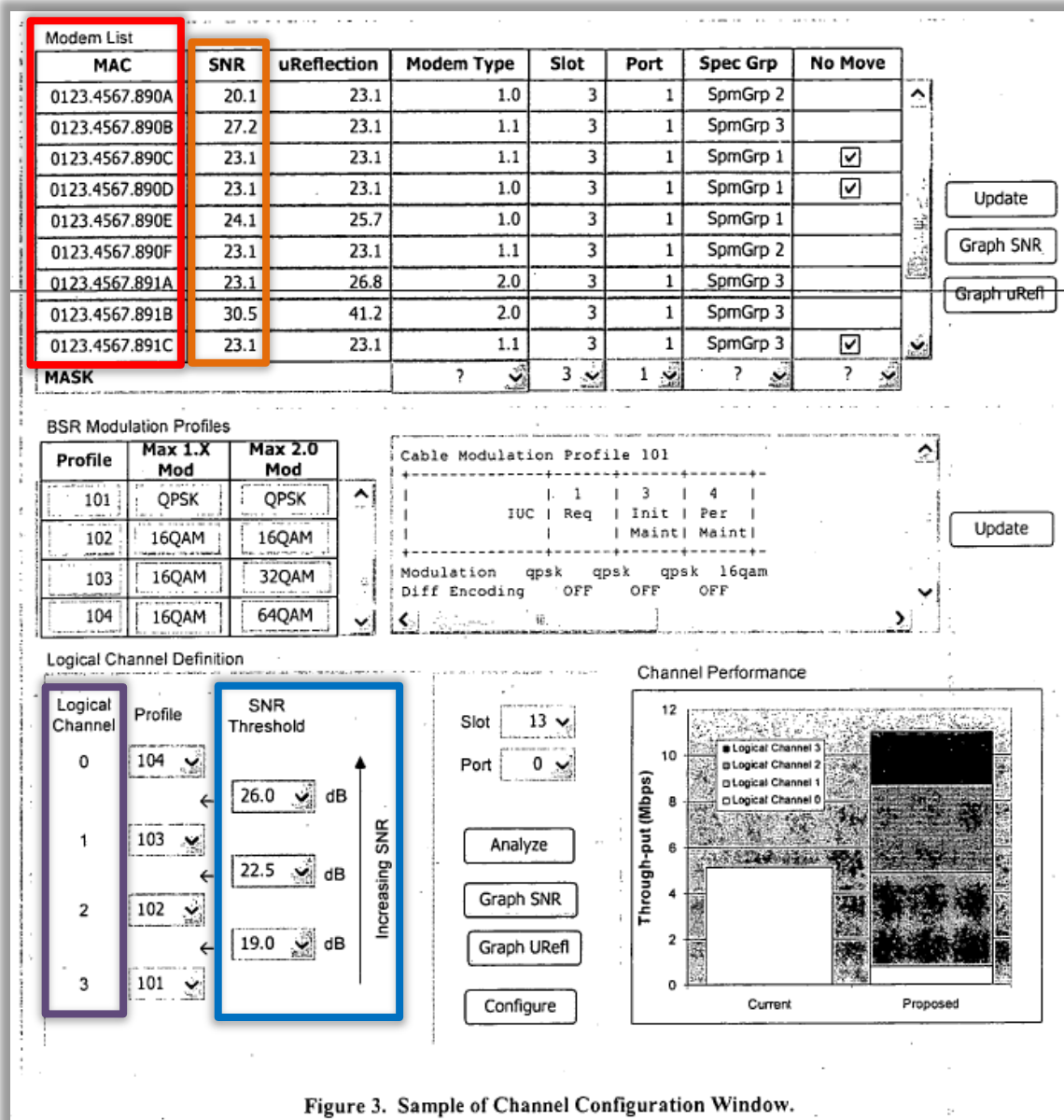


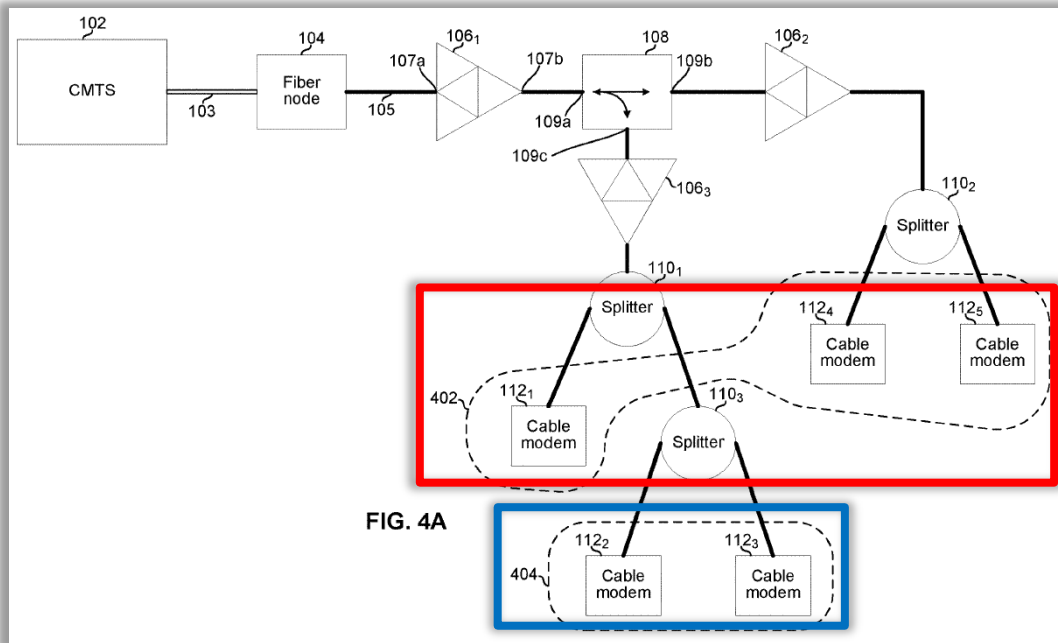
Figure 3. Sample of Channel Configuration Window.

Ex. 1006, 11 (annotated); *see also* Ex. 1005, Fig. 6.

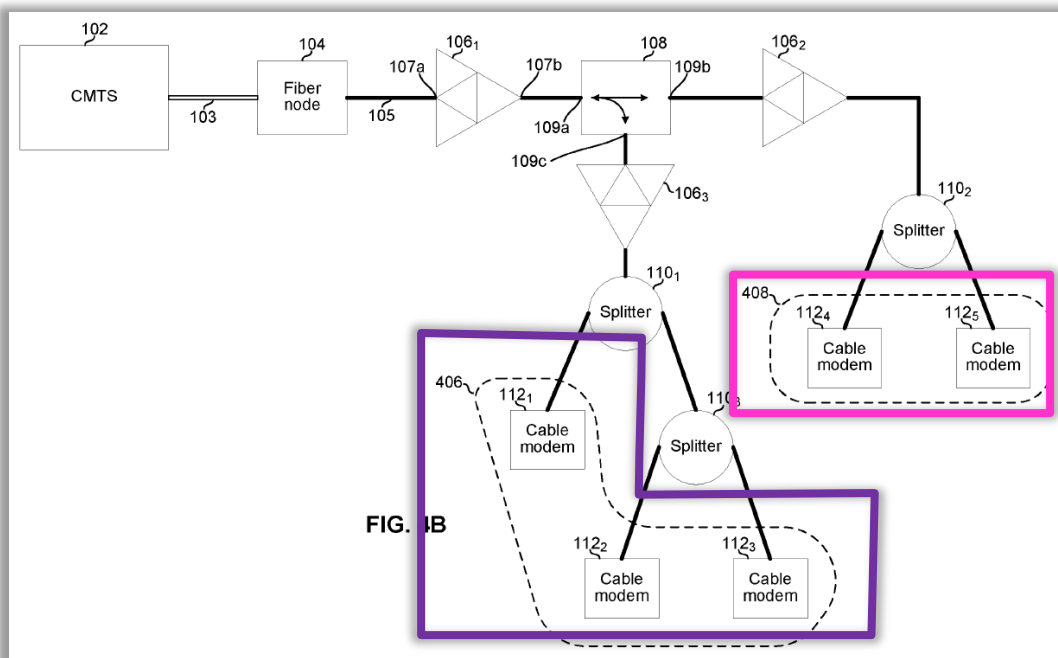
92. As illustrated above, Cooper's process of assigning cable modems to logical channels based on comparing their respective SNR measurements to SNR thresholds results in three groupings of cable modems: (1) a group with measured SNRs above 26.0 assigned to logical channel "0" (i.e., modems with MAC addresses ending in .890B and .891B having measured SNRs of 27.2 dB and 30.5 dB,

respectively); (2) a group with measured SNRs between 22.5 dB and 26.0 dB assigned to logical channel “1” (i.e., modems with MAC addresses ending in .890C-F, .891A, and .891C having measured SNRs of 23.1 dB or 24.1 dB); and (3) a group with measured SNRs between 19.0 dB and 22.5 dB assigned to logical channel “2” (i.e., the modem with the MAC address ending in .890A having a measured SNR of 20.1 dB). Ex. 1006, 11 (Fig. 3); Ex. 1005, Fig. 6.

93. Cooper’s cable modem groups respectively assigned to logical channels discloses the claimed “plurality of service groups”. Indeed, such disclosures in Cooper are very similar to the ’682 patent’s disclosure for this claim term. *Id.* In particular, the ’682 patent discloses “service groups” as groupings that arise from some shared characteristic between the cable modems of a respective group. For example, the ’682 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. 1001, 2:24-27, 5:37-39 (assigning cable modems to service groups based on SNR profile), 6:21-23 (assigning cable modems to service groups based on their location), 6:42-7:22 (generally discussing assigning cable modems to service groups), Figs. 3A-B, 4A-B.



Ex. 1001, Fig. 4A (service group 402 includes cable modems 112₁, 112₄, 112₅ (**red**); service group 404 includes cable modems 112₂, 112₃ (**blue**)) (annotated).



Ex. 1001, Fig. 4B (service group 406 includes cable modems 112₁, 112₂, 112₃ (**pink**); service group 408 includes cable modems 112₄, 112₅ (**purple**)) (annotated).

94. In addition, Cooper’s disclosure of “service groups” is also consistent with the plain meaning of that term as it is used in the specification of the ’682 patent. In prior litigation, 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. 1017, 55-57 (citing the ’682 patent at 2:24-27, 6:39-41); *see also* Ex. 1018, ¶¶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. 1019, 6-7 (Patent Owner’s infringement contentions alleging infringement based on organizing cable modems into groups). Here, the cable modems assigned to one of Cooper’s logical channels 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 ’682 patent.

95. Thus, the claim term, “service groups,” is met by a group of cable modems, including a group of cable modems assigned to the same logical channel as disclosed in Cooper. Ex. 1005, ¶¶30, 32-33, 41, Fig. 6; Ex. 1006, 11 (Fig. 3). The assignment by Cooper’s CMTS (the claimed “assigning, by said CMTS,”) of network elements such as each cable modem (the claimed “cable modem”) to a

particular logical channel based on its SNR measurement (the claimed “based on a respective corresponding SNR-related metric”) results in groups of assigned cable modems that are grouped by logical channel (the claimed “assigning ... among a plurality of service groups”), which is consistent with the ’682 patent’s disclosure regarding service groups.⁴

96. Therefore, Cooper discloses Element [1C].

- 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 SNR-related metrics corresponding to said one of said plurality of service groups;”**

97. Cooper-Saey discloses Element [1D]. As I show above for Element [1B], Cooper discloses determining the SNR for each cable modem. Section X.A.1.b, *supra*; Ex. 1005, ¶¶3, 7, 16, 22, 26-27, 29, Figs. 1, 4. As I also show above for Element [1C], Cooper discloses grouping cable modems by assigning them to

⁴ Cooper’s use of the term “service group” to refer to network elements associated with a service group port at a headend does not impact the fact that the groups resulting from Cooper’s assignment of network elements (*e.g.*, cable modems) to respective logical channels satisfies the plain meaning of the claim term, “service group,” as simply a group of cable modems. Ex. 1005, ¶¶26-27; Ex. 1001, 2:24-27, 6:39-41, Figs. 3A-B, 4A-B; Ex. 1017, 55-57; Ex. 1018, ¶¶ 145-146, 148.

respective logical channels. *See* Section X.A.1.c, *supra*; Ex. 1005, ¶¶2, 6, 8-10, 19-20, 30, 32-33, 41, Figs. 5-6. Cooper does not explicitly disclose determining a “worst case” SNR for each group of cable modems assigned to each logical channel. A POSITA, however, would have found it obvious to do so in view of Saey’s teachings.

98. Saey teaches determining the worst-case SNR for a group of carriers on a communication channel that are used to communicate with different cable modems and determining modem operation parameters respectively relating to each carrier group based on each group’s worst-case SNR. Ex. 1007, Abstract, ¶¶3-4, 14, 25-27, 33, 43, Figs. 3, 5-6. Specifically, Saey teaches “analyz[ing] the SNR data for each individual carrier[,] ... determin[ing] the worst case SNR for the plurality of carriers, and us[ing] this worst case SNR to define a carriergroup [sic] parameter for the one carrier grouping.” Ex. 1007, ¶26; *see also id.*, ¶¶27, 42-43. In other words, Saey teaches that, once the individual carriers have been sorted into groups, the worst-case SNR in the group is used as the carrier group SNR parameter. Ex. 1007, ¶¶10, 13-14, 25-27, 32, 42-43, Figs. 3, 5-6. Saey further teaches that this worst-case SNR is then used to determine the gain and bit loading (the quantity of bits that can be loaded onto each symbol based on the SNR value) for communicating with the modems associated with the carrier group. Ex. 1007, ¶¶4, 5-6, 27, 33, 43, Fig. 3.

99. A POSITA would have recognized that bit loading “is applied to increase the modulation order at carriers with high signal to noise ratio and lower the modulation order at carriers with low signal to noise ratio” (SNR). Ex. 1015, 4:55-59, 8:1-19. A carrier’s SNR, for example, impacts the bit loading of the carrier, and thus the carrier’s modulation order (*e.g.*, 2 bits per symbol (bps) for QPSK, 4 bps for 16QAM, 5 bps for 32QAM). Ex. 1012, 14:54-16:34; Section X.A.1.e, *infra*; Section VIII.B-C, *supra*. Similar to Cooper, Saey’s method of grouping carriers that communicate with cable modems and determining a single parameter for the group allows the system to take advantage of similarity between carriers, which conserves system resources such as, for example, memory and/or transmission costs while also ensuring communication with all cable modems in a group. Ex. 1007, ¶¶14, 27; Ex. 1005, ¶¶11, 19.

100. A POSITA would have also found it obvious to apply Saey’s teaching of determining the worst-case SNR of the carriers for each cable modem group to Cooper’s selection of an optimal physical layer communication parameter (*e.g.*, modulation order) in order to take advantage of similarity between different carriers communicating within a channel, which conserves system resources (*e.g.*, memory, transmission costs) and ensures communication with all cable modems in a group. Ex. 1007, ¶¶14, 27.

101. As I show in the figure below from Cooper, its channel configuration screen includes a “Modulation Profile display panel 1004” (purple) that “provides the ability for the operator to configure various configuration profile templates which may later be assigned to an individual logical channel.” Ex. 1005, ¶36, Fig. 6. With this panel, an “operator may view, create and edit modulation profiles 1007.” *Id.* According to Cooper, its modulation profiles “optimize the specific needs of a subset of the network elements” (*i.e.*, cable modems). *Id.*

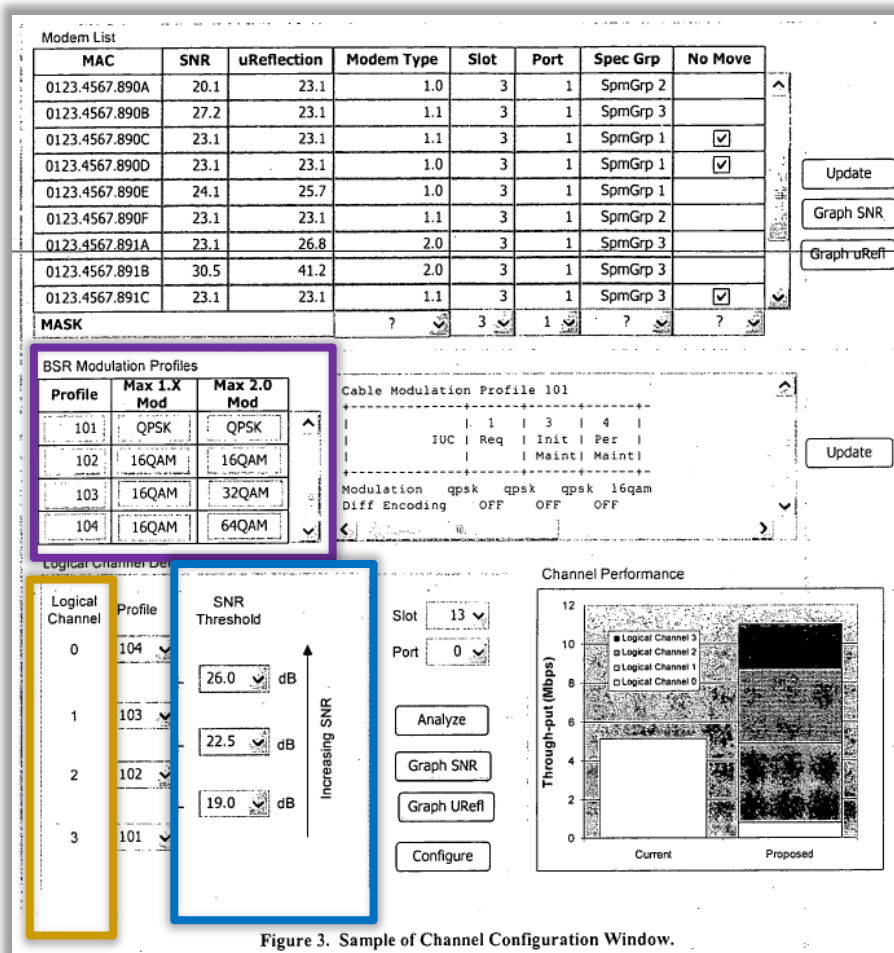


Figure 3. Sample of Channel Configuration Window.

Ex. 1006, 11 (annotated); *see also* Ex. 1005, Fig. 6.

102. As I show in the figure above, Cooper’s modulation profile display panel indicates the maximum modulation scheme used for 1.x cable modems and 2.0 cable modems. Ex. 1006, 11 (“channel configuration window shall also include a panel which displays the modulation profiles as configured on the BSR”), 12 (“[e]ach row represents a different profile” and “each row will display the maximum 1.x modem modulation used in the profile ... and the maximum 2.0 modem modulation used in the profile”). The following table summarizes the physical layer bandwidth and data rate for DOCSIS 1.0 and DOCSIS 2.0. For downstream channel bandwidth, both DOCSIS standards use 6 MHz channels. Ex. 1021, 23-24, (§§2.2.1, 2.3.1); Ex. 1023, 19 (§1.1.1), 43 (§4.2.1), 45-46 (§4.3.1). For upstream channel bandwidth, DOCSIS 1.0 uses channel widths between 200 kHz and 3.2 MHz, and DOCSIS 2.0 uses channel widths of 6.4 MHz. Ex. 1021, 40 (§4.2.2.3), 52 (§4.2.13); Ex. 1023, 93 (§6.2.16). For modulating upstream data, DOCSIS 1.0 uses QPSK or 16QAM, and DOCSIS 2.0 can use QPSK, 8QAM, 16QAM, 32QAM, 64QAM, and 128QAM with trellis coded modulation in S-CDMA mode (with an effective spectral efficiency equivalent to that of 64QAM). Ex. 1021, 13, 37-40 (§§4.2.1-2); Ex. 1023, 81-88 (§6.2.13), 113 (§6.2.23), 153 (Table 8–19).

	DOCSIS 1.0 (April 1999)	DOCSIS 2.0 (December 2001)
Access Method	TDMA	TDMA and S-CDMA

Downstream Bandwidth	6 MHz	6 MHz
Downstream Modulation	64QAM, 256QAM	64QAM, 256QAM
Upstream Channel Width	200 kHz to 3.2 MHz	200 kHz to 6.4 MHz
Upstream Modulation	QPSK, 16QAM	QPSK, 8QAM, 16QAM, 64QAM, 128QAM with Trellis Coded Modulation (TSM)

Ex. 1021, 13, 23-24, (§§2.2.1, 2.3.1), 37-40 (§§4.2.1-2), 40 (§4.2.2.3), 52 (§4.2.13), 53 (§4.3.4); Ex. 1023, 19 (§1.1.1), 43 (§4.2.1), 45-46 (§4.3.1), 58-61 (§§6.2.1-2), 61-62 (§6.2.3), 81-88 (§6.2.13), 93 (§6.2.16), 113 (§6.2.23), 114 (§6.3.3), 153 (Table 8–19). For example, Cooper’s Figure 6 (above) shows that logical channel (**gold**) “1” is assigned profile “103,” which is defined by SNR thresholds (**blue**) and which specifies a maximum modulation scheme of “16QAM” for 1.x cable modems and a maximum modulation scheme of “32QAM” for 2.0 cable modems. Ex. 1005, Fig. 6; *see also* Ex. 1006, 11 (Figure 3). Cooper’s Figure 6 also shows that logical channel “3” is assigned profile “101,” which specifies a maximum modulation scheme of “QPSK” for both 1.x and 2.0 cable modems. Ex. 1005, Fig. 6; *see also* Ex. 1006, 11 (Figure 3).

103. A POSITA would have found it obvious to apply Saey’s teaching of generating a worst-case SNR-profile for a carrier group to determine that group’s group physical layer communication parameters to Cooper’s method of configuring

modulation profiles in order to further Cooper's goals of "optimizing the performance of [Cooper's] network" and "optimizing physical layer configuration parameters" for cable modem groups. Ex. 1005, ¶¶11, 19, 39; Ex. 1007, ¶¶4, 5-6, 27, 33, 43, Fig. 3. As I discuss above, a POSITA would have appreciated that configuring Cooper's modulation profiles by selecting a modulation order (*e.g.*, QPSK, 16QAM, 32QAM, 64QAM) based on the worst-case SNR for a cable modem group would have ensured communication with all cable modems in the group while also optimizing the network.⁵

104. A POSITA would have been familiar with the various modulation schemes used in Cooper (*e.g.*, QPSK, QAM). For example, a POSITA would have understood that QPSK and QAM refer to "quadrature phase key shifting" and "quadrature amplitude modulation," respectively, and were well-known modulation schemes commonly employed in prior art cable systems like Cooper's. Ex. 1012, 14:54-58. A POSITA also would have known that different orders of QAM existed

⁵ Given that Cooper's cable modem groupings would have included different types of cable modems (*e.g.*, 1.x and 2.0), a POSITA would have found it obvious to select the maximum modulation scheme for each cable modem type and would have recognized that the selected modulation scheme would have been suitable for the cable modems of a given type in the cable modem group. Ex. 1005, ¶ 40, Fig. 6.

with higher QAM orders (*e.g.*, 16QAM, 64QAM, 256QAM, etc.) providing an increasing quantity of unique symbols and bits per symbol. Ex. 1012, 14:58-15:19, 15:66-16:27 (Table 2 listing different QAM orders).

105. A POSITA also would have found it obvious to apply Saey's teaching of determining the worst-case SNR for each cable modem group in order to implement Cooper's dynamic thresholds. Ex. 1005, ¶30. Cooper also acknowledges that "SNR parameters will vary over time because of such conditions as climate, temperature, and network degradation and maintenance." Ex. 1005, ¶40. Cooper discloses, therefore, that its CMTS automates periodically rerunning its logical channel configuration, including measuring parameters such as SNR for its CMs, assigning cable modems to the logical channels, and setting thresholds (*e.g.*, SNR thresholds) used to delineate the logical channels. Ex. 1005, ¶¶26-27, 30, 33, 39-40, 43, Fig. 6. Cooper further discloses that its thresholds may be dynamically determined based on measured network parameters. Ex. 1005, ¶30. A POSITA, therefore, would have an additional motivation to apply Saey's teaching of generating a worst-case SNR-profile for a carrier group in order to implement Cooper's dynamic SNR thresholds to address variance in a channel's SNR (*e.g.*, increases and decreases in SNR over time). Ex. 1007, ¶¶10, 13-14, 25-27, 32, 42-43.

106. Such a combination also would have been obvious because it would have been no more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Cooper's CMTS that applies modulation order parameters to CMs that are grouped based on a comparison of the CMs SNR characteristics and SNR thresholds, and Saey's method of determining a worst-case SNR for a group of cable modems also grouped based on the individual SNRs of the 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 modulation order to communicate with the cable modem service group. Applying Saey's teachings to Cooper's CMTS would have been well within the capabilities of a POSITA because it would have involved only minor modifications to the programming of Cooper's CMTS. *See* Ex. 1005, ¶42; Ex. 1007, ¶23.

107. In addition, applying Saey's teachings to Cooper's CMTS would have been well within the capabilities of a POSITA and would have involved only minor modifications to the programming of Cooper's CMTS. Ex. 1005, ¶42 (explaining Cooper's processes "may be implemented in hard wired devices, firmware or software running in a processor" and that the "processing unit for a software or

firmware implementation is preferably contained in the CMTS”). For example, a POSITA would have been able to modify the CMTS’ programming to iterate over the cable modems in each cable modem grouping, compare the SNR measurements to each other, and determine which SNR measurement was the worst-case (i.e., lowest) SNR measurement for the group. Ex. 1005, ¶¶26 (describing Figure 4’s iterative “process for automatically measuring network element parameters in a service group”), 30 (describing Figure 5’s iterative “process for reassigning network elements to logical channels”), Figs. 4-5. A POSITA also would have been able to modify the CMTS’ programming to iterate over each cable modem grouping to determine the worst-case SNR for each group.

108. Applying Saey’s teachings to Cooper would have therefore resulted in Cooper’s modified CMTS evaluating, for each of Cooper’s cable modem groupings, the set of individual SNRs measured for the cable modems of a group and determining the worst-case SNR of those evaluated for the group. As I show above for Elements [1B]-[1C], Cooper’s measured SNRs disclose the claimed “SNR-related metrics,” and Cooper’s cable modem groupings disclose the claimed “plurality of service groups.” *See* Sections X.A.1.b-c, *supra*. Moreover, Cooper’s modified CMTS teaches the claimed “generating, ... for each one of said plurality of services 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” by determining the worst-case SNR for each group of cable modems based on the sets of SNRs that Cooper’s modified CMTS respectively measured for each group.

109. Cooper-Saey’s teaching of the claimed “composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics” by selecting the worst-case (*e.g.*, the lowest SNR) of the cable modems in a cable modem group in order to generate that group’s composite SNR is consistent with what the ’682 patent discloses for the claimed “composite SNR-related metric.” For example, the ’682 patent discloses that a worst-case SNR profile simply includes multiple performance metric measurements (*e.g.*, SNR) for the cable modems of a particular service group. Ex. 1001, 4:9-20, Fig. 2B. The ’682 patent also teaches that physical layer parameters are determined based on the singular worst-case SNR for a service group. Ex. 1001, 5:40-46. I also understand that, in prior litigation, a District Court construed this phrase as having its plain meaning based on the ’682 patent’s disclosure. Ex. 1017, 53-55 (citing the ’682 patent at 4:9-20, 5:7-12, 5:42-57, 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. 1018, ¶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); Ex. 1019, 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. Therefore, Cooper-Saey teaches Element [1D].

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

111. Cooper-Saey discloses Element [1E]. As I show above for Element [1D], Saey teaches using the worst-case SNR determined for a group of carriers (subchannel) to select a network communication parameter for that carrier group. Ex. 1007, ¶¶26-27, 32, 42-43, Fig. 3 (step 340); Section X.A.1.d, *supra*. As also shown, Cooper’s CMTS operator selects the modulation order (*e.g.*, QPSK, 16QAM, 32QAM, 64QAM) for Cooper’s modulation profiles from the “Modulation Profile display panel” 1004 on Cooper’s channel configuration screen. Ex. 1005, ¶36, Fig. 6; *see also* Section X.A.1.d, *supra*. As further shown, Cooper’s modulation profiles are assigned to Cooper’s logical channels associated with Cooper’s cable modem groups (the claimed “plurality of service groups”). Ex. 1005, ¶36; Section X.A.1.c, *supra*.

112. The modulation order selected for Cooper's logical channels (*e.g.*, QPSK, 16QAM, 32QAM, 64QAM) thus discloses the claimed "one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups." Such disclosure in Cooper is very similar to the '682 patent's disclosure for this limitation. For example, the '682 patent explains that the claimed "physical layer communication parameter" includes "modulation type," "modulation order," and "modulation parameters." Ex. 1001, Abstract, 4:56-61. The '682 patent also explains that "modulation parameters" include "type of modulation" such as "phase shift keying (PSK)" and "quadrature amplitude modulation (QAM)." *Id.*, 4:63-66. The '682 patent also acknowledges the different orders of QAM (*e.g.*, 16QAM). *Id.*, 6:1-2 ("the second service group ... uses 16-QAM on channel z").

113. As I also discuss above for Element [1D], a POSITA would recognize that applying Saey's teaching of selecting the bit loading of the carrier based on an SNR metric would include selecting a modulation order based on SNR.

114. Cooper further discloses that its "[l]ogical channels ... are automatically ... configured by using measured network parameters" such as SNR. Ex. 1005, Abstract. Cooper explains that its CMTS automates aspects of its logical channel configuration including measuring parameters such as SNR for its cable modems, assigning cable modems to the logical channels, and setting thresholds

(e.g., SNR thresholds) used to delineate the logical channels. Ex. 1005, ¶¶26-27, 30, 33, 39-40, 43, Fig. 6. Cooper also contemplates fully automating its logical channel configuration by having the CMTS rerun these processes at regular intervals (e.g., daily, weekly, monthly, yearly). Ex. 1005, ¶¶40, 43.

115. Cooper generally explains that automating the determination of logical channels used by cable modems advantageously avoids having to travel to remote locations. Ex. 1005, ¶7. Cooper also explains that automating its logical channel configuration (e.g., using an “integrate[d] algorithm within the CMTS”) advantageously “provide[s] an optimal system performance while simultaneously dealing with any variations that might be encountered for some parameters over time.” Ex. 1005, ¶40. According to Cooper, “SNR parameters will vary over time because of such conditions as climate, temperature, and network degradation and maintenance.” *Id.*

116. Cooper thus discloses that automating configuration of its logical channels would have remedied circumstances where Cooper’s cable modems respective SNRs degrade over time to a point where a currently selected modulation scheme (e.g., 64QAM, 32QAM) was no longer suitable due to the rise in noise-induced errors resulting from the degrading SNR. Cooper further teaches that, by automating configuration of its logical channels, its CMTS would have been able to quickly respond to evolving SNR measurements without human intervention and

ensure each logical channel employed the optimal modulation scheme based on the current SNR conditions at its cable modems. Ex. 1005, ¶40.

117. Cooper (and therefore Cooper-Saey) thus teaches automating the selection of the modulation orders (*e.g.*, QPSK, 16QAM, etc.) for its modulation profiles based on a worst-case SNR metric determined for a group of cable modems as part of its logical channel configuration. Specifically, Cooper-Saey's CMTS (i) automatically selects the modulation profiles for Cooper's logical channels after measuring the SNR for each cable modem (Figure 4), (ii) assigns those cable modems to cable modem groupings based on their measured SNRs and the SNR thresholds delineating the logical channels (Figure 5), (iii) and determines the worst-case SNR (as taught by Saey) for each cable modem grouping. Sections X.A.1.b-d, *supra*. Cooper-Saey's CMTS also automatically selects the modulation order for the modulation profile associated with each logical channel based on the worst-case SNR determined for the cable modem grouping associated with that logical channel (the claimed "selecting, by said CMTS, one or more 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"). Section X.A.1.d, *supra*. Cooper-Saey's CMTS selects the modulation order based on a cable modem grouping's worst-case SNR to ensure the modulation order selected for the modulation profile was sufficiently tolerant of the individual SNRs measured for

each cable modem of that group. Thus, Cooper-Saey's CMTS automatically responds to changing SNR conditions over time and ensure its logical channels are configured with the optimal modulation schemes for current SNR conditions without human intervention. Ex. 1005, ¶40.

118. Moreover, such a combination would have been well-within the capabilities of a POSITA and would have involved only minor modifications to the programming of Cooper's CMTS. Ex. 1005, ¶42. For example, a POSITA would have been able to modify the CMTS' programming to automatically compare the determined worst-case SNR for a cable modem grouping to the respective SNRs and the number of bits per symbol (*e.g.*, 2 bps for QPSK, 3 bps for 8QAM, etc.) that various modulation schemes (*e.g.*, QPSK, 16QAM, 32QAM, 64QAM, etc.) would have been able to tolerate (*e.g.*, a minimum required SNR) and select a suitable modulation scheme based on those comparisons. A POSITA would have understood that suitable modulation schemes for a logical channel would have included modulation schemes requiring a minimum SNR that did not exceed the worst-case SNR measured for a cable modem grouping (*i.e.*, requiring a minimum SNR at or below the worst-case SNR). A POSITA, therefore, would have found it obvious to program Cooper's CMTS to select, for a logical channel, the highest order modulation requiring an SNR that did not exceed the worst-case SNR for the cable modem grouping assigned to that logical channel.

119. As further shown above for Element [1D], therefore, Cooper-Saey teaches a CMTS selecting a network communication parameter (*e.g.*, modulation order) for that group of modems based on a worst-case SNR metric for a service group of modems. Ex. 1007, ¶¶26-27, 32, 42-43, Fig. 3 (step 340); Section X.A.1.d, *supra*. Cooper-Saey's CMTS therefore teaches "selecting ... one or more physical layer communication parameters [(*i.e.*, the modulation order)] to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric."

120. Therefore, Cooper-Saey teaches Element [1E].

f. Element [1F]: "communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter."

121. Cooper-Saey teaches Element [1F]. As I show above for Element [1E], Cooper-Saey's CMTS selects the modulation order for the modulation profiles assigned to its logical channels based on the worst-case SNRs respectively determined for the cable modem groupings assigned to those logical channels. Ex. 1005, ¶36; Ex. 1007, ¶¶26-27, 32, 42-43, Fig. 3; Section X.A.1.e, *supra*. Cooper-Saey's CMTS thus communicates with the cable modems connected to it using the selected modulation order (*e.g.*, QPSK, 16QAM, 32QAM, 64QAM). Ex. 1005, ¶¶19, 30.

122. Therefore, Cooper-Saey teaches “communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.”

2. Dependent Claim 2: “The method of claim 1, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.”

123. Cooper-Saey teaches dependent claim 2. As I show above for Element [1E], Cooper-Saey’s CMTS teaches selecting a modulation order (*e.g.*, 16QAM, 32QAM, 64QAM) based on a composite SNR for the modulation profiles of the logical channels. Ex. 1005, ¶36, Fig. 6; *see also*, Section X.A.1.e, *supra*. Cooper-Saey’s modulation order teaches the claimed “physical layer communication parameter ...” as that term is used in the ’682 patent. Ex. 1001, 4:40-43.

3. Dependent Claim 7: “The method of claim 1, comprising assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.”

124. Independent claim 1 is taught by Cooper-Saey. Section X.A.1, *supra*. Claim 7 depends from independent claim 1 and requires “assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.” Ex. 1001, claim 7. Cooper discloses the additional limitation of dependent claim 7.

125. As I describe above for Element [1C], Cooper's CMTS measures the SNR associated with network elements (*e.g.*, cable modems), and the CMTS then assigns the network elements among a plurality of service groups based on the SNR measurement. Ex. 1005, ¶9. Section X.A.1.c, *supra*. In addition to assigning network elements to groups based on SNR measurements, Cooper discloses that the CMTS also determines the location of network elements (*e.g.*, cable modems) in a cable network, and then assigns the network elements among a plurality of service groups based at least in part on the location of the network element (the claimed "assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems"). Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Section X.A.1.c, *supra*.

126. Therefore, Cooper-Saey teaches dependent claim 7.

4. Dependent Claim 8: "The method of claim 1, comprising assigning any particular one of said 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."

127. Claim 1 is taught by Cooper-Saey. Section X.A.1, *supra*. Claim 8 depends from independent claim 1 and requires "assigning any particular one of said 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.” *Id.*, claim 8. Cooper discloses the additional limitations of dependent claim 8.

128. As I describe above for Element [1C], Cooper’s CMTS measures the SNR associated with network elements (*e.g.*, cable modems), and the CMTS then assigns the network elements among a plurality of service groups based on the SNR measurement. Section X.A.1.c, *supra*. In addition to assigning network elements to groups based on SNR measurements, Cooper also discloses assigning a network element to a service group based at least in part on amplifier cascade depth (the claimed “assigning any particular one of said 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”). Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Section X.A.1.c, *supra*

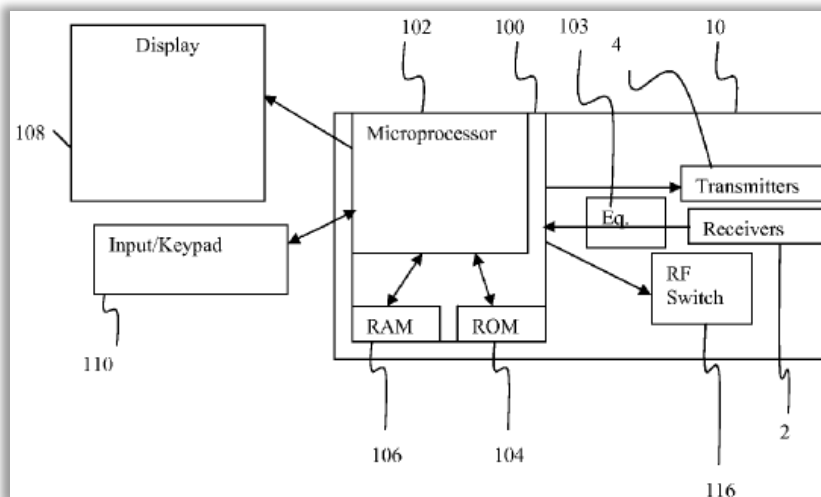
129. Therefore, Cooper-Saey teaches dependent claim 8.

5. Independent Claim 10

- a. 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:”**

130. Cooper’s “network,” which I describe above for Element [1B], discloses a “system” as recited in [10A]. Section X.A.1.b, *supra*; Ex. 1005, ¶22, Figs. 1-2. As I illustrate below in Figure 2, Cooper further discloses that CMTS 10 comprises circuitry that includes: (i) microprocessor 102 (the claimed “circuitry ...

comprising a ... processor”) that receives information such as instructions and data from a ROM 104 or RAM 106, and (ii) transmitters 4 and receivers 2 (the claimed “circuitry ... comprising a network interface”) that provide bi-directional communication with network elements 8. Ex. 1005, ¶¶22-25, Fig. 2.



Ex. 1005, Fig. 2

131. Therefore, Cooper-Saey teaches Element [10A].

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

132. I note that Elements [10B]-[10E] are nearly identical to Elements [1B]-1E] with the exception that Elements [10B]-[10E] recite that the “processor” in the CMTS “is configured to” perform the limitations recited in Elements [1B]-1E]. Cooper-Saey teaches that microprocessor 102 in CMTS 10 is configured to perform the limitations I describe above in Elements [1B]-[1E]. Sections X.A.1.b-e, *supra*; Ex. 1005, 22-25, Figs. 1-2. Accordingly, for the reasons I provide above with respect to Elements [1B]-[1E], Cooper-Saey’s microprocessor 102

teaches and is configured to perform the limitations recited in Elements [10B]-[10E].
Id.

133. I also note that Element [10F] is nearly identical to Element [1F] with the exception that [10F] recites that the claimed “network interface” is configured to perform the limitations recited in Element [1F]. Cooper-Saey teaches that transmitters 4 and receivers 2 (the claimed “network interface”) provide bi-directional communication with network elements 8. Ex. 1005, ¶¶22-25, Fig. 2. Accordingly, for the reasons I provide above with respect to Element [1F], Cooper-Saey comprises a network interface that teaches and is configured to perform the limitations recited in Element [10F]. *Id.*

6. Dependent Claims 11 and 16-17

134. I note that the language of dependent claim 11 is substantially similar to the language of dependent claim 2. Dependent claim 11 is therefore rendered obvious by Cooper-Saey for the same reasons as dependent claim 2. Section X.A.2, *supra*.

135. I note that the language of dependent claims 16-17 is substantially similar to the language of dependent claims 7-8, respectively, except that they identify “said processor” to make the assignments. Ex. 1001, 10:30-37. As discussed in Section X.A.5.a, Cooper’s CMTS comprises the claimed processor, and

therefore, dependent claims 16-17 are rendered obvious by Cooper-Saey for the same reasons as dependent claims 7-8. Sections X.A.3-4, *supra*.

B. Cooper in View of Gross Renders Claims 1–2, 7-8, 10-11, and 16-17 Obvious

1. Independent Claims 1 and 10

a. Elements [1A]-[1C] and Elements [10A]-[10C]

136. For the reasons I describe above for independent claim 1 and independent claim 10, Cooper discloses Elements [1A]-[1C] and [10A]-[10C]. Sections X.A.1.a-c and X.A.5.a-b, *supra*.

b. Element [1D] and Element [10D]

137. As I discussed above for Element [1C], Cooper discloses assigning cable modems to logical channels based on a comparison between the determined SNR for each cable modem and SNR thresholds. Section X.A.1.c, *supra*. Cooper does not explicitly disclose determining a “worst-case” SNR for each group of cable modems in each logical channel. A POSITA, however, would have found it obvious to do so in view of Gross’ teachings.

138. Gross teaches a method of setting communication parameters in a communication system between modems that ensures efficient transmission of data despite interruptions and/or disturbances in the network. Ex. 1008, Abstract, ¶¶22, 27. Gross teaches, for example, setting the communication parameter of bit allocation based on a measured carrier’s SNR. Ex. 1008, ¶¶14-15, 32, 43, 88. Bit

allocation is the number of bits that can be accommodated on a carrier and is dependent on the SNR. Ex. 1008, ¶¶14-15, 32, 88. A POSITA would have recognized this allocation as bit loading, which is a method of allocating a higher order of modulation to carriers that have higher signal to noise ratio and a lower order modulation to carriers that have lower signal to noise ratio. Ex. 1015, 8:1-19, 4:55-59. A POSITA would have understood that higher order QAM signals would have been capable of transmitting more information compared to lower order QAM signals. Ex. 1012, 16:33-34 (“by moving to a higher QAM modulation order it is possible to transmit more bits per symbol”). Such a POSITA, however, also would have appreciated that a fundamental tradeoff exists between a QAM signal’s digital bandwidth and its susceptibility to noise: a higher order QAM signal has a higher digital bandwidth than a lower order QAM signal but is less resilient to noise (and thus more likely to contain errors) whereas the lower order QAM signal has a lower digital bandwidth but is more tolerant of noise (and thus less likely to contain errors). Ex. 1012, 16:49-55, 30:55-31:8, 31:29-53, Figs. 6-9 (illustrating QAM constellations with different densities), Figs. 16. A carrier’s SNR thus impacts the bit loading of the carrier and thus the carrier’s modulation order (*e.g.*, 2 bits per symbol (bps) for QPSK, 4 bps for 16QAM, 5 bps for 32QAM). Ex. 1015, 4:55-59, 8:1-19, 9:9-11, 10:55-67, Fig. 10; Ex. 1012, 14:54-16:34; Section X.B.1.c, *infra*.

139. While Gross teaches setting communication parameters for each carrier, Gross also teaches a simplified approach that uses single, composite parameters to represent the “worst case” condition for communicating with a group of modems. Ex. 1008, ¶¶44, 100. The SNR of carriers communicating with different modems, for example, may be measured, and the “worst case” SNR may be chosen in order to determine a “worst case” or minimum bit allocation to communicate with any of the modems. Ex. 1008, ¶¶44, 100. A POSITA would have understood that this simplified approach assures transmission of data to any modem in the group regardless of which modems are activated. Ex. 1008, ¶¶44, 100.

140. A POSITA also would have found it obvious to apply Gross’ teaching of determining the worst-case SNR for a cable modem group to Cooper’s selection of the optimal modulation order of a logical channel is used to determine the modulation order for that channel. Ex. 1008, ¶¶44, 100; Ex. 1005, ¶36, Fig. 6. Like I discuss above for Element [1D] in the Cooper-Saey combination, Cooper allows the optimization of modulation profiles, and a POSITA would have appreciated that selecting a modulation order (*e.g.*, 16QAM, 32QAM, 64QAM) for a Modulation Profile based on the worst-case SNR of a cable modem group in order to ensure communication with all cable modems in the group regardless of which modems are activated. Section X.A.1.d, *supra*.

141. Similar to the Cooper-Saey combination, a POSITA also would have found it obvious to apply Gross' teaching of determining the worst-case SNR for each cable modem group in order to implement Cooper's dynamic thresholds. Ex. 1005, ¶30 As I further discuss above for Element [1D], Cooper acknowledges that SNR parameters will vary over time, requiring periodically rerunning its logical channel configuration, including measuring parameters such as SNR for its cable modems, assigning cable modems to the logical channels, and setting thresholds (*e.g.*, SNR thresholds) used to delineate the logical channels. Ex. 1005, ¶¶26-27, 30, 33, 37, 39-40, 43; Section X.A.1.d, *supra*; *see also* Section X.A.1.e. Cooper also discloses that thresholds may be dynamically determined based on measured network parameters. Ex. 1005, ¶30. A POSITA, therefore, also would have been motivated to apply Gross' teaching of generating a worst-case SNR-profile for a carrier group in order to implement Cooper's dynamic SNR threshold to address variance in the SNR measured for a channel.

142. A POSITA also would have found such a combination to be obvious because it would have been no more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Cooper's CMTS and Gross' method of determining a worst-case SNR for a group of modems based on the individual SNRs of the modems. The known methods include programming of 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. Furthermore, like I note above for the Cooper-Saey combination, Cooper-Gross’ teaching of the claimed “composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics” by selecting the worst-case (*e.g.*, the lowest SNR) of the cable modems in a cable modem group in order to generate that group’s composite SNR is consistent with what the ’682 patent discloses for the “composite SNR-related metric” as claimed. Ex. 1001, 4:9-20, 5:40-46, Fig. 2B; Ex. 1017, 53-55; Ex. 1018, ¶187; Ex. 1019, 8-10; Section X.A.1.d, *supra*.

143. Applying Gross’ teachings to Cooper’s CMTS would have been well within the capabilities of a POSITA because it would have involved only minor modifications to the programming of Cooper’s CMTS. Ex. 1005, ¶42; Ex. 1007, ¶23.

144. Cooper-Gross, therefore, teaches Element [1D] and Element [10D].

c. Elements [1E]-[1F] and Elements [10E]-[10F]

145. For reasons similar to those I describe above for Cooper-Saey, Cooper-Gross teaches Elements [1E]-[1F] and Elements [10E]-[10F]. Sections X.A.1.e-f and X.A.5.b, *supra*. In particular, Cooper-Gross’ CMTS would have similarly selected and used the modulation orders for its modulation profiles automatically based on the worst-case SNR metrics determined for the groups of cable modems

assigned to its logical channels to ensure communication with all modems in the group while also optimizing the network. Ex. 1005, ¶40; *see also* Sections X.A.1.e and X.A.5.b, *supra*. Cooper-Gross' CMTS also would have communicated with the cable modems connected to it using the selected modulation order. Ex. 1005, ¶¶19, 30; *see also* Sections X.A.1.f and X.A.5.b, *supra*.

2. Dependent Claims 2 and 11

146. For reasons similar to those that I describe above for Cooper-Saey, Cooper-Gross teaches dependent claim 2 and dependent claim 11. Sections X.A.2 and X.A.6, *supra*. In particular, Cooper-Gross' CMTS selects a modulation order (*e.g.*, QPSK, 16QAM, 32QAM) for its modulation profiles. Ex. 1005, ¶36, Fig. 6; *see also* Sections X.A.2 and X.A.6, *supra*. Cooper-Gross' modulation order teaches the claimed “physical layer communication parameter ...” as that term is used in the '682 patent. Ex. 1001, 4:40-67.

3. Dependent Claims 7-8 and 16-17

147. For reasons similar to those that I describe above for Cooper-Saey, Cooper-Gross teaches dependent claims 7-8 and dependent claims 16-17. Sections X.A.3-4 and X.A.6, *supra*. In particular, with regard to dependent claim 7 and dependent claim 16, Cooper-Gross teaches a CMTS comprising a processor configured to assign cable modems among a plurality of services groups based at least in part on distances between the CMTS and cable modems. Ex. 1005, Abstract,

¶¶8, 21, 27-28, 37; *see also* Sections X.A.3-4 and X.A.6, *supra*. In addition, with regard to dependent claim 8 and dependent claim 17, Cooper-Gross teaches a CMTS comprising a processor configured to assign a cable modem to a service group based at least in part on which of a plurality of branch amplifiers is upstream of the cable modem. *Id.*

C. Cooper in View of Saey and Monk or Cooper in View of Gross and Monk Render Claims 1-8 and 10-17 Obvious

1. Claims 1-2, 6-8, 10-11, and 15-17

148. As I describe above for Element [1E] and [10E], Cooper-Saey and Cooper-Gross teach a CMTS that selects a network communication parameter (*e.g.*, modulation order) for a group of modems based on a worst-case SNR metric for a service group of modems. Sections X.A.1.e, X.A.5.b, and X.B.1.c, *supra*. Cooper-Saey and Cooper-Gross, therefore teach Element [1E] and Element [10E].

149. In the event that it is asserted that Cooper-Saey or Cooper-Gross do not teach Element [1E], for example, because a POSITA would not have recognized that Saey's selection of a bit loading parameter or Gross' selection of a bit allocation parameter teaches the selection of Cooper-Saey's or Cooper-Gross' modulation order, then Monk expressly discloses this. *See* Sections X.A.1.e and X.B.1.c, *supra*. Specifically, Monk discloses different methods of multi-carrier communication that address signal impairments, such as of multipath and high attenuation in building cable wiring, that restrict high bandwidth communication with cable modems. Ex.

1015, Abstract, 1:29-31, 4:25-43. For example, Monk discloses that bit loading includes allocating more bits per carrier, which “is applied to increase the modulation order at carriers with high signal to noise ratio and lower the modulation order at carriers with low signal to noise ratio.” Ex. 1015, 4:55-59, 8:1-19, 10:55-67, Fig. 10. Monk teaches, for example, that carriers with higher SNRs can support higher order modulations (*e.g.*, 16QAM or 64QAM), while carriers with lower SNRs use lower order modulations (*e.g.*, QPSK). Ex. 1015, 4:55-59, 8:1-19, 9:9-11, 10:55-67, Fig. 10. Monk further discloses that selecting the appropriate modulation order based on the SNR—along with bit-loading, modulation order, and power control—helps to overcome problems of multipath and high attenuation in building cable wiring while still maximizing a carrier’s data capacity. Ex. 1015, 4:38-43, 4:55-59, 8:1-19, 10:57-64.

150. A POSITA would have found it obvious to apply Monk’s teachings to Cooper-Saey’s and Cooper-Gross’ method of using a composite SNR to select a physical layer communication parameter by selecting a modulation order (as an application of bit loading/allocation) instead because this would better maximize data capacity and ensure communication with all modems in the group while also optimizing the network, in light of common problems of multipath and high attenuation in building cable wiring.

151. The Cooper-Saey and the Cooper-Gross combinations also 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 Cooper-Saey's and Cooper-Gross' CMTS that selects physical layer communication parameters based on a worst-case composite SNR and Monk's method of selecting a modulation order based on an SNR. The known methods include programming of a CMTS. The predictable results include a CMTS that selects a modulation order based on a worst-case composite SNR.

152. Applying Monk's teachings to Cooper-Saey's/Cooper-Gross' CMTS would have been well within the capabilities of a POSITA and would have involved only minor modifications to the programming of the CMTS. *See* Ex. 1005, ¶42; Ex. 1015, 10:22-31.

153. Cooper-Saey-Monk's and Cooper-Gross-Monk's CMTS, therefore, teaches "selecting ... one or more physical layer communication parameter [(i.e., the modulation order)] to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric" as claimed. Therefore, Cooper-Saey-Monk and Cooper-Gross-Monk render claims 1-2, 6-8, 10-11 and 15-17 obvious.

2. 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.”**

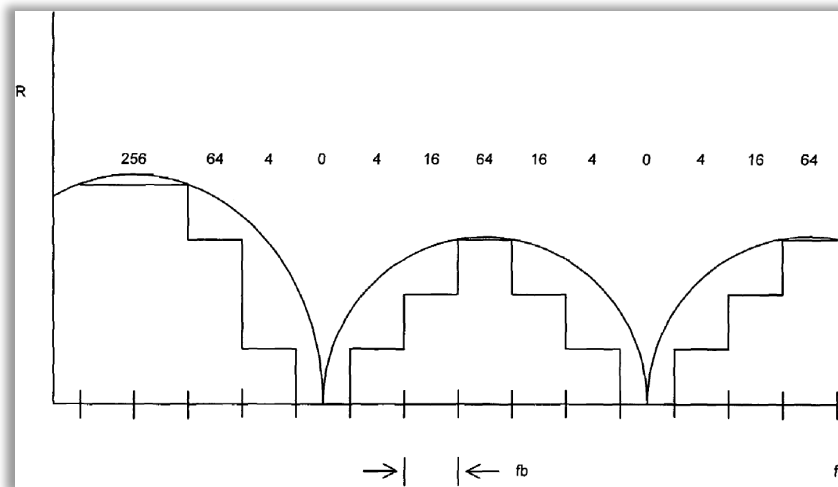
154. As I describe above, independent claim 1 is taught by Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk. Sections X.A.1, X.B.1, and X.C.1, *supra*. Claim 3 depends from claim 1 and includes additional requirements regarding the use of OFDM. Ex. 1001, claim 3. As I discuss above for Elements [1D]-[1F], Cooper-Saey and Cooper-Gross teach that the CMTS selects a physical layer communication parameter and then, using that parameter, communicates with one or more cable modems. *See* Sections X.A.1.d-f and X.B.1.b-c, *supra*. Although Cooper-Saey, Cooper-Gross, and the combinations that include Monk do not teach communicating using OFDM over a plurality of subcarriers, Monk discloses this feature. And as I explain below, a POSITA would have found it obvious to further modify each of these combinations based on the additional teachings in Monk.

155. Monk discloses a method of communication over a broadband network using OFDM. Ex. 1015, Abstract, 4:25-38, 4:60-64, 7:13-9:19, Figs. 5-6, 10. Specifically, Monk discloses dividing a frequency bandwidth into narrower channels or “bins” to transmit subcarriers, which are an integer multiples of a common frequency. Ex. 1015, 7:14-16, 8:20-28. Each of these subcarriers is independent and can be modulated on a per-subcarrier basis depending on the channel’s SNR,

with higher SNR channels supporting higher data capacity or modulation schemes.

Ex. 1015, 8:1-19, 10:55-67.

156. Monk's Figure 10 (below), for example, shows an OFDM waveform in which the different subcarriers that correspond to frequency bins with a bandwidth of "fb" have different SNR and are encoded with a different QAM (*e.g.*, 4, 16, 64, 256) based on the level of response at each frequency bin, which corresponds to that bin's SNR. Ex. 1015, 10:55-67.



Ex. 1015, Fig. 10

157. Monk teaches that, by using OFDM, cable TV networks can overcome signal impairments caused by issues such as noise, coupling, and/or micro-reflections. Ex. 1015, 4:16-43, 6:20-27, 7:36-50. OFDM, for example, allows data bits that are generated at a higher rate to be distributed over many subcarriers with lower data rates, which reduces the potential of interference. Ex. 1015, 7:36-50.

158. A POSITA would have been motivated to combine the OFDM communication techniques taught by Monk with the communication techniques taught by Cooper-Saey's and Cooper-Gross' CMTS in order to overcome signal impairments caused by reflections in a real-world cable TV network. As I discuss above for Element [1E], Cooper-Saey's and Cooper-Gross' communication techniques teach selecting different modulation orders for different carriers or channels based on a composite worst-case SNR. *See* Sections X.A.1.e and X.B.1.c. And although Cooper, Saey, and Gross acknowledge that there are ever increasing capacity demands put on communication networks (*e.g.*, cable networks) to transmit higher quality and reliable services, none addresses the issue of signal impairments caused by imperfect terminations in connections and impedance mismatches. *See* Ex. 1005, ¶4; Ex. 1007, ¶¶2-3; Ex. 1008, ¶¶10, 22. Monk's OFDM communication technique would address this issue, allowing for higher quality and more reliable services to each service group by splitting up each logical channel further and allowing bits to be spread over multiple subcarriers, which would still utilize different modulation orders of QAM but on a per-subcarrier basis depending on a SNR.

159. Such combinations also 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 Cooper-Saey's

and Cooper-Gross' CMTS method of communication and Monk's OFDM method. The predictable results include a CMTS that uses OFDM to communicate over a plurality of subcarriers that use QAM on a per-subcarrier basis.

160. Applying Monk's teachings to Cooper-Saey's and Cooper-Gross' CMTS also would have been well within the capabilities of a POSITA as it would have only required modifications to the programming of the microprocessor in the CMTS. A POSITA would have a reasonable expectation of success in these programming modifications as Cooper-Saey's and Cooper-Gross' microprocessor would function as a programmed signal processor, which Monk discloses may be used for its OFDM method, and OFDM was a well-known technique. Ex. 1005, ¶¶8, 24-25, 42; Ex. 1015, 10:22-31. Cooper-Saey's and Cooper-Gross' CMTS as modified by Monk, therefore, teaches the claimed use of "(OFDM) over a plurality of subcarriers for said communicating."

161. Therefore, dependent claim 3 is invalid as obvious over Cooper-Saey-Monk and Cooper-Gross-Monk.

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

162. Dependent claim 3 is taught by Cooper-Saey-Monk and Cooper-Gross-Monk. Section X.C.2, *supra*. Claim 4 depends from dependent claim 3 and includes additional requirements regarding selecting a physical layer communication

parameter. Ex. 1001, claim 4. As I discuss above for dependent claim 3, Cooper-Saey-Monk's and Cooper-Gross-Monk's CMTS teaches using OFDM where a particular modification scheme (*e.g.*, QAM) is selected on a per-subcarrier basis depending on a SNR. Section X.C.2; Ex. 1015, 7:14-16, 8:1-28, 10:55-67, Fig. 10. Cooper-Saey's and Cooper-Gross' CMTS as modified by Monk, therefore, also teaches the CMTS "selecting ... said one or more physical layer communication parameter on a per-OFDM-subcarrier basis" as claimed.

163. Dependent claim 4, therefore, is invalid as obvious over Cooper-Saey-Monk and Cooper-Gross-Monk.

4. Dependent Claim 5: "The method of claim 4, wherein said one or more physical layer communication parameter includes 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."

164. As I show above, dependent claim 4 is taught by Cooper-Saey-Monk and Cooper-Gross-Monk. Section X.C.3, *supra*. Claim 5 depends from dependent claim 4 and includes additional requirements regarding the physical layer communication parameter. Ex. 1001, claim 5.

165. As I discuss above for Element [1E], Cooper-Saey-Monk's and Cooper-Gross-Monk's CMTS selects "one or more physical layer communication parameter" on a per-OFDM-subcarrier basis based on a composite SNR-related metric. Sections X.A.1.e, X.B.1.c, X.C.1, and X.C.3, *supra*. Cooper also discloses

the use of DOCSIS CMTSs and modems, which transmit and receive in different, designated frequency bands that would determine which frequencies of OFDM subcarriers are used for communication between equipment. Ex. 1005, Abstract, ¶¶5-6, 8, 11, 20-21, 27; Ex. 1021, 1, 3 (Figure 0-2 indicating different frequencies for transmitting and receiving at the headend), 7 (Section 2.2.1 describing a frequency plan for downstream and upstream signals), 8 (Table 0-1 indicating frequencies for downstream transmissions), 9 (Table 0-2 indicating frequencies for upstream transmissions); Ex. 1022, i (DOCSIS 1.1 standard), 4 (Figure 1-2), 7 (frequency plan), 8-9 (Table 2-1 indicating frequencies for downstream transmissions), 10 (Table 2-2 indicating frequencies for upstream transmissions); Ex. 1023, i (DOCSIS 2.0 standard), 3 (Figure 1-2), 25 (frequency plan), 27 (Table 4-1 indicating frequencies for downstream transmissions and Table 4-2 indicating frequencies for upstream transmissions). This is consistent with Monk's disclosure, which also shows different frequency bands used for upstream and downstream signals. Ex. 1015, 5:66-6:5, Fig. 4.

166. As I discuss above for Element [1B], Cooper further discloses that the CMTS determines separate upstream (*i.e.*, "transmission to said CMTS") and downstream (*i.e.*, "reception of information from said CMTS") SNR metrics. Ex. 1005, ¶¶8, 27; Section X.A.1.b, *supra*. Because Cooper discloses determining separate upstream and downstream SNR metrics in different frequency bands,

Cooper-Saey-Monk's and Cooper-Gross-Monk's CMTS teaches selecting a separate upstream and downstream "one or more physical layer communication parameter" on a per-OFDM-subcarrier basis based on a composite upstream or downstream SNR-related metric. Thus, Cooper-Saey-Monk's and Cooper-Gross-Monk's CMTS teaches "one or more physical layer communication parameter includes 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.

167. Dependent claim 5, therefore, is invalid as obvious over Cooper-Saey-Monk and Cooper-Gross-Monk.

5. Dependent Claim 6

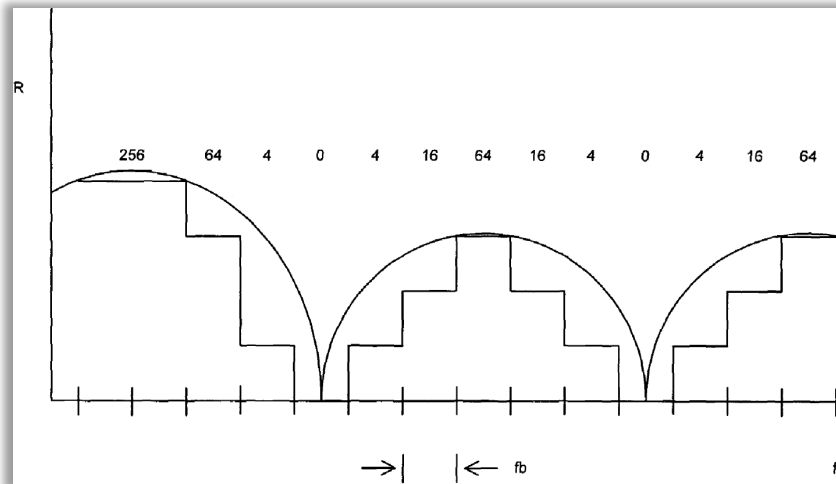
- a. Element [6A]: "The method of claim 1, wherein: said plurality of service groups comprises a first service group and a second service group; said first service group has a first composite SNR versus frequency profile, said second service group has a second composite SNR versus frequency profile,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

168. As I show above, independent claim 1 is taught by Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk. Sections X.A.1, X.B.1, X.C.1, *supra*. Claim 6 depends from independent claim 1 and includes additional requirements relating to the service groups and assigning cable modems to the service groups. Ex. 1001, claim 6.

169. As I show above for Element [1C], Cooper assigns cable modems into at least four different service groups or logical channels based on comparing a modem's measured SNR to an SNR threshold. Ex. 1005, ¶¶31-33, 41, Fig. 6; Sections X.A.1.c and X.B.1.a, *supra*. Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk teach at least “a first service group and a second service group” as claimed.

170. As I also show above for Element [1D], Cooper-Saey and Cooper-Gross teach generating a composite SNR-related metric for each service group based at least in part on a worst-case SNR profile. Sections X.A.1.d and X.B.1.b, *supra*. While Cooper-Saey, Cooper-Gross and the combinations above that include Monk do not expressly describe these composite SNRs as SNR versus frequency profiles, Monk discloses this feature and a POSITA would have found it obvious to further modify each of these combinations based on the additional teachings in Monk.

171. As I show below, Monk's Figure 10 shows a signal's SNR profile over a channel that has been segmented into different frequency bins of width f_b and with different QAM orders applied (*e.g.*, 4, 16, 64, 256). Ex. 1015, 10:55-67.



Ex. 1015, Fig. 10

172. Monk's Figure 10 shows a SNR versus frequency profile similar to line 222 in Figure 2B of the '682 patent. *Compare* Ex. 1001, 4:6-17, Fig. 2B; *with* Ex. 1015, 10:55-67, Fig. 10. Although Monk's Figure 10 shows OFDM signal, a POSITA would recognize, and the '682 patent acknowledges, that such SNR versus frequency profiles can apply to an SNR profile over a frequency range for one modem or a group of modems. Ex. 1001, 4:13-15. As seen above, an SNR profile over a range of frequencies indicates the maximum modulation order for each frequency band. *See* Ex. 1015, 4:55-59, 8:1-19, 10:55-67.

173. A POSITA would have found it obvious to apply Monk's teachings of determining an SNR profile over a range of frequencies to Cooper-Saey's, Cooper-Gross', Cooper-Saey-Monk's, and Cooper-Gross-Monk's method of determining an SNR metric in order to optimize modulation order by both SNR and frequency. *See* Sections X.A.1.b and X.B.1.a, *supra*. While Cooper discusses modems

communicating in dedicated bands of frequencies, Monk's methods would allow the CMTS of Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk to divide those frequency bands into multiple channels and determine which frequency band best suits each communication. *See* Ex. 1005, ¶3. For example, when assigning each cable modem to a plurality of service groups based on an SNR versus frequency profile, a CMTS would assign modems by their SNR versus frequency profile rather than singular SNR thresholds.

174. Furthermore, and for similar reason that I explain above for Element [1D], once the modems have been assigned to a service group, a POSITA would have also found it obvious to apply Monk's teaching to Cooper-Saey's, Cooper-Gross', Cooper-Saey-Monk's, and Cooper-Gross-Monk's CMTS to determine a first composite SNR versus frequency profile for each service group so as to determine an optimal modulation order and optimal frequency band for each of Cooper's Modulation Profiles as well as dynamically adjust thresholds based on these measured composite SNR versus frequency profiles. Ex. 1005, ¶¶11, 19, 30, 39; Sections X.A.1.d and X.B.1.b, *supra*.

175. Implementing this combination would have been nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Cooper-Saey's, Cooper-Gross', Cooper-Saey-Monk's, and Cooper-Gross-Monk's CMTS that measures and assigns modems

to service groups based on their measured SNR, and determines a worst-case SNR for each group as well as Monk's method of measuring a modem's SNR over a range of frequencies. The known methods include programming a CMTS. The predictable results include a CMTS that measures and assigns modems to service groups based on their measured SNR versus frequency profile, and determines a composite SNR versus frequency profile for each group.

176. Applying Monk's teachings to Cooper-Saey's, Cooper-Gross', Cooper-Saey-Monk's, and Cooper-Gross-Monk's CMTS would have been well within the capabilities of a POSITA and would have involved only minor modifications to the programming of the CMTS. *See also* Ex. 1005, ¶42; Ex. 1015, 10:22-31.

177. The combinations of Cooper-Saey-Monk and Cooper-Gross-Monk described in this section teach the claimed "first composite SNR versus frequency profile" and "second composite SNR versus frequency profile" associated with their respective service group. Further, because these combinations also teach measuring a SNR versus frequency profile for each modem, the combinations also teach "a particular cable modem has a particular SNR versus frequency profile."

178. Cooper-Saey-Monk and Cooper-Gross-Monk, therefore, teach the additional requirements of Element [6A].

- b. Element [6B]: "said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular 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 particular 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.”

179. As I discuss above for Element [6A], Cooper-Saey-Monk and Cooper-Gross-Monk teach at least a first and second service group that each have their own composite SNR versus frequency profile. Section X.C.5.a, *supra*. Cooper-Saey-Monk and Cooper-Gross-Monk also teach “a particular cable modem has a particular SNR versus frequency profile.” *Id.* Cooper-Saey-Monk and Cooper-Gross-Monk teaches assigning the particular cable modem to the service group that has a composite SNR versus frequency profile most similar to the particular SNR versus frequency profile of the particular cable modem as required by Element [6B].

180. Cooper discloses that modems are assigned to logical channels based on their individual measured values compared with the threshold values. Ex. 1005, ¶¶8, 30-31. Cooper also discloses that these thresholds can be dynamic and updated based on network measurements. Ex. 1005, ¶30. Cooper then teaches assigning or reassigning modems to logical channels based on these updated thresholds. Ex. 1005, ¶31. Thus, based on this teaching, Cooper-Saey-Monk and Cooper-Gross-Monk teaches assigning the particular modem to the service group with a composite

SNR versus frequency profile that is the most similar to the modem's particular SNR versus frequency profile.

181. Dependent claim 6, therefore, is invalid as obvious over Cooper-Saey-Monk and Cooper-Gross-Monk.

6. Dependent Claims 12-15

182. Dependent claim 12 is substantially similar to dependent claim 3 except that it identifies "said network interface and cable modems" are configured to use OFDM. Ex. 1001, 9:41-44. As discussed, Cooper's CMTS comprises the claimed network interface that it uses to communicate with CMs, and therefore, dependent claim 12 is rendered obvious by Cooper-Saey-Monk and Cooper-Gross-Monk for the same reasons as claim 3. Sections X.A.5.a, X.B.1.a, X.C.2, *supra*.

183. Dependent claim 13 is substantially similar to dependent claim 4 except that it identifies "said network interface" is configurable on a per-OFDM-subcarrier basis. Ex. 1001, 9:45-10:2. As discussed, Cooper's CMTS comprises the claimed network interface, and therefore, dependent claim 13 is rendered obvious by Cooper-Saey-Monk and Cooper-Gross-Monk for the same reasons as claim 4. Sections X.A.5.a, X.B.1.a, X.C.3, *supra*.

184. Dependent claim 14 is substantially similar to dependent claim 5. Dependent claim 14, therefore, is rendered obvious by Cooper-Saey-Monk and Cooper-Gross-Monk for the same reasons as claim 5. Section X.C.4, *supra*.

185. Dependent claim 15 is substantially similar to dependent claim 6. Claim 15 is therefore rendered obvious by Cooper-Saey-Monk and Cooper-Gross-Monk for the same reasons as claim 6. Section X.C.5, *supra*.

D. Cooper in View of Saey, Monk, and Cooper-437 or Cooper in View of Gross, Monk, and Cooper-437 Render Claims 9 and 18 Obvious

- 1. Dependent Claim 9: “The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem.”**

186. Independent claim 1 is taught by Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk. Sections X.A.1, X.B.1, and X.C.1, *supra*. Claim 9 depends from claim 1 and further requires that the “determining said plurality of SNR-related metrics comprises” the following:

transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and
receiving a metric reporting message from each cable modem.

Ex. 1001, claim 9.

187. As I discuss above for Element [1B], Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk, teach determining a SNR-related metric for each cable modem served by the CMTS based on a measurement at either

the CMTS or the cable modem. Sections X.A.1.b, X.B.1.a, X.C.1, *supra*. While none of these combinations 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 Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, or Cooper-Gross-Monk in view of Cooper-437.

188. Monk discloses a method of communication over a broadband network that relies on different modulation schemes based on a communication channel's SNR. Ex. 1015, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. For example, Monk teaches that higher SNR channels can support 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. 1015, 4:55-59, 8:1-10, 9:9-11, 10:58-62. To determine the SNR of a channel, 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. Ex. 1015, 4:44-59, 9:28-41, Abstract. 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. 1015, 9:41-50. Monk, which lists the same assignee as the '682 patent, acknowledges that determining an SNR profile from a known signal was well known in the art. Ex. 1015, 10:2-5.

189. A POSITA would have found it obvious to transmit a probe message to each cable modem (the claimed “transmitting a probe message to each cable modem”) and to receive a reporting message including SNR raw data or a bit loading profile (the claimed “receiving a metric reporting message from each cable modem”) as taught by Monk in order to implement Cooper’s disclosure of measuring an SNR-related metric at each cable modem and reporting it back to the CMTS. Ex. 1005, ¶11; Ex. 1015, 4:44-59, 8:4-5, 9:9-11, 9:26-41, 10:60-62, Abstract. A POSITA would have further found it obvious to measure at the CMs to distribute processing requirements among the CMs.

190. Incorporating the use of Monk’s probe messages and reporting messages into the proposed combinations 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 the Cooper-Saey, Cooper-Gross, Cooper-Saey-Monk, and Cooper-Gross-Monk combinations and the probe messages and reporting messages of Monk. The known methods include programming the CMTS to send probe messages and receive reporting messages that provide an analysis of a channel’s SNR. The predictable results include a system that uses probe messages and reporting messages to have cable modems rather than a CMTS measure the SNR of a channel.

191. Applying Monk's teachings to the CMTS in the proposed combinations would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the microprocessor in the CMTS. A POSITA would have a reasonable expectation of success in making these programming modifications as the microprocessor in the proposed combinations would function as a programmed signal processor, which Monk discloses may be used for its teachings. Ex. 1005, ¶¶8, 24-25, 42; Ex. 1015, 10:22-31.

192. While Monk teaches a probe message, it does not teach a probe message that includes instructions for measuring a metric and reporting said measured metric back to the CMTS. Cooper-437, however, does. Cooper-437 discloses a method for a CMTS to ask for and receive specific noise signal power measurements from cable modems in its network. Ex. 1016, 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. 1016, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1.

193. After receiving the probe message, a 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. 1016, 10:56-11:28, Table 1. By including the measurement and reporting modes

(*i.e.*, instructions) in the message, Cooper-437's method 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. 1016, 8:9-64, 10:56-11:28, Table 1.

194. A POSITA would have found it obvious to modify Monk's probe message (which initiates the measurement of channel characteristics) to identify a measurement mode and reporting mode, as taught by Cooper-437, so that the CMTS in the proposed combinations can send customized probe messages to specific CMs or service groups to determine the SNR of specific service groups or at specific frequencies. Such a modification would allow a CMTS to more quickly identify groups of modems or frequencies that have had a change in their SNR.

195. 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") also would have been nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Cooper-Saey's, Cooper-Gross', Cooper-Saey-Monk's, and Cooper-Gross-Monk's probe message as well as Cooper-437's measurement mode and reporting mode. 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

196. Applying Cooper-437's teachings to the CMTS in the proposed combinations would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the microprocessor in the CMTS. A POSITA would have a reasonable expectation of success in these programming modifications as the proposed combinations 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. 1005, ¶¶8, 20-21, 24-25, 27, 42; Ex. 1016, 5:3-14, 7:6-22.

197. Accordingly, Cooper-Saey-Monk or Cooper-Gross-Monk in view of Cooper-437 teach claim 9.

2. Dependent Claim 18

198. The language of dependent claim 18 is substantially similar to the language of dependent claim 9. Cooper-Saey-Monk or Cooper-Gross-Monk in view of Cooper-437, therefore, teach dependent claim 18 for the same reasons as claim 9. Section X.D.1, *supra*.

E. Prodan in View of Saey Renders Claims 1-2 and 6 Obvious

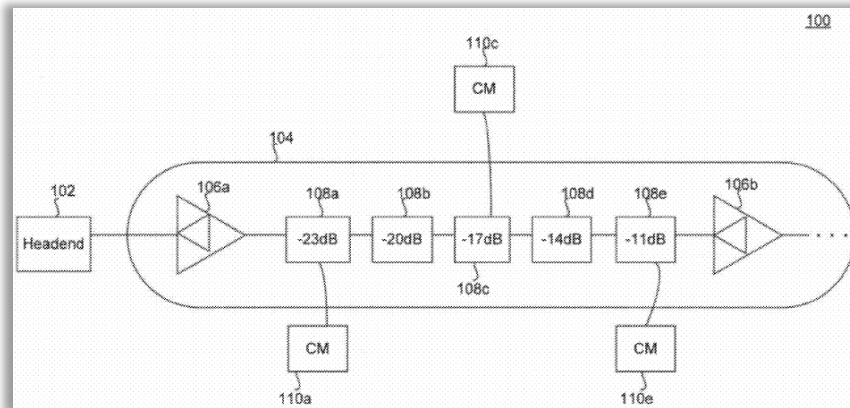
1. Independent Claim 1

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

199. To the extent the preamble [1A] is limiting, Prodan discloses it. Specifically, Prodan discloses a “method of assigning transmission frequency bands to cable modems in a cable network.” Ex. 1011, ¶¶12, 42; *see also id.*, ¶¶11, 30, claims 1 and 16.

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

200. As I illustrate below in Figure 1, Prodan discloses a network of cable modems 110a, 110c, and 110e (hereinafter “CMs”) connected to headend 102. Ex. 1011, ¶16, Fig. 1.



Ex. 1011, Fig. 1

201. Prodan further provides that a CMTS (the claimed “cable modem termination system”) may sit between the cable modems and headend 102. Ex.

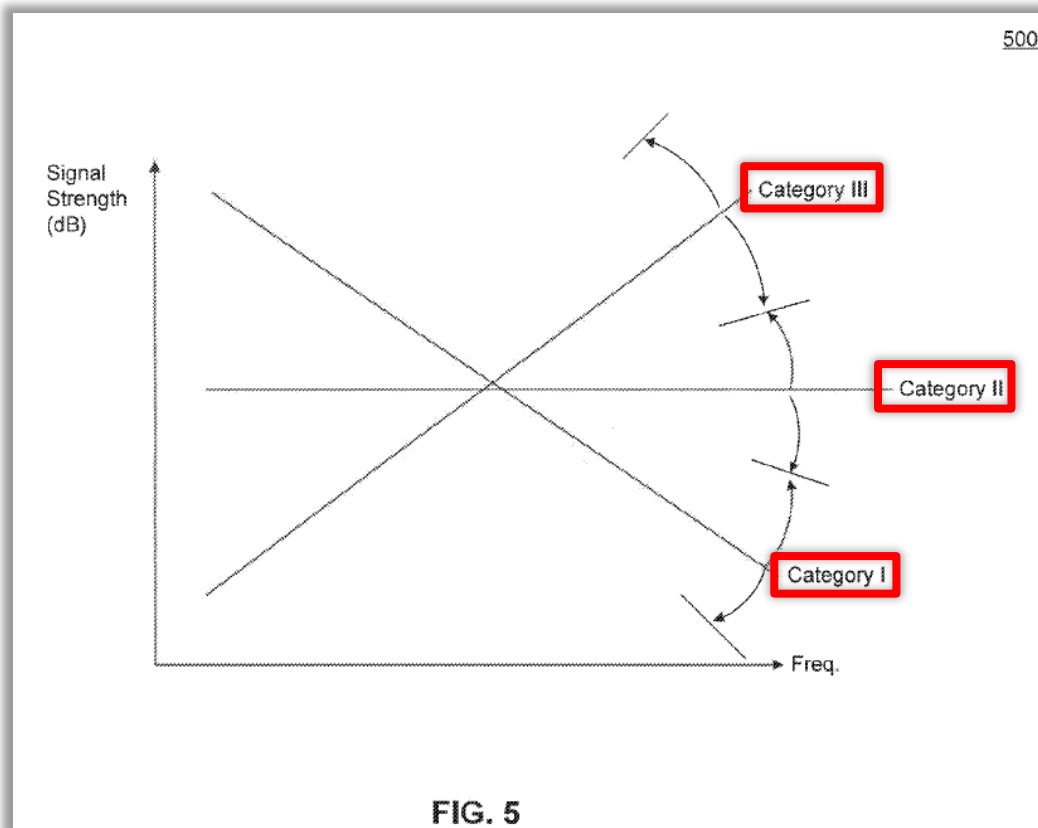
1011, ¶32. According to Prodan, the CMTS measures the signal strength versus frequency profiles of the cable modems. Ex. 1011, ¶¶25, 32, 44. Prodan explains that different measures are associated with the signal strength, including SNR. Ex. 1011, ¶32. Prodan's signal strength versus frequency profiles, therefore, represent SNR versus frequency profiles (the claimed "signal-to-noise ratio (SNR) related metric"). Ex. 1011, ¶32, claim 5 ("The method of claim 1, wherein said signal strength versus frequency profiles represent signal-to-noise ratio (SNR) versus frequency profiles."). Prodan thus 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 each cable modem served by said CMTS, a corresponding [SNR] related metric").

202. Therefore, Prodan discloses Element [1B].

c. Element [1C]: "assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;"

203. Prodan discloses that each of the cable modems are into multiple categories based on the SNR versus frequency profile of each cable modem. Ex. 1011, ¶¶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. 1011, Fig. 5.



Ex. 1011, Fig. 5 (annotated)

204. 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 CM'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. 1011, ¶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.”).

205. Prodan further explains that this category information is used to make frequency allocation decisions and/or modulation scheme assignment decisions. Ex. 1011, ¶34. Thus, 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 [1C]. *See* Section X.A.1.c, *supra*.

206. Therefore, Prodan discloses limitation [1C].

- 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 SNR-related metrics corresponding to said one of said plurality of service groups;”**

207. Prodan-Saey 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. 1011, ¶¶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. 1011, ¶¶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-Saey does.

208. As I discuss above for Element [1D], Saey teaches determining the worst-case SNR for a group of carriers (sub-channels) on a communication channel and determining modem operation parameters respectively relating to each carrier group based on each group’s worst-case SNR. Section X.A.1.d, *supra*; Ex. 1007, Abstract, ¶¶9-14, 25-27, 33, 42-43, Figs. 3, 5-6. Specifically, Saey teaches “analyz[ing] the SNR data for each individual carrier[,] ... determin[ing] the worst case SNR for the plurality of carriers, and us[ing] this worst case SNR to define a carriergroup [sic] parameter for the one carrier grouping.” *Id.*, ¶26; *see also id.*, ¶¶27, 42-43. Put differently, Saey teaches grouping carriers based on a measured network parameter, such as SNR for example, and assigning the worst-case measurement for the group (*e.g.*, the worst-case SNR) as the carrier group network parameter (*e.g.*, the carrier group SNR parameter). *Id.*, ¶¶9-14, 25-27, 33, 42-43, Figs. 3, 5-6. As I also discuss above, Saey teaches using the worst-case SNR to determine the gain and bit loading (*e.g.*, modulation order) for the carrier group to use when communicating with the modems associated with the carrier group, which allows the system to conserve resources while also ensuring communication with the modems of the group. *Id.*, ¶¶14, 27; Section X.A.1.d, *supra*.

209. A POSITA would have found it obvious to apply Saey's teachings to Prodan in order to determine the modulation order used for communication with Prodan's cable modems assigned to each category in order to conserve system resources (*e.g.*, memory, transmission costs) while ensuring communication with all cable modems of a group. Ex. 1007, ¶¶14, 27. Prodan teaches, for example, that algorithms compatible with the process performed by Prodan's CMTS include those that optimize modulation schemes, which would include a modulation order, according to a "**minimum required SNR.**" Ex. 1011, ¶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. 1013, ¶51.

210. Additionally, Prodan explains that its process of 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. 1011, ¶29. Prodan further explains that its process "makes optimizing frequency allocation more tractable as an optimization problem and more manageable by a flow scheduler." Ex. 1011, ¶34.

211. A POSITA, equipped with Saey's teachings of determining the worst-case SNR for a group, would have recognized that configuring Prodan's modulation schemes based on the worst-case SNR determined for each of Prodan's 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. 1011, ¶¶28, 39, 47.

212. Further, a POSITA would have recognized that applying Saey'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 modulation order parameters to cable modems that are grouped based on a comparison of the SNR characteristics, and Saey's method of determining a worst-case SNR for a group of CMs based on the individual SNRs of the CMs. 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 CMs in that group.

213. 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.

214. Applying Saey's teachings to Prodan's CMTS would have been well within the capabilities of a POSITA because it would have involved only minor modifications to the programming of Prodan's CMTS. Ex. 1011, ¶47. For the same reasons I discuss above for the Cooper-Saey combination, these teachings of the Prodan-Saey combination are similar the disclosure in the '682 patent regarding the claimed "composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics." Ex. 1001, 4:3-67, 5:7-20; Ex. 1017, 53-55; Ex. 1018, ¶187; Ex. 1019, 8-10; Section X.A.1.d, *supra*.

215. Therefore, Prodan-Saey teaches Element [1D].

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

216. Prodan-Saey teaches Element [1E]. As I show above for Element [1D], Saey teaches using the worst-case SNR determined for a group of carriers (subchannel) to select a network communication parameter for that carrier group. Ex. 1007, ¶¶26-27, 32, 42-43, Fig. 3 (step 340); Section X.A.1.d, *supra*.

217. As I also show, Prodan's CMTS assigns a "modulation scheme" for each cable modem based on the service group category with which the cable modem

is associated. Ex. 1011, ¶¶34, 44-45 (“[A] multiplicity of modulation schemes may be determined for each CM ...”), Fig. 4 (illustrating the method by which each cable modem is assigned a respective modulation scheme based on SNR versus frequency profiles of the CMs). 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, one or more physical layer communication parameter to be used for communicating with said one of said plurality of service groups.” Such disclosure in Prodan is very similar to the ’682 patent’s disclosure for this limitation. *Id.* For example, the ’682 patent explains that the claimed “physical layer communication parameter” includes “modulation parameters,” which may further include “modulation type,” and “modulation order,”—all determined based on each CM’s SNR metric(s). Ex. 1001, 4:40-43, 4:56-57, 4:63-67. Prodan’s “modulation scheme,” therefore, is a physical layer communication parameter as taught by the ’682 patent.

218. Prodan further discloses that its CMTS may automatically perform modulation scheme assignments. Ex. 1011, ¶¶45-46. Prodan explains that its CMTS automates 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. 1011, ¶46. Prodan thus teaches that automating 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. 1011, ¶46.

219. Prodan (and therefore Prodan-Saey) therefore teaches automating the selection of the 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-Saey’s CMTS automatically: (i) selects the modulation schemes for Prodan’s cable modems after measuring the SNR versus frequency profiles for each cable modem (Ex. 1011, Fig. 4, step 402); (ii) assigns those cable modems to service group categories based on their measured SNR versus frequency profiles (Ex. 1011, Fig. 5); and (iii) determines the worst-case SNR (as taught by Saey) for each cable modem service group category. Ex. 1007, ¶26. Prodan-Saey’s CMTS also automatically selects the modulation scheme based on the worst-case SNR determined for the cable modem service group category (the claimed “selecting, by said CMTS, one or more 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”). Section X.A.1.d, *supra*.

220. Therefore, Prodan-Saey teaches Element [1E].

f. Element [1F]: “communicating, by said CMTS, with one or more cable modems corresponding to said one

of said plurality of service groups using said selected one or more physical layer communication parameter.”

221. Prodan-Saey teaches Element [1F]. As I show above for Element [1E], Prodan’s modified CMTS selects 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. Ex. 1011, ¶¶45-47. A POSITA would have understood that Prodan’s modified CMTS communicates with the cable modems connected to it using the selected modulation scheme (the claimed “communicating, by said CMTS, with one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.”).

222. Specifically, Prodan’s disclosure encompasses both upstream and downstream communications. *See, e.g.*, Ex. 1011, ¶¶17-18. Prodan, therefore, teaches using the selected modulation scheme for upstream communications. Ex. 1011, ¶¶17-19, 41, 45. Prodan’s upstream communications thus disclose the “communicating” step in Element [1F], which encompasses both upstream and downstream communications as I explain below.

223. Indeed, such disclosures in Prodan are similar to the ’682 patent’s disclosure for the limitation “communicating, by said CMTS.” In particular, the ’682 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 one or more physical layer communication parameter includes 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. 1001, claims 4-5 (emphasis added).

224. Finally, Prodan’s disclosure of “communicating, by said CMTS” is also consistent with the scope accorded that term by Patent Owner in a District Court litigation. Specifically, Patent Owner asserted that the accused products satisfied Element [1F] because they “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. 1019, 14 (emphasis added). Thus, Patent Owner contended that the scope of “communicating, by said CMTS,” encompasses both downstream communications (i.e., from the CMTS to the connected CMs) and upstream communications (i.e., from the connected cable modems and received at the CMTS). *Id.*

225. Accordingly, Prodan-Saey discloses Element [1F].

2. Dependent Claim 2: “The method of claim 1, wherein said one or more physical layer communication

parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation type, modulation order, forward error correction (FEC) type, and FEC code rate.”

226. Prodan-Saey teaches dependent claim 2. As I show above for Element [1E], Prodan-Saey’s CMTS selects a modulation scheme, which includes a modulation order, for each cable modem service group category. Ex. 1011, ¶45, Fig. 4; *see also*, Section X.E.1.e, *supra*. A POSITA would have understood that Prodan-Saey’s “modulation scheme” includes the modulation order. Ex. 1013, ¶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-Saey’s modulation scheme teaches the claimed “physical layer communication parameter ...” as that term is used in the ’682 patent. Ex. 1001, 4:40-43.

3. Dependent Claim 6

- a. 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**

particular cable modem has a particular SNR versus frequency profile; and”

227. As I show above, independent claim 1 is taught by Prodan-Saey. Section X.E.1, *supra*. Claim 6 depends from independent claim 1. Ex. 1001, claim 6.

228. As I show above for Element [1C], Prodan assigns cable modems into at least three different service group categories based on comparing the CM’s SNR versus frequency profile to a threshold. Ex. 1011, ¶¶33, 44, Fig. 5; Section X.E.1.c, *supra*. Thus, Prodan 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 show above for Element [1D], Prodan-Saey 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.E.1.d, *supra*. Lastly, I show above for Element [1B] that Prodan discloses measuring an SNR versus frequency profile for individual cable modems, which discloses a “cable modem [with] a particular SNR versus frequency profile” as recited in Element [6A]. Section X.E.1.b, *supra*.

229. Prodan-Saey, therefore, teaches Element [6A].

- b. **Element [6B]: “said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular 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 particular 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.”**

230. As I discuss above for Element [6A], Prodan-Saey teaches at least a first and second cable modem service group having respective composite SNR versus frequency profiles. Section X.E.3.a, *supra*. Prodan-Saey also teaches assigning a particular cable modem to a service group having a composite SNR versus frequency profile most similar to that of the particular CM, as required by Element [6B], in order to make a modulation scheme assignment.

231. Prodan teaches that a cable modem is assigned to a particular service group category based on the individual measured SNR versus frequency profile of the cable modem. Ex. 1011, ¶32, Figs. 2, 5. Prodan further teaches that its CMTS updates its system and dynamically adjusts its frequency allocations and modulation schemes (*i.e.*, in real time) including whenever a new cable modem connects to the network. Ex. 1011, ¶¶33-34, 36, 40, 45-46. For example, Prodan teaches that when a new cable modem connects to the network, the CMTS measures its SNR versus frequency profile and assigns the new cable modem to the service groups with the

closest composite SNR versus frequency profile. Ex. 1011, ¶¶33-34. Based on these teachings, therefore, Prodan-Saey teaches assigning the particular cable modem to the service group with a composite SNR versus frequency profile that is the most similar to the CM's particular SNR versus frequency profile.

232. Prodan-Saey, therefore, teaches Element [6B].

F. Prodan in View of Gross Renders Claims 1-2 and 6 Obvious

1. Independent Claim 1

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

233. For the reasons I describe above for independent claim 1, Prodan discloses [1A]-[1C]. Sections E.1.a-c, *supra*.

b. Element [1D]

234. As I discuss 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 E.1.c, *supra*. Prodan, however, does not explicitly disclose determining a “worst case” SNR for such groups of cable modems. Prodan-Gross teaches making such a determination for reasons similar to those I describe above for Prodan-Saey. Section X.E.1.d, *supra*.

235. I describe Gross above, which teaches a method of setting the modulation order for communicating with groups of cable modems where the modulation order for each group is determined by the measured “worst case” SNR

in the group of modems. *See* Sections X.A.1.d and IX.C, *supra*. A POSITA would have also found it obvious to apply Gross’ teaching of determining the worst-case SNR for a cable modem group to Prodan’s selection of a modulation order to assure communication with any modem assigned to that logical channel, regardless of which modems are activated. Ex. 1008, ¶¶43-46, 100. Prodan already discloses that its CMTS may optimize modulation schemes, which would include a modulation order, according to a “minimum required SNR.” Ex. 1011, ¶¶[0047], [0028]-[0029], [0034], [0039], [0047], Fig. 5; Ex. 1013, ¶[0051]; Section X.E.1.d, *supra*.

236. Such a combination would therefore 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 modulation order parameters to CMs that are grouped based on a comparison of their SNR characteristics, and Gross’ method of determining and applying a worst-case SNR-based parameter for a group of modems also grouped based on their individual SNRs. 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 modulation scheme to communicate with the cable modem service group.

237. Applying Gross' teachings to Prodan's CMTS would have been well within the capabilities of a POSITA and would have involved only routine modifications to the programming of Prodan's CMTS.

238. Prodan-Gross thus teaches Element [1D].

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

239. For reasons similar to those that I describe above for Prodan-Saey, Prodan-Gross teaches Elements [1E]-[1F]. Sections X.E.1.e-f, *supra*. In particular and as I discuss above, Prodan-Gross' CMTS would have similarly selected the modulation schemes based on the worst-case SNR metrics determined for the groups of cable modems assigned to service group categories to ensure communication with all modems in the group while also optimizing the network. Ex. 1011, ¶47; *see also* Section X.E.1.e, *supra*.

240. Prodan-Gross' CMTS also would have communicated with the connected cable modems using the selected modulation schemes. Ex. 1011, ¶¶45-47; *see also* Section X.E.1.e, *supra*.

2. Dependent Claim 2

241. For reasons similar to those that I describe above for Prodan-Saey, Prodan-Gross teaches dependent claim 2. Section X.E.2, *supra*. In particular, Prodan-Gross' CMTS selects a modulation scheme, which would include a modulation order, for each cable modem service group category. Ex. 1011, ¶45,

Fig. 4; Ex. 1013, ¶51; *see also*, Sections X.E.2, X.F.1.b-c, *supra*. Prodan-Gross' modulation scheme teaches the claimed “physical layer communication parameter” as that term is used in the '682 patent. Ex. 1001, 4:40-43.

3. Dependent Claim 6

a. Element [6A]

242. As I show above, independent claim 1 is taught by Prodan-Gross. Section X.F.1, *supra*. Claim 6 depends from independent claim 1. Ex. 1001, claim 6.

243. As I also show above for Element [1C], Prodan assigns cable modems into at least three different service group categories based on comparing the CM's SNR versus frequency profile to a threshold. Ex. 1011, ¶¶33, 44, Fig. 5; Sections X.E.1.c and X.F.1.a, *supra*. Prodan, therefore, 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 show above for Element [1D], Prodan-Gross 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.F.1.b, *supra*. Prodan-Gross, therefore, teaches Element [6A].

b. Element [6B]

244. As I discuss above for Element [6A], Prodan-Gross teaches at least a first and second cable modem service group having respective composite SNR versus frequency profiles. Section X.F.3.a, *supra*. Prodan-Gross also teaches assigning a particular cable modem to a service group having a composite SNR versus frequency profile most similar to that of the particular CM, as required by Element [6B], in order to make a modulation scheme assignment.

245. Prodan discloses that a cable modem is assigned to a particular service group category based on the individual measured SNR versus frequency profile of the cable modem. Ex. 1011, ¶32. Prodan further discloses that its CMTS measures and/or updates the SNR versus frequency profile of a particular cable modem (and subsequently performs per cable modem modulation scheme assignments) either, *inter alia*, dynamically (*i.e.*, in real time) or every time the cable modem connects to the network. Ex. 1011, ¶¶33, 46. Based on this teaching, Prodan-Gross, therefore, teaches assigning the particular cable modem to the service group with a composite SNR versus frequency profile that is the most similar to the CM's particular SNR versus frequency profile.

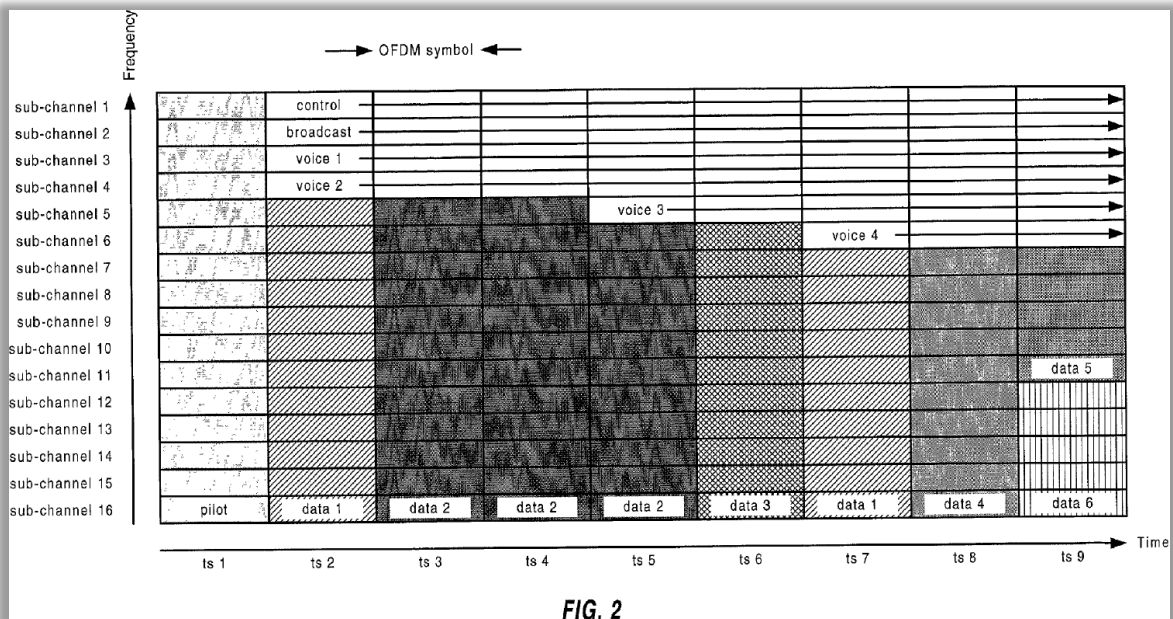
G. Prodan in View of Saey and Jalali or Prodan in View of Gross and Jalali Render Dependent Claims 3-5 Obvious

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.”**

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

247. Jalali discloses a method of transmitting and receiving multiple types of services (*e.g.*, video, voice) along multiple carriers using OFDM. Ex. 1014, Abstract, 3:1-4, 3:29-49, 5:41-6:13, 25:62-26:17, Fig. 1. Jalali's Figure 2 (below), 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. 1014, 13:49-58.



Ex. 1014, Fig. 2.

248. Jalali's Figure 2 also shows data transmission that is partitioned into nine different timeslots that correspond to the duration of the OFDM modulation symbol. Ex. 1014, 13:58-63. The first timeslot, in this example, 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. 1014, 13:64-14:13. Jalali's communication system provides the flexibility that data can be transmitted through multiple sub-channels, achieving both a high performance and a high efficiency. Ex. 1014, 14:20-60, 15:26-35.

249. Jalali also 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. 1014, 15:36-42, 11:51-12:9, 17:21-34, 22:19-24, 23:54-65, 32:34-44. Jalali also teaches that “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. 1014, 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.

250. A POSITA would have been motivated to combine the OFDM communication techniques taught by Jalali with the communication techniques taught by Prodan-Saey’s and Prodan-Gross’ CMTS in order to provide increased flexibility, performance, and efficiency in transmitting multiple types of services. As I discuss above for Element [1E], Prodan-Saey’s and Prodan-Gross’ communication techniques teach selecting different modulation schemes for different service group categories or channels based on a composite worst-case SNR. Sections X.E.1.e and X.F.1.c, *supra*. As Prodan, Saey, Gross, and Jalali acknowledge, 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. 1007, ¶¶2-3; Ex. 1011, ¶¶5-7; Ex. 1014, 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 relying on similar modulation schemes (*e.g.*, QAM) for the subcarriers. Utilizing OFDM, therefore, would allow Prodan-Saey's and Prodan-Gross' CMTS to communicate more reliably, with more CMs, and/or more efficiently and optimally to smaller service groups of cable modems based on more refined composite SNR-related metrics.

251. Such combinations also 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-Saey's and Prodan-Gross' CMTS method of communication and Jalali's OFDM method. The known methods include programming a CMTS. The predictable results include a CMTS that uses OFDM to communicate over a plurality of subcarriers that also use different modulation schemes.

252. Moreover, applying Jalali's teachings to Prodan-Saey's and Prodan-Gross' CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the CMTS. A POSITA would have a reasonable expectation of success in these programming modifications as Jalali's method is implemented with basic electronic circuits, which a POSITA would recognize would be included in Prodan-Saey's and Prodan-Gross' CMTS. Ex. 1011, ¶¶32, 44, 48; Ex. 1014, 33:44-49. Prodan-Saey's and Prodan-Gross'

CMTS as modified by Jalali teaches the claimed use of “[OFDM] over a plurality of subcarriers for said communicating.”

253. Dependent claim 3, therefore, is invalid as obvious over Prodan-Saey-Jalali and Prodan-Gross-Jalali.

2. Dependent Claim 4: “The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.”

254. Dependent claim 3, from which claim 4 depends, is taught by Prodan in view of Saey and Jalali. Section X.G.1, *supra*. As I discuss above for Element [1E], Prodan-Saey’s and Prodan-Gross’ CMTS selects one or more physical layer communication parameter (*e.g.*, modulation schemes) for different service groups. Sections X.E.1.e, X.C.2, X.G.1, *supra*. As modified by Jalali, this selection process by the CMTS happens on a per-OFDM-subcarrier basis.

255. As discussed above for dependent claim 3, Prodan-Saey-Jalali’s and Prodan-Gross-Jalali’s CMTS teaches the use of OFDM where each sub-carrier can have a particular modification scheme (*e.g.*, M-PSK, M-QAM). Sections X.G.1, *supra*. Jalali discloses that each sub-carrier’s particular modulation scheme is based on, for example, the particular sub-channel’s channel state information, which includes the carrier-to-noise-plus-interference ratio. Ex. 1014, 11:51-12:9, 12:45-48, 15:54-62, 17:25-34; *see also id.*, 5:30-33, 10:47-57. Thus, Prodan-Saey-Jalali’s

and Prodan-Gross-Jalali's CMTS teaches the CMTS "selecting ... said one or more physical layer communication parameter on a per-OFDM-subcarrier basis."

256. Therefore, claim 4 is invalid as obvious over Prodan-Saey-Jalali and Prodan-Gross-Jalali.

3. Dependent Claim 5: "The method of claim 4, wherein said one or more physical layer communication parameter includes 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."

257. Claim 5 depends from dependent claim 4. Dependent claim 5 is taught by Prodan in view of Saey and Jalali and by Prodan in view of Gross and Jalali. As I discuss above for Element [1E], Prodan-Saey-Jalali's and Prodan-Gross-Jalali's CMTS selects "one or more physical layer communication parameter" on a per-OFDM-subcarrier basis based on a composite SNR-related metric. Sections X.E.1.e, X.F.1.c, X.G.2, *supra*.

258. Prodan also discloses 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. 1011, ¶19; Ex. 1021, 1, 3 (Figure 0-2 indicating different frequencies for transmitting and receiving at the headend), 7 (Section 2.2.1 describing a frequency plan for downstream and upstream signals), 8 (Table 0-1 indicating frequencies for downstream transmissions), 9 (Table 0-2 indicating frequencies for upstream

transmissions); Ex. 1022, i (DOCSIS 1.1 standard), 4 (Figure 1-2), 7 (frequency plan), 8-9 (Table 2-1 indicating frequencies for downstream transmissions), 10 (Table 2-2 indicating frequencies for upstream transmissions); Ex. 1023, i (DOCSIS 2.0 standard), 3 (Figure 1-2), 25 (frequency plan), 27 (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.E.1.f, *supra*; Ex. 1011, ¶¶5, 17-18, 23.

259. Given that Prodan discloses using different frequency bands for upstream and downstream communication, Prodan-Saey-Jalali's and Prodan-Gross-Jalali's CMTS teaches selecting separate upstream and downstream "one or more physical layer communication parameter[s]" on a per-OFDM-subcarrier basis based on specific frequency bands and a composite upstream or downstream SNR-related metric. Prodan-Saey-Jalali's and Prodan-Gross-Jalali's CMTS, therefore, teaches "one or more physical layer communication parameter includes 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.

260. Dependent claim 5, therefore, is obvious over Prodan-Saey-Jalali and Prodan-Gross-Jalali.

H. Prodan in View of Saey and Cooper or Prodan in View of Gross and Cooper Render Dependent Claims 7-8 Obvious

1. Dependent Claims 7-8

261. Independent claim 1 is taught by Prodan-Saey and Prodan-Gross. Sections X.E.1 and X.F.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 respective distances between said CMTS and said 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. 1001, 8:62-9:3.

262. As I describe 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 CM’s SNR versus frequency profile. Section X.E.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. 1011, ¶27. Cooper, however, does.

263. As I explain above for Element [1C] and dependent claims 7-8, Cooper discloses assigning cable modems among a plurality of service groups based on various measured network parameters. Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Sections X.A.1.c and X.A.3-4, *supra*. For example, in addition to assigning network elements to service groups based on SNR measurements, Cooper also discloses a CMTS assigning network elements to service groups based at least in part on determined the locations of network elements in a cable network. Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Sections X.A.1.c and X.A.3-4, *supra*. In another example, Cooper discloses 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. 1005, ¶43. 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 would allow 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. 1005, ¶19.

264. It would have been obvious to modify Prodan-Saey's and Prodan-Gross' CMTS to also assign cable modems to service groups based at least in part on parameters associated with the location of cable modems in a cable network or based at least in part on amplifier cascade depth to allow for more proactive maintenance of the network. Ex. 1005, ¶19. More specifically, it would have been obvious to configure Prodan-Saey's and Prodan-Gross' 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 satisfying claim 7's requirement of "assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems"). In addition, it would have been obvious to configure Prodan-Saey's and Prodan-Gross' 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 satisfying claim 8's requirement of "assigning any particular one of said 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").

265. 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-Saey's and Prodan-Gross' CMTS as well as Cooper's methods of assigning cable modems to service groups based on parameters associated with each cable modems location in a cable network. 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. Applying Cooper's teachings to Prodan-Saey's and Prodan-Gross' CMTS would have been well within the capabilities of a POSITA and would have involved straightforward modifications to the programming of Prodan-Saey's and Prodan-Gross' CMTS.

266. Therefore, dependent claims 7-8 are invalid as obvious over Prodan-Saey-Cooper and Prodan-Gross-Cooper.

I. Prodan in View of Saey, Monk, and Cooper-437 or Prodan in View of Gross, Monk, and Cooper-437 Render Claim 9 Obvious

267. As I show above, independent claim 1 is taught by Prodan-Saey and Prodan-Gross. Sections X.E.1 and X.F.1, *supra*. Claim 9 depends from independent claim 1. Ex. 1001, claim 9; *see* Sections X.D.1-2, *supra*.

268. As I discuss above for Element [1B], Prodan-Saey and Prodan-Gross teach determining an SNR-related metric for each cable modem served by the CMTS based on a measurement at the CMTS. Section X.E.1.b and X.F.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.

269. Prodan discloses a cable system that transmits data via upstream and downstream channels. Ex. 1011, ¶¶17-18, 23, 56; *see* Section X.E.1.f, *supra*. Prodan explains that, 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. 1011, ¶¶32-34. While Prodan does not explicitly mention a downstream embodiment, Prodan teaches using a variety of algorithms to make modulation scheme assignments. Ex. 1011, ¶47.

270. I describe Monk and its probe message above for dependent claim 9. Section X.D.1, *supra*. Specifically, Monk teaches that for non-symmetrical channels (such as those in Prodan), a sending node transmits a probe message to a receiving device, which analyzes the probe message and sends the results of the analysis back to the sending device, which determines the transmission parameters. Ex. 1015, 4:44-59, 9:28-50. In a downstream context, therefore, a POSITA would have found it obvious to modify Prodan-Saey's and Prodan-Gross' CMTS to send a probe message to the cable modem (the claimed "transmitting a probe message to each cable modem") in order to implement the measurement and reporting by the cable

modem of the downstream channel's SNR, as taught by Monk. A POSITA would have further found it obvious to send probe messages to the CMs to distribute processing requirements for measuring among the CMs.

271. Incorporating Monk's probe messages and reporting messages into Prodan-Saey and Prodan-Gross 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-Saey and Prodan-Gross and the probe messages and reporting messages of Monk. 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.

272. Applying Monk's teachings to Prodan-Saey's and Prodan-Gross CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the CMTS. A POSITA would have a reasonable expectation of success applying Monk's teachings to Prodan-Saey's and Prodan-Gross's CMTS as it would have only required minor modifications to the programming of the CMTS, which would have been well within the capabilities of a POSITA.

273. Although Prodan-Saey-Monk and Prodan-Gross Monk teach a probe message, they do not teach a probe message that includes instructions for measuring a metric and reporting said measured metric back to the CMTS. Cooper-437, however, does. Sections X.D.1-2, *supra*. For the same reasons I provide above, a POSITA would have found it obvious to modify Prodan-Saey-Monk's and Prodan-Gross Monk's probe message to identify a measurement mode and a reporting mode as taught by Cooper-437. *Id.* A POSITA would have recognized that this would allow Prodan-Saey-Monk's and Prodan-Gross-Monk CMTS to focus on determining the SNR of specific service groups or frequencies. *See* Sections X.D.1-2, *supra*; Ex. 1016, 8:9-64, 10:53-11:28, Table 1. Such a modification would allow more robust communication between the CMTS and cable modems on the network.

274. Moreover, 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-Saey-Monk's and Prodan-Gross-Monk's probe message with 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.

275. Applying Cooper-437's teachings to Prodan-Saey-Monk's and Prodan-Gross-Monk's CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the CMTS. A POSITA would have a reasonable expectation of success in these programming modifications as Prodan-Saey-Monk, Prodan-Gross-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. 1011, ¶19; Ex. 1016, 5:3-14, 7:6-22.

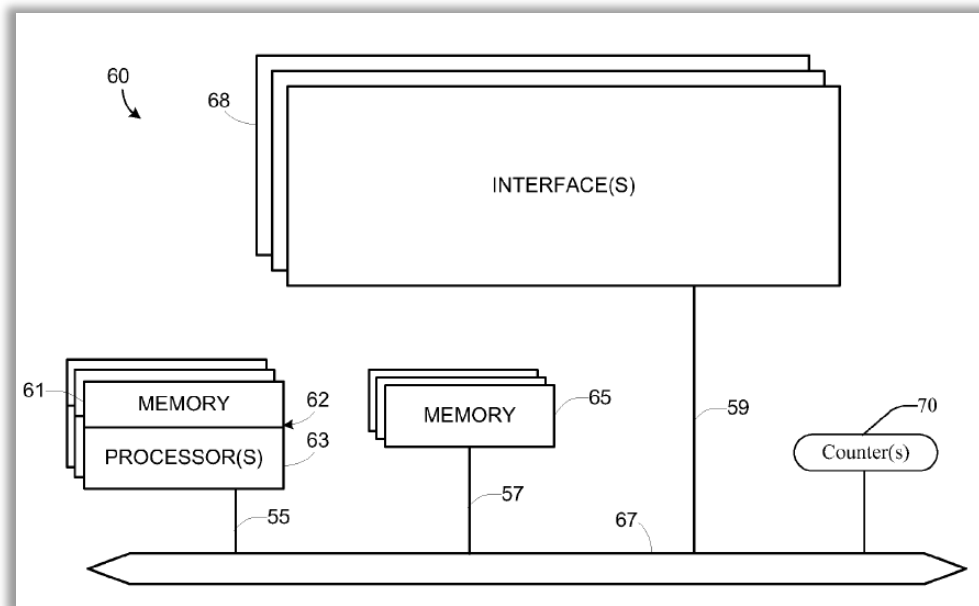
276. Prodan-Saey in view of Monk and Cooper-437 as well as Prodan-Gross in view of Monk and Cooper-437 teach dependent claim 9.

J. Prodan in View of Saey and Pai or Prodan in View of Gross and 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:"

277. Prodan's "network" described above in Section X.E.1.b discloses a system as it is recited in element [10A]. Ex. 1011, ¶¶ 16-17, 32, Fig. 1. And although Prodan broadly discloses the use of a CMTS that communicates with connected CMs, Prodan fails to expressly disclose that its CMTS includes circuitry comprising

a network interface and a processor. Pai, however, does. Ex. 1020, ¶¶179-181, Fig. 6. Pai shows that it was known to implement a CMTS with a processor and a network interface in order to control operations of the CMTS and to communicate with other network devices. As seen below, Pai’s Figure 6 discloses 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. 1020, ¶¶179-181, Fig. 6.



Ex. 1020, Fig. 6.

278. It would have been obvious for a POSITA to implement Prodan-Saey’s and Prodan-Gross’ CMTS with the processor and network interface as disclosed by

Pai in order to control the operations of Prodan-Saey's and Prodan-Gross' CMTS and to communicate with other network devices, as taught by Pai.

279. Such implementation also 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-Saey's and Prodan-Gross CMTS and Pai's CMTS' circuitry. 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.

280. Applying Pai's teachings to Prodan-Saey's and Prodan-Gross' CMTS 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-Saey's and Prodan-Gross' CMTS. Ex. 1011, ¶¶32, 44, 48; Ex. 1020, ¶¶134, 190, 198, Figs. 2, 4, 7. Prodan-Saey's and Prodan-Gross' CMTS, as modified by Pai, thus teaches Element [10A].

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

281. 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]. Prodan-Saey-Pai and

Prodan-Gross-Pai teaches that processor(s) 63 in CMTS 60 is configured to perform the limitations described above in Elements [1B]-[1E]. Sections X.E.1.b-e, *supra*. Accordingly, for the reasons set forth above with respect to Elements [1B]-[1E], Prodan-Saey-Pai's and Prodan-Gross-Pai's processor(s) 63 teaches and is configured to perform the limitations recited in Elements [10B]-[10E]. *Id.*

282. Element [10F] is nearly identical to Element [1F], except Element [10F] recites that the claimed "network interface" is configured to perform the limitations recited in [1F]. Prodan-Saey-Pai and Prodan-Gross-Pai teaches that interface(s) 68 communicate bidirectionally with network devices and control the sending and receiving of data packets over the network. Ex. 1020, ¶181, Fig. 6. Therefore, for the reasons set forth above with respect to Element [1F], Prodan-Saey-Pai's and Prodan-Gross-Pai's interface(s) 68 comprise a network interface that teaches and is configured to perform the limitations recited in Element [10F]. *Id.*; Section X.E.1.f, *supra*.

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

283. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.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. Prodan-Saey-Pai and Prodan-Gross-Pai, therefore, teach dependent claim 11 for the same reasons as dependent claim 2. *See* Sections X.E.2 and X.F.2, *supra*.

4. **Dependent Claim 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 particular cable modem has a particular SNR versus frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular 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 particular 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.”**

284. Independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.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. Prodan-Saey-Pai and Prodan-Gross-Pai, therefore, teach dependent claim 15 for the same reasons as dependent claim 6. *See* Sections X.C.5 and X.F.3, *supra*.

K. Prodan in View of Saey, Pai, and Jalali or Prodan in View of Gross, Pai, and Jalali Render Claims 12-14 Obvious

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

285. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.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-Saey-Pai and Prodan-Gross-Pai teach interface(s) 68 that communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1020, ¶¶179-181, Fig. 6; Sections X.J.1-2, *supra*. As I also discuss above for dependent claim 3, applying Jalali’s teachings of OFDM to Prodan-Saey and Prodan-Gross teach the limitations of dependent claim 3. Section X.G.1, *supra*. Jalali is equally applicable to Prodan-Saey-Pai and Prodan-Gross-Pai. For the same reasons discussed in Section X.G.1, a POSITA would have found it obvious and been motivated to apply the OFDM communication techniques taught by Jalali to Prodan-Saey-Pai’s/Prodan-Gross-Pai’s CMTS. A POSITA would have a reasonable expectation of success applying Jalali’s teachings to Prodan-Saey-Pai’s and Prodan-Gross-Pai’s CMTS as it would have only required minor modifications to the

programming of the CMTS's processor—well within the capabilities of a POSITA—that would then communicate through the network interface. Ex. 1020, ¶¶[0179]-[0181], Fig. 6; Ex. 1014, 33:44-49. Therefore, for the reasons set forth above with respect to dependent claim 3, Prodan-Saey-Pai-Jalali and Prodan-Gross-Pai-Jalali comprises a network interface that teaches and is configured to perform the limitations as recited in claim 12. *See* Sections X.J.1-2 and X.G.1, *supra*.

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

286. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.1-2, *supra*. Claim 13 depends from dependent claim 12, which depends from independent claim 10. 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 discuss in Sections X.G.2 and X.K.1, Prodan-Saey-Pai-Jalali and Prodan-Gross-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. Therefore, Prodan-Saey-Pai-Jalali and Prodan-Gross-Pai-Jalali comprises a network interface that teaches and is configured to perform the limitations recited in dependent claim 13. *See* Sections X.G.2, X.J.1, X.K.1, *supra*.

3. Dependent Claim 14: “The system of claim 12, wherein said one or more physical layer communication parameter includes 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.”

287. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.1-2, *supra*. As I also show above, dependent claim 12 is taught by Prodan-Saey-Pai-Jalali and Prodan-Gross-Pai-Jalali. Section X.K.1, *supra*. Claim 14 depends from dependent claim 12, which depends from independent claim 10. The language of dependent claim 14 is nearly identical to the language of dependent claim 5. Prodan-Saey-Pai-Jalali and Prodan-Gross-Pai-Jalali, therefore, teach dependent claim 14 for the same reasons as dependent claim 5. See Sections X.G.3 and X.J.1-2, *supra*.

L. Prodan in View of Saey, Pai, and Cooper or Prodan in View of Gross, Pai, and Cooper Render Claims 16 and 17 Obvious

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

288. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.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-Saey-

Pai and Prodan-Gross-Pai teach a CMTS that includes a processor 63 configured to implement Prodan-Saey's and Prodan-Gross' methods. Ex. 1020, ¶¶179-181, Fig. 6; Section and X.J.1, *supra*. As I further discuss above for dependent claim 7, Prodan-Saey-Cooper and Prodan-Gross-Cooper teach the limitations of dependent claim 7. Section X.H.1, *supra*. For the same reasons discussed in Section X.H.1, a POSITA would have found it obvious and been motivated to apply the Cooper's method of assigning CMs to service groups based on geographic distances from CMTS to Prodan-Saey-Pai's and Prodan-Gross-Pai's CMTS. A POSITA would have a reasonable expectation of success applying Cooper's teachings, which are performed by a microprocessor, to Prodan-Saey-Pai's and Prodan-Gross-Pai's CMTS as it would have only required minor modifications to the programming of the CMTS's processor, well within the capabilities of a POSITA. Ex. 1020, ¶¶[0179]-[0181], Fig. 6; Ex. 1005, ¶¶[0008], [0023]-[0024]. Therefore, for the reasons set forth above with respect to dependent claim 7, Prodan-Saey-Pai-Cooper and Prodan-Gross-Pai-Cooper comprises a processor that teaches and is configured to perform the limitations recited in dependent claim 16. *See* Sections X.H.1 and X.J.1-2, *supra*.

2. Dependent Claim 17: “The system of claim 10, wherein said processor is configured to assign each of said cable modems among said plurality of service groups based

on one or more branch amplifier that serves said each of said cable modems.”

289. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.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. As I discuss above for Element [10A], Prodan-Saey-Pai and Prodan-Gross-Pai teach a CMTS that includes a processor 63 configured to implement Prodan-Saey’s and Prodan-Gross’ methods. Ex. 1020, ¶¶179-181, Fig. 6; Section X.J.1, *supra*. As I further discuss above for dependent claim 8, Prodan-Saey-Cooper and Prodan-Gross-Cooper teach the limitations of dependent claim 8. Section X.H.1, *supra*. For the same reasons discussed in Section X.H.1, a POSITA would have found it obvious and been motivated to apply the Cooper’s method of assigning CMs to service groups based on amplifier cascade depth to Prodan-Saey-Pai’s and Prodan-Gross-Pai’s CMTS. A POSITA would have a reasonable expectation of success applying Cooper’s teachings, which are performed by a microprocessor, to Prodan-Saey-Pai’s and Prodan-Gross-Pai’s CMTS as it would have only required minor modifications to the programming of the CMTS’s processor, well within the capabilities of a POSITA. Ex. 1020, ¶¶[0179]-[0181], Fig. 6; Ex. 1005, ¶¶[0008], [0023]-[0024]. Therefore, for the reasons set forth above with respect to dependent claim 8, Prodan-Saey-Pai-Cooper and Prodan-Gross-Pai-

Cooper comprises a processor that teaches and is configured to perform the limitations recited in claim 17. Sections X.H.1 and X.J.1-2, *supra*.

M. Prodan in View of Saey, Pai, Monk, and Cooper-437 or Prodan in View of Gross, Pai, Monk, and Cooper-437 Render Claim 18 Obvious

290. As I show above, independent claim 10 is taught by Prodan-Saey-Pai and Prodan-Gross-Pai. Sections X.J.1-2, *supra*. As I also discuss above for dependent claim 9, Prodan-Saey-Monk-Cooper-437 and Prodan-Gross-Monk-Cooper-437 teach the limitations of dependent claim 9. Section X.I, *supra*. As I further discuss above for Element [10A], Prodan-Saey-Pai and Prodan-Gross-Pai teach an interface(s) 68 that communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1020, ¶¶179-181, Fig. 6; Section X.J.1, *supra*. 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. Therefore, for the reasons set forth above with respect to dependent claim 9, Prodan-Saey-Pai-Monk-Cooper-437 and Prodan-Gross-Pai-Monk-Cooper-437 comprises a network interface that teaches and is configured to perform the limitations recited in claim 18. *See* Sections X.I and X.J.1-2, *supra*.

XI. CONCLUSION

291. 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: Feb 14-2024

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XII. CLAIM LISTING APPENDIX

U.S. Pat. No. 10,135,682

Designation	Claim Language
Claim 1	
[1A]	1. A method comprising:
[1B]	determining, by a cable modem termination system (CMTS), for each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
[1C]	assigning, by said CMTS, each cable modem among a plurality of service groups based on a respective corresponding SNR-related metric;
[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 SNR-related metrics corresponding to said one of said plurality of service groups;
[1E]	selecting, by said CMTS, one or more physical layer communication parameter 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 one or more cable modems corresponding to said one of said plurality of service groups using said selected one or more physical layer communication parameter.
Claim 2	
2	2. The method of claim 1, wherein said one or more physical layer communication parameter includes 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.

Designation	Claim Language
Claim 4	
4	4. The method of claim 3, comprising selecting, by said CMTS, said one or more physical layer communication parameter on a per-OFDM-subcarrier basis.
Claim 5	
5	5. The method of claim 4, wherein said one or more physical layer communication parameter includes 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 particular cable modem has a particular SNR versus frequency profile; and
[6B]	said assigning said each cable modem among said plurality of service groups comprises, for the particular cable modem: assigning said particular 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 particular 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 cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems.
Claim 8	

Designation	Claim Language
8	8. The method of claim 1, comprising assigning any particular one of said 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.
Claim 9	
9	9. The method of claim 1, wherein said determining said plurality of SNR-related metrics comprises: transmitting a probe message to each cable modem, said probe message comprising instructions for measuring a metric and reporting said measured metric back to said CMTS; and receiving a metric reporting message from each cable modem.
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 each cable modem served by said CMTS, a corresponding signal-to-noise ratio (SNR) related metric;
[10C]	said processor is configured to assign each of said cable modems among a plurality of service groups based on a respective corresponding SNR-related metric;
[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 SNR-related metrics corresponding to said one of said plurality of service groups;
[10E]	said processor is configured to select one or more physical layer communication parameter 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 one or more cable modems corresponding to said one of said plurality of service groups using the one or more selected physical layer communication parameter.
Claim 11	

Designation	Claim Language
11	11. The system of claim 10, wherein said one or more physical layer communication parameter includes one or more of: transmit power, receive sensitivity, timeslot duration, modulation 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 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 at least one of said one or more physical layer communication parameters are configurable on a per-OFDM-subcarrier basis.
Claim 14	
14	14. The system of claim 12, wherein said one or more physical layer communication parameter includes 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	
15	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 particular cable modem has a particular SNR versus frequency profile; said assignment of said each cable modem among said plurality of service groups comprises, for the particular cable modem: assignment of said particular 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 particular

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