

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

Patent No. 9,866,438

Filing Date: February 16, 2017

Issue Date: January 9, 2018

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

Inter Partes Review No.: IPR2025-00183

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 3

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

I. INTRODUCTION

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

2. I have been asked to provide a declaration regarding certain matters pertaining to U.S. Patent No. 9,866,438 (“the ’438 patent”) (Ex. 1001) and the unpatentability grounds set forth in the Petition for this proceeding. I understand the ’438 patent is owned by Entropic Communications, LLC.

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

II. PROFESSIONAL BACKGROUND AND QUALIFICATIONS

4. A full description of my educational background, professional achievements, qualifications, and publications in the past 30+ years are set forth more fully in my curriculum vitae, which is attached to this Declaration as Exhibit 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. 9,866,438 (Ex. 1001).

26. In preparing this declaration, I also reviewed and considered the Petition and the file history (Ex. 1004) of the '438 patent 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. 1012: U.S. Patent No. 10,084,538 (“Nielsen-538”)
- Ex. 1013: U.S. Patent Application Publication No. 2013/0004179 (“Nielsen-179”)
- Ex. 1015: U.S. Patent No. 7,573,822 (“Monk”)
- Ex. 1016: U.S. Patent No. 6,772,437 (“Cooper437”)
- 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. Pub. 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 No. 8,503,546 (“Ashrafi”)
- Ex. 1026: Tanenbaum, “Computer Networks,” 4th ed. (2003).
- Ex. 1027: Driscoll, “Next Generation IPTV Services and Technologies” (2008)
- Ex. 1028: U.S. Patent Application Publication No. 2005/0097617 (“Currivan”)
- Ex. 1029: U.S. Patent No. 10,135,682 (“the ’682 patent”)
- Ex. 1030: U.S. Patent Application Publication No. 2008/0291840 (“Cooper840”)

- Ex. 1031: U.S. Patent Application Publication No. 2005/0122996 (“Azenkot”)
- Ex. 1033: ITU-T J.222.1, *Series J: Cable Networks and Transmission of Television, Sound Programme and Other Multimedia Signals* (Jul. 2007)
- Ex. 1034: “[Tentative] Claim Construction Order,” *Entropic Communications, LLC v. Comcast Corporation*, No. 2:23-cv-01050 (C.D. Cal. filed Feb. 10, 2023) and *Entropic Communications, LLC v. Cox Communications, Inc.*, No. 2-23-cv-01049 (C.D. Cal. filed Feb. 10, 2023) (collectively, “CA litigation”)
- Ex. 1035 U.S. Patent No. 6,816,463 (“Cooper463”)

IV. UNDERSTANDING OF APPLICABLE LEGAL STANDARDS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

38. In my opinion, the relevant field of art for the '438 patent is cable television networks. Ex. 1001, Abstract, 1:47-50.

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

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

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

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

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

VI. CLAIM CONSTRUCTION

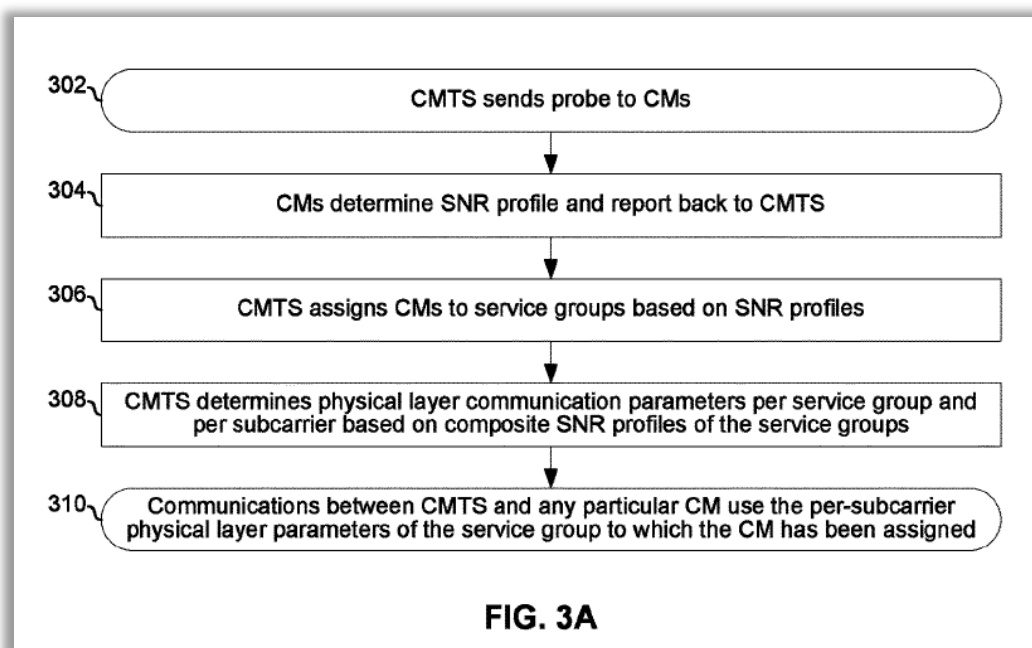
44. I understand that all claim terms herein should be given their ordinary and customary meaning to a POSITA, consistent with the prosecution history. I further understand that, with regard to the claim term “CMTS”, the District Court in the CA litigation issued a “[Tentative] Claim Construction Order” construing “CMTS” as “hardware and accompanying software, with the hardware located at the point at which the cable modem’s connection to the hybrid-fiber coaxial network terminates.” Ex. 1034, pp. 17-21, 25. I have considered this construction when forming my opinions below. I also understand that the Petitioner does not contend that the claims include any means-plus-function limitations.

VII. OVERVIEW OF THE '438 PATENT

A. '438 Patent

45. The '438 patent relates to service group management in a cable television network. Ex. 1001, 1:48-50. "A cable modem termination system (CMTS) may determine, for a plurality of cable modems served by the CMTS, a corresponding plurality of SNR-related metrics. The CMTS may assign[] the modems among a plurality of service groups based on the SNR-related metrics." Ex. 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 reports the profile back to a cable modem termination

system (CMTS). Ex. 1001, 4:22-27, 5:32-35. The '438 patent describes an SNR profile as “SNR at a particular frequency or SNR over a range of frequencies.” *Id.*, 3:52-56; *see also* 3:61-63 (noting that message 202 “may”—but is not required to—span multiple frequencies), 4:40-43. This is consistent with the ordinary understanding of the term that a POSITA would have. The CMTS then assigns the cable modems to service groups based on the SNR profiles. Ex. 1001, Abstract, 4:49-53, 5:35-37, 6:44-7:4. A service group is simply a group of cable modems serviced by a CMTS. *Id.*, 6:44-46, 6:60-62, Fig. 4A (Elements 402 and 404), Fig. 4B (elements 406 and 408). A composite SNR profile based on the worst-case SNR profile for each service group is used to determine physical layer communication parameters used for communication between the CMTS and cable modems. Ex. 1001, Abstract, 4:37-53, 5:38-48. Physical layer communication parameters include well-known encoding and modulation parameters, such as modulation type and modulation order. Ex. 1001, Abstract, 4:53-64.

B. Prosecution History

48. The application that led to the '438 patent, U.S. Application No. 15/434,673, was filed on February 16, 2017. Ex. 1001, 1-2.

49. All claims were rejected in an Office Action dated April 10, 2017, on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,577,886 to Ling *et al.* and claims 1-18 of U.S. Patent No.

9,419,858 to Ling *et al.* Ex. 1004, 56-74. The claims were also rejected as obvious over combinations of prior art references that included U.S. Patent No. 8,743,933 to Prodan in view of U.S. Patent Publication 2009/0219856 to Richardson. Ex. 1004, 75-93.

50. The Applicant responded to the rejections by filing a Terminal Disclaimer on August 10, 2017 and amending both independent claims to require that the composite SNR-related metric is based “at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups.” Ex. 1004, 105, 107-108 (emphasis in original), 112. The Examiner then issued a Notice of Allowance on September 7, 2017. *Id.*, 152-154.

51. The ’438 patent issued on January 9, 2018. Ex. 1001, 1-2.

C. Priority Date

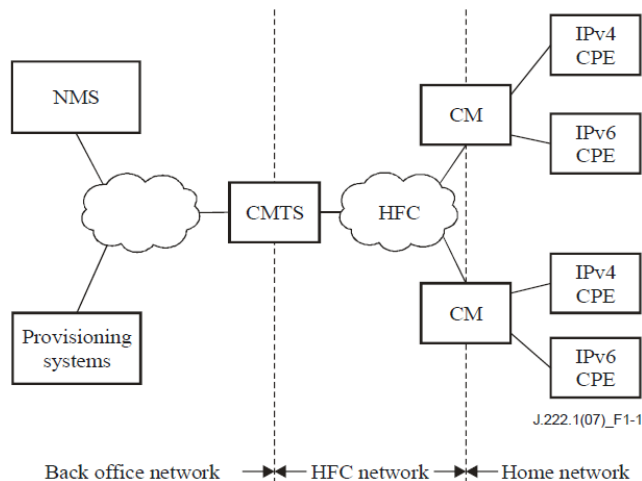
52. I understand that the earliest possible priority date for the ’438 patent claims is July 23, 2012, which is the filing date of U.S. Provisional Application No. 61/674,742. As described below, all of the prior art references I rely on were published or issued prior to this date.

VIII. TECHNICAL BACKGROUND

A. Cable Systems

53. At the time of the earliest possible priority date for the ’438 Patent, cable systems allowed the transmission of data between a cable operator’s headend and customer locations over all-coaxial or hybrid-fiber/coax (HFC) cable networks.

Ex. 1033, 2-4. A simplified version of this is shown below, which includes a cable modem termination system (CMTS) at the headend, cable modems, and customer premises equipment (CPE). Examples of CPEs include home routers, set-top devices, and personal computers. Ex. 1033, 2.



Ex. 1033, Fig. 1-1

54. A CMTS connects a cable operator's back office network at the headend with the HFC network. Ex. 1033, 2. Using the HFC network, the CMTS transmits data to cable modems on downstream channels and receives data from cable modems on upstream channels. *Id.*

55. The CMTS also configures the physical layer parameters (*e.g.*, modulation scheme) of each channel used to communicate data to and from the cable modems. Ex. 1031, ¶¶7, 13, 26-34; Ex. 1033, 15-17, 88-91. For example, a CMTS may send a plurality of cable modems an Upstream Channel Descriptor Message (UCD) that includes, among other things, modulation scheme, frequency, preamble pattern, and burst parameters. Ex. 1031, ¶¶26, 72-75. In response, a cable modem

transmits an initial training burst that includes identification information, and from which, the CMTS may calculate the SNR and upstream equalization coefficients. Ex. 1031, ¶102. The CMTS then sends a downstream message to the cable modem to make certain adjustments to its transmission. Ex. 1031, ¶102.

56. Further, at the time of the '438 Patent, it was common for a cable network to have hundreds or thousands of cable modems, each of which could have different throughput capabilities. Ex. 1031, ¶1. Because the throughput of a channel would be determined by the cable modem with the lowest throughput, a CMTS would group cable modems into channels by modem type (*e.g.*, DOCSIS type) and/or throughput ability as measured by performance characteristics (*e.g.*, SNR, bit error rate, packet error rate). Ex. 1031, ¶¶2-13, 37-46. By grouping cable modems, those cable modems with higher throughput capabilities would not be penalized by having cable modems on the same channel with lower throughput capabilities. Ex. 1031, ¶2.

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

(QAM)), while older DOCSIS modems (*e.g.*, DOCSIS 1.0, DOCSIS 1.1) and others with lower SNRs can transmit using less complex modulation techniques with lower throughput (*e.g.*, Quadrature Phase Shift Keying (QPSK)).

B. Orthogonal Frequency Division Multiplexing (OFDM)

58. OFDM is a modulation method for efficiently transmitting large amounts of data over a signal processing network. Ex. 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.

59. In OFDM, the data bits are grouped as symbols based on the number of bits per symbol. The group of symbols are then modulated by the inverse Fourier transform. The OFDM output signal is generated by calculating an Inverse Fast Fourier Transform (IFFT) on a set of symbols. Ex. 1024, ¶3. Each symbol of the set of symbols defining the OFDM symbol represents a specific plurality of data bits

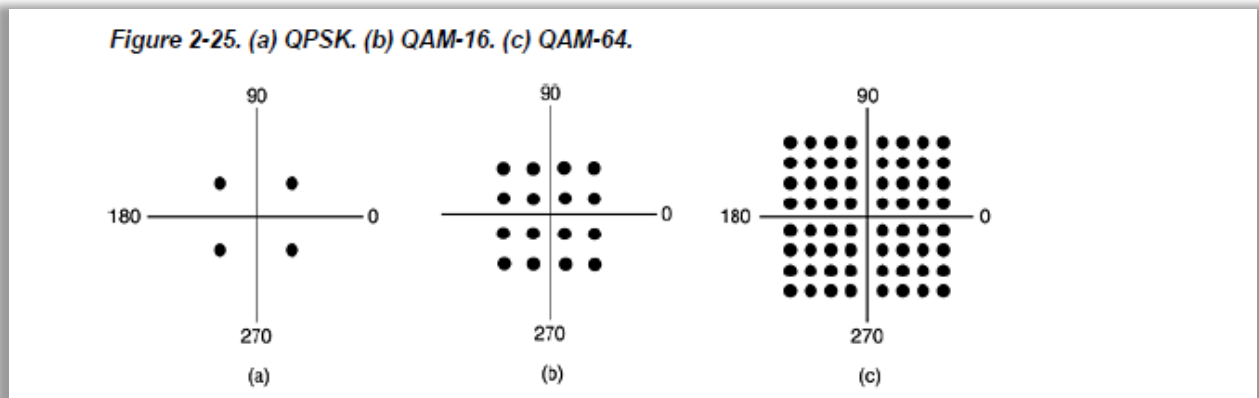
and may be retrieved by performing the Fourier transform on the OFDM symbol. Ex. 1024, ¶3. In this way, only one symbol will be generated for any subcarrier frequency. Ex. 1024, ¶3. Further, because transmitted data is divided over multiple carrier sub-bands (sub-channels), the symbol intervals become 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.

60. 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.

C. Quadrature Amplitude Modulation (QAM)

61. 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.

62. 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.

63. 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. 1025, 5:10-33; Ex. 1026, 98-99. A timing feature is employed to determine the start of each new symbol. Ex. 1025, 1:25-55.

D. Quadrature Phase Shift Keying (QPSK)

64. 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.

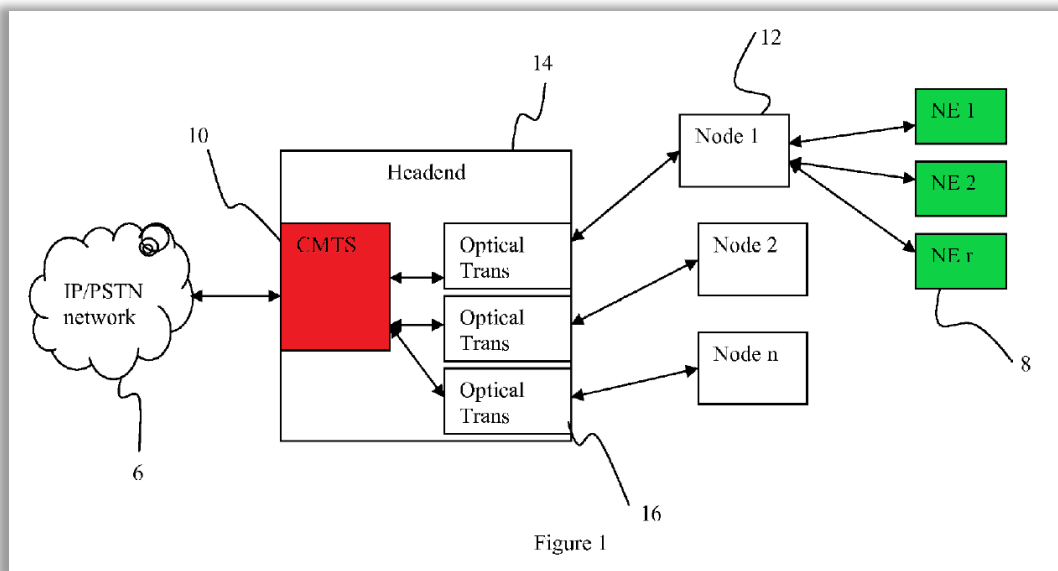
IX. OVERVIEW OF THE PRIOR ART

A. Cooper

65. 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.

66. Like the '438 patent, Cooper describes a cable system that measures network parameters, such as a cable modem's SNR, and uses those parameters to

reconfigure logical channels (i.e., group cable modems to a particular channel). Ex. 1005, ¶¶2, 7-10. In particular, Cooper describes a “process for reconfiguring logical channels” in a network. Ex. 1005, ¶17; *see also* id., ¶¶2, 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)

67. Cooper explains that CMTS 10 resides at a headend 14, which includes transceivers 16 that communicate with the network elements by receiving upstream communications from the network elements and sending downstream communications to the network elements. Ex. 1005, ¶¶3, 22. The measured network parameters are determined in cooperation with the network elements without interruption of active communication services. Ex. 1005, Abstract, ¶¶26-27, 30, Figs. 4-5. 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, and downstream receive power level. Ex. 1005, Abstract. Using these measurements, cable modems are grouped based upon performance similarities. Ex. 1005, ¶19. According to Cooper, “[t]hese groupings may then be used to configure logical channels and subsequently the assignment of [cable modems] to these logical channels.” Ex. 1005, ¶19.

B. Cooper840

68. Cooper840 (Ex. 1030) is a U.S. Published Application published November 27, 2008. Cooper840 is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1001, 1-2.

69. Cooper840 shows that it was known to use the lowest SNR for a group of cable modems when selecting a common modulation profile for use by all cable modems within the group. Ex. 1030, ¶¶28, 31, 34. Specifically, Cooper840 describes determining a network element to be used to communicate with a network controller to measure and monitor parameters of a network. Ex. 1030, ¶1. In one embodiment, Cooper840 discloses a network that includes a CMTS 10 (**red**) and a multiple cable modems 8 (**green**). Ex. 1030, ¶20, Fig. 1 (reproduced below).

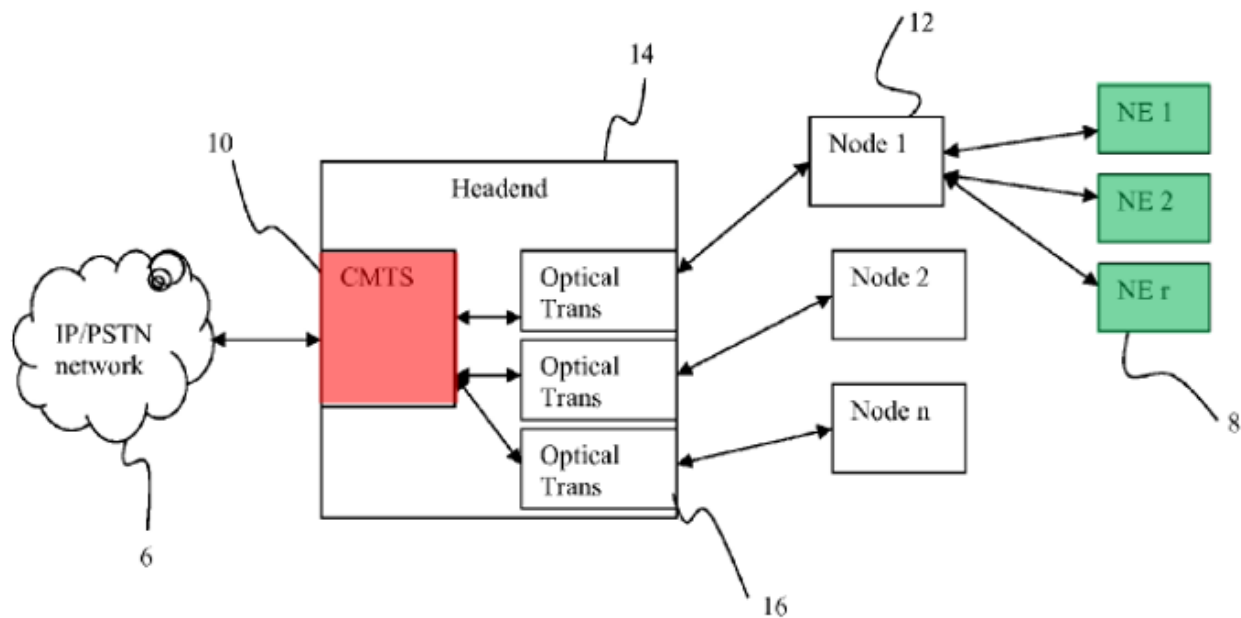


Figure 1
Ex. 1030, Fig. 1

70. Cooper840 additionally discloses a process for controlling modulation parameters, such as modulation order. Ex. 1030, ¶¶20, 28. Cable modems are sorted based on MER or SNR. Ex. 1030, ¶¶9-11, 29-30, Fig. 5 (element S3). Cooper840 describes that “[i]deally, we want to set the modulation profile as a function of the lowest MER in the network element pool” when describing the MER embodiment. Ex. 1030, ¶31. According to Cooper840, the modulation parameters that are set based on the lowest SNR within a service group include modulation order, *e.g.*, QPSK, 8QAM, 16QAM, etc. Ex. 1030, ¶¶6, 28, 32.

C. Azenkot

71. Azenkot (Ex. 1031) is a U.S. Published Application published June 9, 2005. Azenkot is prior art under pre-AIA 35 U.S.C. § 102(b). Azenkot was cited

during prosecution, but not applied in any rejection during prosecution. Ex. 1001, 1-2.

72. Azenkot shows that it was known to set parameters of a common burst profile used for communications by multiple cable modems based on the least capable cable modem (i.e., the cable modem with the lowest SNR). Ex. 1031, ¶¶1, 7, 68. In particular, Azenkot describes a process for grouping cable modems by type/modulation profile and/or throughput ability into different logical groups. Ex. 1031, Abstract, ¶7.

73. Each logical group is commanded to transmit upstream with a burst profile set to effectively use the throughput ability of the worst-performing cable modem. *Id.* Azenkot specifically teaches grouping cable modems by SNR. Ex. 1031, ¶¶7, 13, 16, 40-41, 92. Burst profiles used for communications are thus selected for a group based on SNR, and are selected so as to allow communication with the CM having the lowest SNR in the group. Ex. 1031, ¶¶16, 40-41, 92-94.

D. 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 shows that it was known to send a probe message to cable modems when determining the SNR of a channel and the corresponding modulation

schemes to be used with that channel. Ex. 1015, Abstract, 4:44-59, 9:28-41. In particular, a sending node transmits a probe message having a predetermined data sequence to a CM, which then analyzes the probe message for impairment at each frequency. Ex. 1015, 4:44-59, 9:28-41, Abstract. The CM 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.

76. Monk also discloses using orthogonal frequency division multiplexing (OFDM) to address signal impairments that restrict high bandwidth communication with cable modems in a cable network. Ex. 1015, Abstract, 1:29-31, 2:34-37, 4:25-43, 4:60-64, 5:52-55, 7:13-9:19, Figs. 5-6, 10. The available bandwidth is divided into narrower channels or “bins” to transmit subcarriers that are modulated independently (on a per-subcarrier basis) depending on the channel’s SNR. *Id.*, 7:14-16, 8:1-28, 10:55-67. OFDM is used by networks to overcome signal impairments, which may be caused by micro-reflections and impedance mismatches. Ex. 1015, 4:16-43, 6:20-27, 7:36-62.

E. Cooper437

77. Cooper437 (Ex. 1016) is a U.S. Patent filed July 28, 1999 and granted on August 3, 2004. Cooper437 is prior art under pre-AIA U.S.C. § 102(b) and was not considered during prosecution. Ex. 1001, 1-2.

78. Cooper437 shows that it was known to use cable modem probe messages that include instructions for measuring noise and reporting the noise to a CMTS. Ex. 1116, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1. Cooper437 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.

79. For example, in Cooper437 a CMTS initiates noise signal power measurements by transmitting a message to cable modems that defines the measurement techniques to be used and how to report the measurements. Ex. 1016, 8:11-29, 8:60-9:5, 10:53-11:28, Table 1.

80. Cooper also 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, 10:53-11:28, Table 1.

F. Currivan

81. Currivan (Ex. 1028) is a U.S. Patent Application Publication published May 5, 2005. Currivan is prior art under pre-AIA U.S.C. § 102(b) and was considered, but not applied, during prosecution. Ex. 1001, 1-2.

82. Currivan shows that it was known for a CMTS to segregate cable modems into groups and to select physical layer communication parameters for each

group. Ex. 1128, [0017], [0026]. In particular, Currivan discloses a cable modem system in which a CMTS segregates cable modems into groups to allow for optimal use of bandwidth. Ex. 1028, ¶¶26, 65. Physical layer communication parameters are selected based on the SNR required to support those parameters. Ex. 1028, ¶¶34, 65-66, 69, 79. Three of the physical layer communication parameters selected are: (1) modulation order or modulation density (Ex. 1028, ¶¶17, 138, 157, 164, Figs. 14A-14B), (2) forward error correction (FEC) rate (Ex. 1028, ¶¶17, 155, 161-162, 181, Fig. 14A) and (3) transmit power (Ex. 1028, ¶¶33, 67-68, 142, 151, 157-158, 169, 176-177, 200, Claim 25).

X. OPINIONS WITH RESPECT TO THE '438 PATENT

A. Cooper in View of Cooper840 Renders Claims 1-2, 7-8, 10-11, and 16-17 Obvious

1. Independent Claim 1

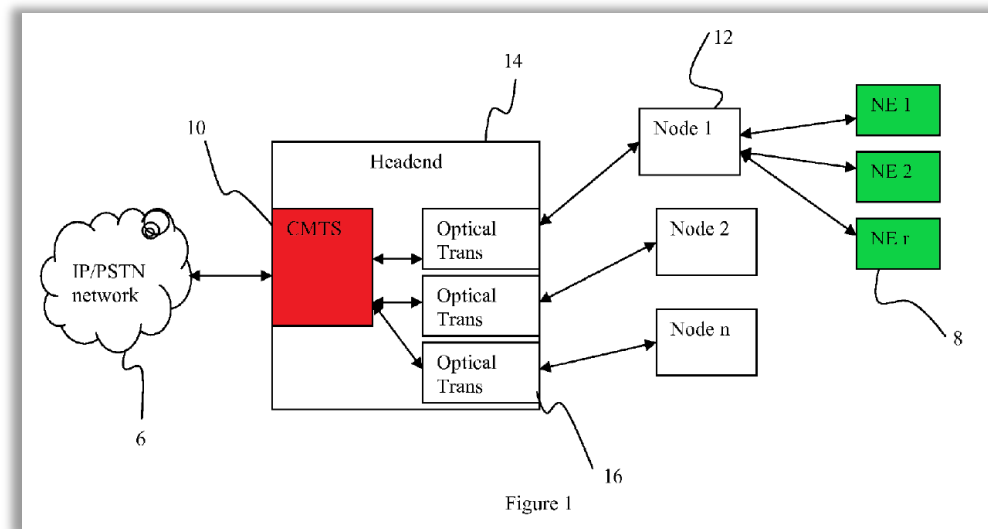
a. Element [1A]: “A method comprising:”

83. If the preamble [1A] is limiting, then Cooper-Cooper840 teaches the claimed method for the reasons I describe below.

b. Element [1B]: “determining, by a cable modem termination system (CMTS), for a plurality of cable modems served by said CMTS, a corresponding

plurality of signal-to-noise ratio (SNR) related metrics;”

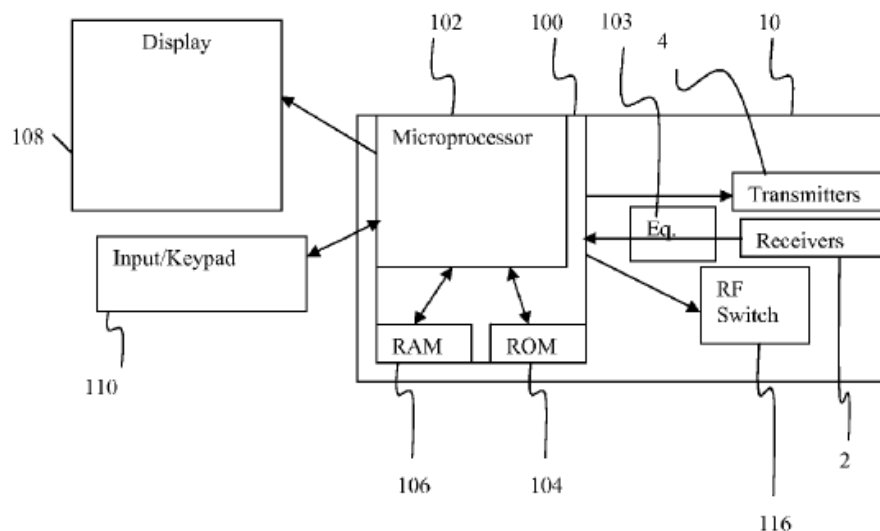
84. It is my opinion that Cooper discloses Element [1B]. According to Cooper, his system is “directed toward grouping network elements according to certain parameters to configure logical channels in a network.” Ex. 1005, ¶2.



Ex. 1005, Fig. 1 (annotated).

85. As I show above in Figure 1, in one example 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. Cooper explains that CMTS 10 is located at a headend 14, which includes transceivers that communicate with and serve the network elements by receiving upstream communications for the network elements and sending downstream communications to the network elements (the claimed “a plurality of cable modems 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.



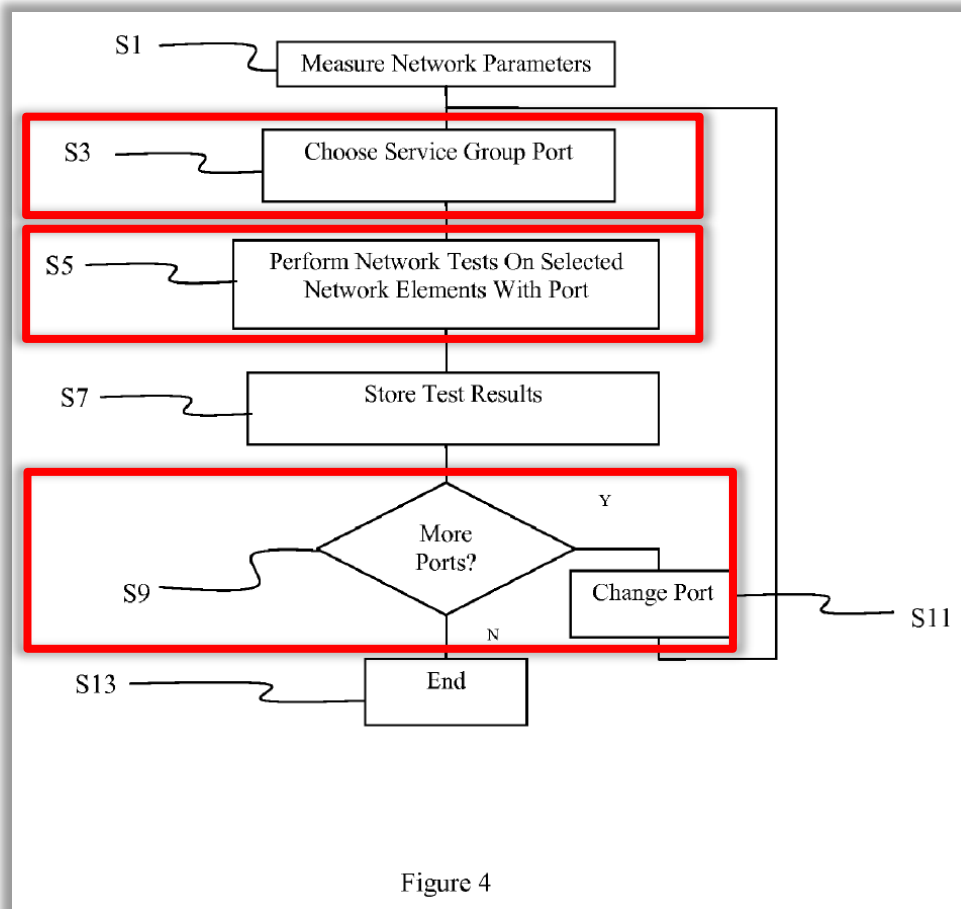
Ex. 1005, Fig. 2

86. As shown above in Figure 2, CMTS 10 includes a microprocessor 102 that receives instructions and data from ROM 104/RAM 106 and controls the operation of the CMTS. Ex. 1005, ¶¶22-23, Figs. 1-2. In my opinion, Cooper’s CMTS meets the District Court’s tentative construction of “CMTS” in the CA litigation because it comprises hardware and accompanying software, with the hardware located at the point at which the CMs’ connection to a hybrid-fiber coaxial network terminates, as the name CMTS suggests. Ex. 1005, ¶¶3, 22-25, Figs. 1-2.

87. Cooper also discloses optimizing network communications based on measuring various network parameters at the CMTS or at each of the plurality of cable modems. 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

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, ¶¶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*.

According to Cooper, 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 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 for a plurality of cable modems connected to the selected port. Ex. 1005, ¶¶7-8, 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.



Ex. 1005, Fig. 4 (annotated).

88. Cooper’s CMTS performs the testing, which includes testing “upstream or downstream modulation error ratio (MER) [or] upstream or downstream signal to noise ratio (SNR).” Ex. 1005, ¶¶8, 27. Modulation error ratio and SNR are both ratios that consider noise and indicate signal quality and are each independently an “SNR-related metric”. Ex. 1030, ¶4. Therefore, it is my opinion that Cooper discloses a CMTS testing SNR-related metrics for a plurality of network elements (e.g., cable modems) connected to and in communication with a CMTS (the claimed

“determining, by a [CMTS], for a plurality of cable modems served by said CMTS, a corresponding plurality of signal-to-noise ratio (SNR) related metrics”).

89. It is therefore my opinion that Cooper discloses Element [1B].

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

90. It is my opinion that 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. According to Cooper, while prior CMTS implementations for configuring logical channels involved manual processes, Cooper’s system discloses “an automated process to determine logical channels using [cable modems] in conjunction with measurements made at the headend, via a CMTS device...” Ex. 1005, ¶¶6-7; *see also* Abstract.

91. To that end, Cooper teaches a method that includes “determining network parameters [(e.g., SNR or MER)] 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.”

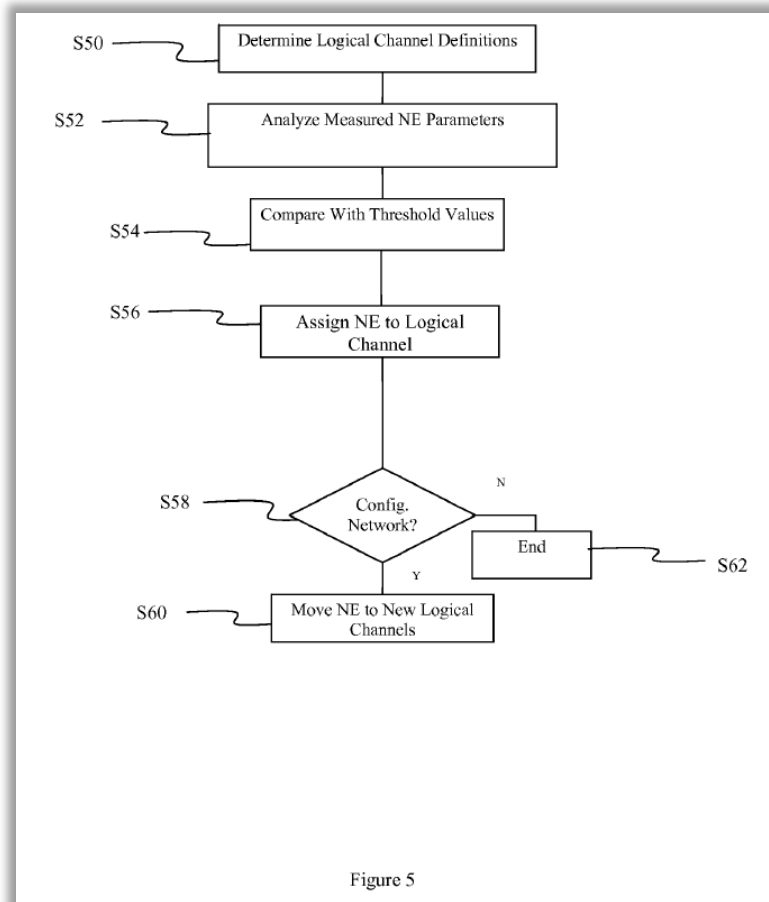
Ex. 1005, ¶9; *see also id.*, ¶¶8, 10 (similar determining and assigning language).

92. 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]).

93. 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 optimal 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

94. 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 (**green**), and a list of three SNR thresholds (**blue**) used to delineate four logical channels (**gold**) 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.

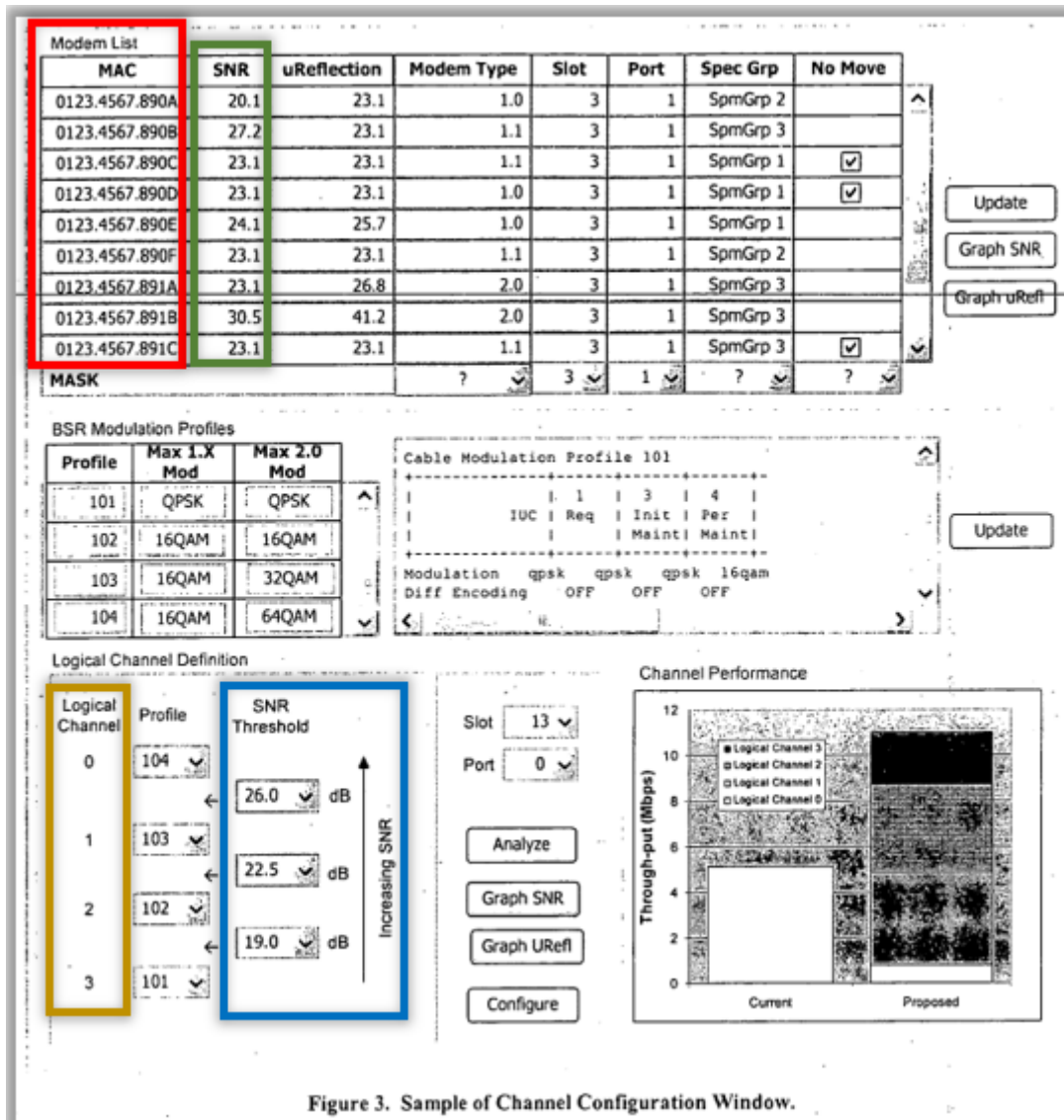


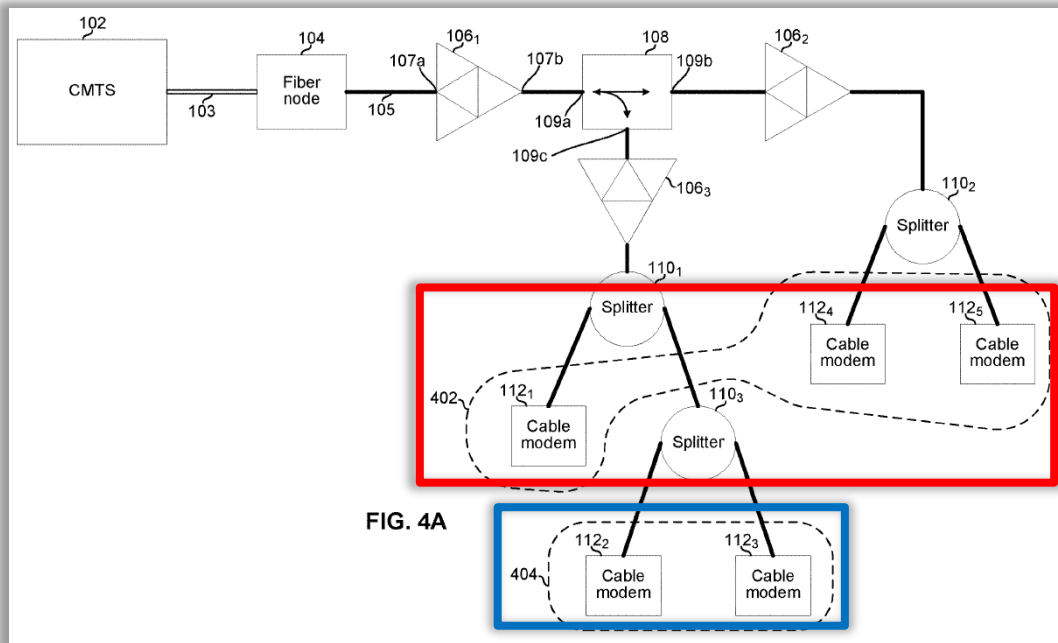
Figure 3. Sample of Channel Configuration Window.

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

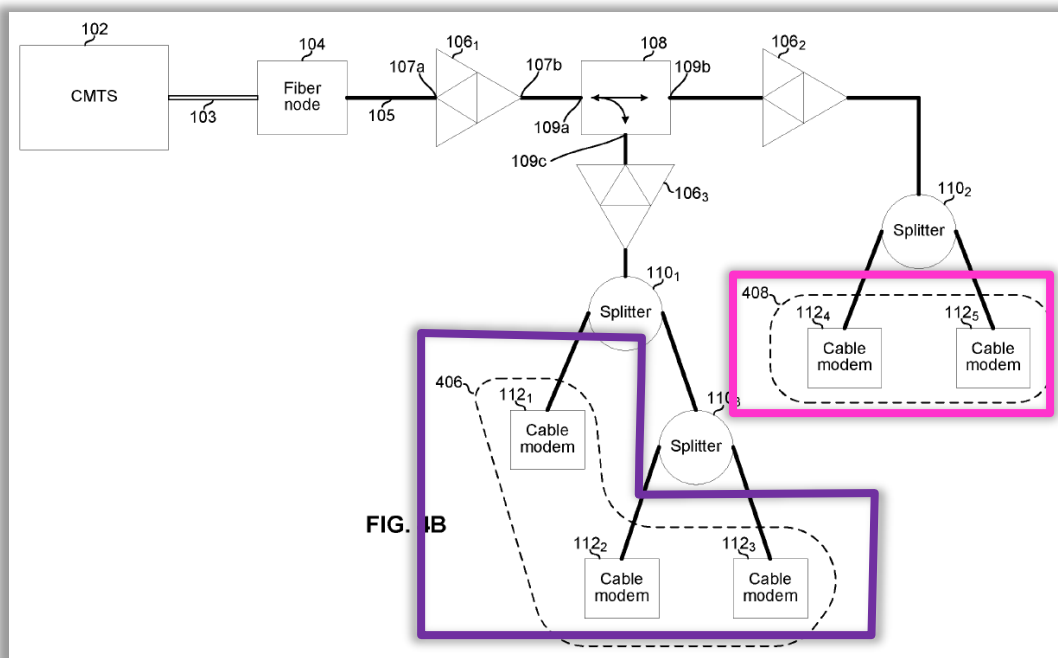
95. As shown in the figure above, Cooper's process of assigning cable modems to logical channels based on comparing their respective SNR-related metric measurement to SNR thresholds results in three groupings of cable modems: (1) a group with measured SNRs above 26.0 assigned to logical channel "0" (i.e., 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.

96. Cooper’s cable modem groups respectively assigned to logical channels discloses the claimed “plurality of service groups”. See Ex. 1005, ¶¶26-27 (describing the process as encompassing a “service group”). Indeed, such disclosures in Cooper are very similar to the ’438 patent’s disclosure for this claim term. In particular, the ’438 patent discloses “service groups” as groupings that arise from some shared characteristic between the cable modems of a respective group. For example, the ’438 patent illustrates service groups in Figures 4A and 4B in which the groupings are based on performance characteristics measured for the cable modems or their location in the cable network. Ex. 1001, 2:22-25, 5:35-37 (assigning cable modems to service groups based on SNR profile), 6:19-21 (assigning cable modems to service groups based on their location), 6:40-7:21 (generally discussing assigning cable modems to service groups), Figs. 3A-3B, 4A-4B.



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 (**purple**); service group 408 includes cable modems 112₄, 112₅ (**pink**)) (annotated).

97. 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 ’438 patent. The ’438 patent is a parent of U.S. Pat. No. 10,135,682 (the “’682 patent”), which issued from a continuation application that claims priority to the ’438 patent. Ex. 1029, cover. Similar to the ’438 patent, claim 1 of the ’682 patent includes the claim term “service groups”. Ex. 1029, 8:8. In prior litigation involving the ’682 patent, a District Court construed the claim term “service group[s]” as having its plain meaning based on the ’682 patent’s reference to grouping cable modems when using this term. Ex. 1017, 55-57 (citing the ’682 patent at 2:24-27, 6:39-41, which corresponds to identical disclosure in the ’438 patent at 2:22-25, 6:37-39); *see also* Ex. 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 ’438 patent.

98. 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 “said plurality of cable modems”) to a particular logical channel based on their SNR or MER measurements (the claimed “based on said plurality of SNR-related metrics”) 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 ’438 patent’s disclosure regarding service groups.⁴

99. It is therefore my opinion that Cooper discloses Element [1C].

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-3B, 4A-4B; Ex. 1017, 55-57; Ex. 1018, ¶¶145-146, 148.

- d. Element [1D]: “generating, by said CMTS for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics corresponding to said one of said plurality of service groups;”**

100. It is my opinion that Cooper-Cooper⁸⁴⁰ discloses Element [1D]. As I show above for Element [1B], Cooper discloses determining SNR-related metrics for a plurality of cable modems. 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], the CMTS also groups cable modems and assigns them to logical channels based on a comparison between the determined SNR or MER for each cable modem and SNR or MER thresholds; cable modems with similar SNRs or MERs are grouped together. *See* Section X.A.1.c, *supra*; Ex. 1005, ¶¶2, 6, 8 (“...wherein the microprocessor is configured to assign the network element to a logical channel based on the network parameters. The network parameters may include one of: upstream or downstream modulation error ratio (MER), upstream or downstream signal to noise ratio (SNR)...”), 9-10, 19-20, 30 (“As illustrated in step S50, the process begins by determining the logical channel definitions. This process may be implemented as an automated process whereby the processor determines which parameter to optimize and selects the optimal grouping of modems to be assigned to each of multiple logical channels”), 32-33, 41, Figs. 5-6. Cooper also teaches leveraging grouping benefits to optimize physical layer configuration parameters for groups of cable modems. Ex. 1005, ¶¶6,

19. Each of the logical channels in Cooper are configured so that the CMTS uses the same physical layer configuration parameters (including modulation order) to communicate with all the cable modems within a service group. Ex. 1005, ¶¶19-21, 30, 36. I note that what Cooper refers to as a “modulation rate” corresponds to what the ’438 patent refers to as “modulation order”. See Ex. 1005, ¶21. As I describe below for Element [1E], Cooper discloses the CMTS executing an algorithm to automatically select configuration parameters. Section X.A.1.e; Ex. 1005, ¶¶30, 31-32, 42, Figs. 2, 5-6. I note that Cooper does not explicitly disclose determining a “worst case” SNR for each group of cable modems assigned to each logical channel prior to selecting the configuration parameters. However, it is my opinion that a POSITA would have found it obvious to do so in view of Cooper840’s teachings.

101. Cooper840 describes a network that includes cable modems and a CMTS. Ex. 1030, ¶20, Fig. 1. I note that the Cooper840 system’s network and components are substantially similar to the Cooper network and components. For example, figures and disclosure in Cooper that describe its logical architecture and network are identical or substantially similar to illustrations and disclosure in Cooper840. *E.g., compare* Ex. 1005, ¶¶22-25, Figs. 1-3 to Ex. 1030, ¶¶20-23, 27, Figs. 1-2, 4. Cooper840 further discloses a process for selecting a network element (*e.g.*, a cable modem) to evaluate a service group and control modulation parameters (*e.g.*, modulation order). Ex. 1030, ¶¶20, 28. Cable modems are grouped by either

modulation error ratio (MER) or SNR. Ex. 1030, ¶¶9-11, 29-30, Fig. 5 (step S3). Modulation error ratio is a measurement that considers noise and distortion effects and indicates signal quality. Ex 1030, ¶4. Modulation error ratio and SNR are both ratios that consider noise and indicate signal quality and in my opinion are each independently an SNR related metric. Ex. 1030, ¶4. According to Cooper840, “[i]deally, we want to set the modulation profile as a function of the lowest MER in the network element pool” when describing the MER embodiment. Ex. 1030, ¶31. Cooper840 further teaches that the modulation parameters include modulation order. Ex. 1030, ¶¶6, 28, 32. I note that what Cooper840 refers to as a “modulation type” corresponds to what the ’438 patent refers to as “modulation order”. *See* Ex. 1030, ¶6. It is my opinion that a POSITA would have understood from Cooper840 that setting the modulation profile as a function of the lowest MER or SNR is ideal because such a setting ensures that all of the network elements can pass data on the channel (i.e., no cable modem in a group has an SNR too low for the modulation order selected for that group). Ex. 1030, ¶¶5-6, 31-32.

102. Cooper840 therefore teaches a POSITA to determine the lowest SNR or MER for cable modems in a service group (the claimed “composite SNR-related metric based on a worst-case SNR profile ...”) and to use that to select modulation parameters (such as modulation order) for the service group. In my opinion, a POSITA would have been motivated to apply this teaching to Cooper’s algorithm

(executed at the CMTS) that selects optimal physical layer communication parameter (*e.g.*, modulation order, whether or not to use differential encoding) in order to ensure that all of the cable modems can pass data on the channel. Ex. 1030, ¶¶5-6, 32.

103. Cooper determines multiple physical layer communication parameters for each service group. As I show in the figure below from Cooper, its channel configuration screen includes a “Modulation Profile display panel 1004” (purple) that (i) shows channel configuration parameters (such as modulation orders, *e.g.*, QPSK, 16QAM, etc.) and whether to use differential encoding, and (ii) allows the configuration of profile templates that may be assigned to an individual logical channel, thus optimizing the specific needs of a subset of the CMs. Ex. 1005, ¶36, Fig. 6; Ex. 1006, 11 (Fig. 3). According to Cooper, its modulation profiles “optimize the specific needs of a subset of the network elements” (*i.e.*, cable modems). Ex. 1005, ¶36.

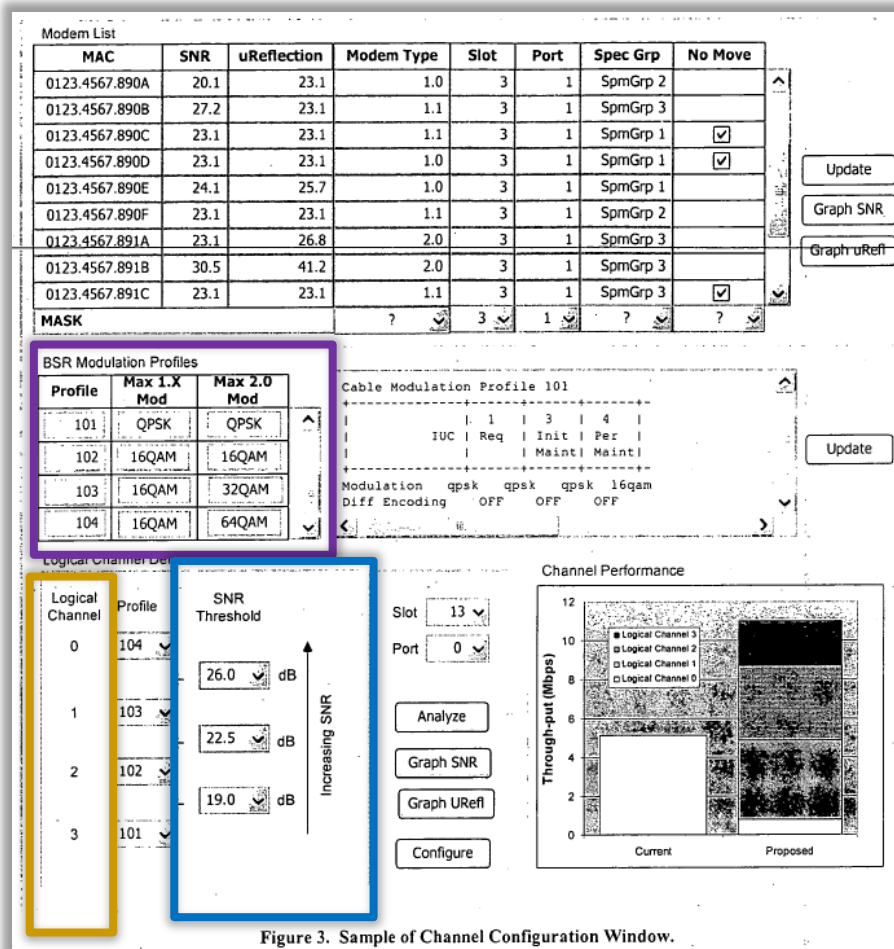


Figure 3. Sample of Channel Configuration Window.

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

104. 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), 43-46 (§§4.2.1, 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 (§§4.2.1-4.2.2); 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 (§§4.2.1-4.2.2), 40 (§4.2.2.3), 52 (§4.2.13), 53 (§4.3.4); Ex. 1023, 19 (§1.1.1), 43 (§4.2.1), 44-46 (§4.3.1), 58-61 (§§6.2.1-6.2.2), 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, ¶¶36-37, Fig. 6; *see also* Ex. 1006, 11 (Fig. 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 (Fig. 3).

105. A POSITA would have additionally found it obvious to apply Cooper’s teaching of determining the lowest MER or SNR of a cable modem in a service group in order to select modulation parameters for the service group to Cooper’s method (executed at the CMTS) of configuring modulation profiles in order to further Cooper’s goals of “optimiz[ing] the performance of [Cooper’s] network” and “optimizing physical layer configuration parameters” for cable modem groups. Ex. 1005, ¶¶11, 19, 39. In my opinion, 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 profile

for a cable modem group would have ensured communication with all cable modems in the group while also optimizing the network and conserving resources.⁵

106. 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 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).

107. In my opinion, a POSITA also would have found it obvious to apply Cooper’s teaching of determining the lowest MER or SNR of a cable modem in a service group to select modulation parameters for the service group to Cooper’s

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.

algorithm (executed at the CMTS) in order to implement Cooper's dynamic SNR thresholds for assigning cable modems to a logical channel. Ex. 1005, ¶30. Cooper 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 and MER 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 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 Cooper⁸⁴⁰'s teaching of determining the lowest MER or SNR of a cable modem in a service group to select modulation parameters for the service group 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).

108. It is my further opinion that 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 uniform modulation order parameters to CMs that are grouped based on SNR or MER, and Cooper⁸⁴⁰'s use of the lowest SNR or

MER of a cable modem in a service group to select modulation parameters for the service group. The known methods include programming a CMTS. The predictable results include a CMTS that generates a worst-case SNR-related metric for a cable modem service group and uses that metric to determine the communication parameters—including modulation order—applied to the group.

109. It is my additional opinion that the proposed combination also represents the application of a known technique to a known system ready for improvement to yield predictable results. The known technique comprises Cooper840's use of the lowest SNR or MER of a cable modem in a service group to select modulation parameters for the service group. The known system ready for improvement comprises Cooper's system that applies uniform modulation order parameters to CMs that are grouped based on having similar SNRs. The predictable results include an improved system that furthers Cooper's goals of "optimizing the performance of [Cooper's] network" and "optimizing physical layer configuration parameters" for CM groups. If it is argued that the "worst-case SNR profile" recited in [1D] must comprise the SNR-related metric of a cable modem over a range of frequencies, it is my opinion that such a feature is also taught by Cooper-Cooper840. In particular, Cooper840 discloses a technique for measuring MER over a range of frequencies in order to select the best relative channel quality for routing a communications signal. Ex. 1030, ¶35 (incorporating Ex. 1035 by reference); Ex.

1035, Abstract, 1:45-48, 2:62-67, 3:55-65, 5:33-44, Figs. 1, 3. It is my opinion that a POSITA would have been motivated to further modify Cooper to generate a worst-case SNR profile that comprises an SNR-related metric over a range of frequencies in order to facilitate selection of the best relative channel quality for routing a communications signal, as taught by Cooper840.

110. In addition, applying Cooper840's teachings to Cooper's CMTS would have been well within the capabilities of a POSITA and would have involved only straightforward 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.

111. Applying Cooper840'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 or MERs 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 or MER (i.e., the lowest SNR or MER) for each group of cable modems based on the sets of SNRs or MERs that Cooper's modified CMTS respectively measured for each group. The use by Cooper's modified CMTS of the lowest SNR or MER within a cable modem group to select the physical layer parameters for that group is a "composite" SNR-related metric because it is applied to all of the cable modems within a service group.

112. In my opinion, Cooper-Cooper840's teaching of the claimed "composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics" is consistent with what the '438 patent discloses for the limitation. For example, according to the '438 patent, 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, 4:7-17, Fig. 2B. In addition, the '438 patent teaches that physical layer parameters are determined based on the singular worst-case SNR for a service group. Ex. 1001, 5:4-18, 5:38-44.

113. I also understand that, in prior litigation, a District Court construed a nearly identical phrase in the claims of the '682 patent (which as I discuss above issued from a continuation that claims priority to the '438 patent) as having its plain meaning based on the '682 patent's disclosure. Ex. 1017, 53-55 (citing the '682 patent at 4:9-20, 5:7-12, 5:42-57, Fig. 2C, which corresponds to identical disclosure in the '438 patent at 4:7-17, 5:4-9, 5:40-55, Fig. 2C); *see also id.*, 54 (noting Patent Owner's position that "'composite' means that something is **for** more than one cable modem" and that a POSITA "would understand that the term 'composite SNR-related metric' **relates to** multiple cable modems") (emphasis added); Ex. 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, Fig. 2C); 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).

114. It is therefore my opinion that Cooper-Cooper840 teaches Element [1D].

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

115. In my opinion, Cooper-Cooper840 discloses Element [1E]. As I show above for Element [1D], Cooper-Cooper840 discloses determining the lowest MER or SNR of a cable modem in a service group to select modulation parameters for the service group. Section X.A.1.d, *supra*; Ex. 1030, ¶¶6, 20, 28, 31, 32. In addition, as I also show above, Cooper discloses a channel configuration screen (reproduced below), and the screen includes a **Modulation Profile display panel** 1004 and an **expanded detail window** 1009 that (i) show channel configuration parameters (such as modulation orders, *e.g.*, QPSK, 16QAM, etc.) and whether to use differential encoding, and (ii) allow the configuration of modulation profiles that may be assigned to Cooper’s logical channels associated with Cooper’s CM groups (the claimed “plurality of service groups”). Ex. 1005, ¶36, Fig. 6; Ex. 1006, 11 (Fig. 3); Section X.A.1.d, *supra*.

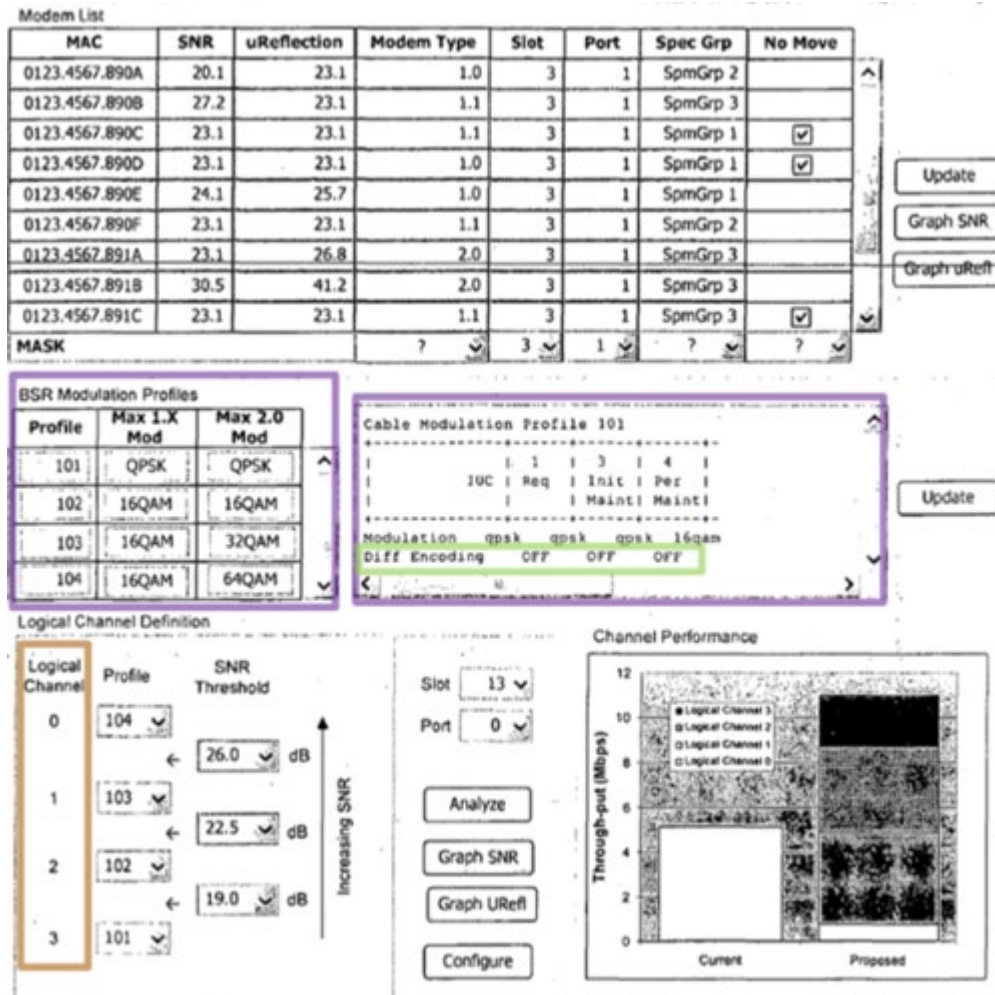


Figure 3. Sample of Channel Configuration Window.

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

116. As shown in the figure above, Cooper describes that multiple different modulation profile parameters may be selected based on SNR and used for communicating with the cable modems assigned to each **logical channel** (e.g., logical channel 3). Ex. 1005, ¶36, Fig. 6; Ex. 1006, 11 (Fig. 3). As shown in the **Modulation Profile display panel** and the **expanded detail window** (which in this illustration shows expanded details for “Modulation Profile 101”), for example, such

modulation profile parameters that can be selected include the modulation order (e.g., QPSK, 16QAM, 32QAM, 64QAM) and whether or not to use **differential encoding**. Ex. 1005, ¶36, Fig. 6; Ex. 1006, 11 (Fig. 3).

117. Cooper also discloses that the CMTS selects pre-equalization parameters and preamble lengths based on a measured SNR and instructs each cable modem to use these parameters for communications between the CMTS and each cable modem. Ex. 1005, ¶¶17, 25, 27, 40, 42, Fig. 3. Such parameters (i.e., modulation order, pre-equalization parameters, preamble lengths and whether or not to use differential encoding) disclose the claimed “physical layer communication parameters to be used for communicating with said one of said plurality of service groups.” I note that such disclosure in Cooper (as modified by Cooper840) is very similar to the ’438 patent’s disclosure for this limitation. The ’438 patent, for example, explains that the claimed “physical layer communication parameters” include, but are not limited to, “encoding parameters”, “modulation type,” “modulation order,” and “modulation parameters.” Ex. 1001, Abstract, 4:53-64, claims 2 and 5. In my opinion, a POSITA would have understood that Cooper discloses “encoding parameters” (i.e., whether or not to use differential encoding, preamble length, and pre-equalization parameters) as well as “modulation order” (e.g., QPSK, 16QAM, 32QAM, 64QAM). It is therefore my opinion that Cooper

discloses the same types of “physical layer communication parameters” described in the ’438 patent.

118. Cooper further teaches that the process described above of selecting physical layer configuration parameters may be performed by the CMTS’s microprocessor. For example, Cooper teaches an automated process in which Cooper’s CMTS’s processor determines which parameter to optimize and selects the optimal grouping of modems to be assigned to each of the multiple logical channels. Ex. 1005, ¶¶30, 42, Figs. 5-6. Based on such an optimization process, the CMTS’s processor determines the optimal value for thresholds to isolate the various logical channels and “the associated channel profile configuration (parameters)” for each logical channel. *Id.*, ¶¶30, 42, Figs. 1-2, 5-6. Cooper also teaches automating its logical channel configuration, and describes that the CMTS may also rerun these processes at regular intervals, including daily, weekly, monthly, yearly, etc. *Id.*, Abstract, ¶¶30, 40, 43.

119. Cooper-Cooper840 therefore teaches a CMTS selecting/determining network communication parameters (e.g., modulation order, whether to use differential encoding, preamble length, and pre-equalization parameters) for a group of cable modems as part of its logical channel configuration. *See* Section X.A.1.d, *supra*. Cooper-Cooper840’s CMTS therefore teaches “selecting, by said CMTS, physical layer communication parameters [(i.e., modulation order, whether to use

differential encoding, preamble length, and pre-equalization parameters)] to be used for communicating with said one of said plurality of service groups based on said composite SNR-related metric.”

120. Therefore, Cooper-Cooper840 teaches Element [1E].

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

121. It is my opinion that Cooper-Cooper840 also teaches Element [1F]. As I show above for Elements [1D]-[1E], Cooper-Cooper840’s CMTS selects a modulation order and encoding parameters (i.e., whether or not to use differential encoding, preamble length, and pre-equalization parameters) for the modulation profiles assigned to its logical channels based on the worst-case SNR-related metrics respectively determined for the cable modem groupings assigned to those logical channels. Ex. 1005, ¶36; Section X.A.1.d-e, *supra*. Cooper-Cooper840’s CMTS then uses the selected modulation orders and encoding parameters to communicate with the connected cable modems in the respective logical channels. Ex. 1005, ¶¶19, 30.

122. Cooper-Cooper840 therefore teaches Element [1F] and renders claim 1 invalid as obvious.

- 2. **Dependent Claim 2: “The method of claim 1, wherein said physical layer communication parameters include**

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

123. It is my opinion that Cooper-Cooper840 teaches dependent claim 2. As I show above for Element [1E], Cooper-Cooper840’s CMTS teaches selecting a modulation order (*e.g.*, 16QAM, 32QAM, 64QAM) based on a composite SNR-related metric for the modulation profiles of the logical channels. Ex. 1005, ¶36, Fig. 6; *see also*, Section X.A.1.e, *supra*. Cooper-Cooper840’s modulation order teaches the claimed “physical layer communication parameters include one or more of: ... modulation order ...”. Ex. 1001, 8:23-27.

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

124. It is my opinion that Cooper (as modified by Cooper840) teaches the additional limitations of dependent claim 7.

125. As I show above for Element [1C], Cooper’s CMTS measures the SNR or MER 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/MER measurement. Ex. 1005, ¶9. Section X.A.1.c, *supra*. In addition to assigning network elements to groups based on SNR/MER 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 on the additional factor of the location of the network element (the claimed “assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems”). Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Section X.A.1.c, *supra*.

126. Therefore, Cooper-Cooper⁸⁴⁰ teaches dependent claim 7.

4. Dependent Claim 8: “The method of claim 1, comprising assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.”

127. It is my opinion that Cooper (as modified by Cooper⁸⁴⁰) discloses the additional limitations of dependent claim 8.

128. As I describe above for Element [1C], Cooper discloses that its CMTS measures the SNR or MER 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/MER measurement. Section X.A.1.c, *supra*. In addition to assigning network elements to groups based on SNR/MER 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 plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said

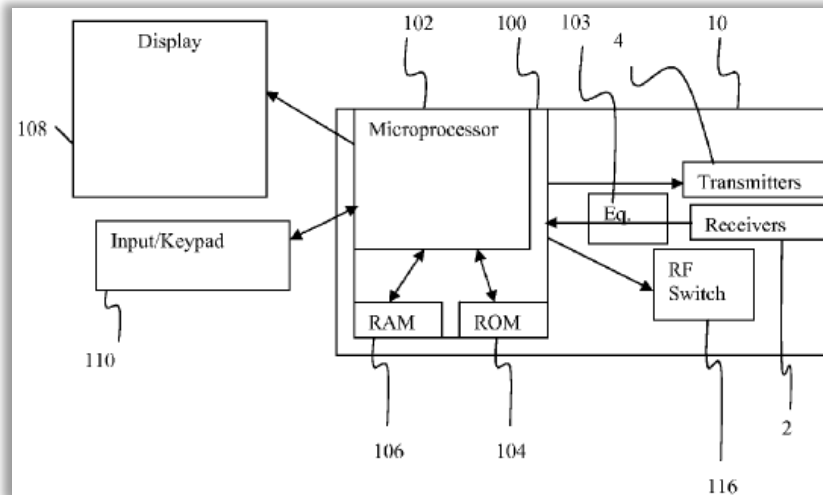
plurality of cable modems”). Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Section X.A.1.c, *supra*.

129. Cooper-Cooper840 therefore 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. I describe Cooper’s “network” above in connection with Element [1B]. Section X.A.1.b, *supra*. In my opinion, Cooper’s “network” discloses a “system” as recited in [10A]. *Id.*; Ex. 1005, ¶¶22-23, Figs. 1-2. As I illustrate below in Figure 2, Cooper further discloses that CMTS 10 includes circuitry such as: (1) a microprocessor 102 (the claimed “circuitry ... comprising a ... processor”) that controls the operation of the CMTS and that receives information such as instructions and data from a ROM 104 or RAM 106, and (2) 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. It is therefore my opinion that Cooper-Cooper840 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-Cooper840 teaches that the microprocessor 102 included in CMTS 10 is configured to perform the limitations I describe above in Elements [1B]-[1E]. Ex. 1005, ¶¶22-25, Figs. 1-2; Sections X.A.1.b-e, *supra*. For the reasons I provide above with respect to Elements [1B]-[1E], Cooper-Cooper840’s microprocessor 102 therefore teaches and is configured to perform the limitations recited in Elements [10B]-[10E]. Ex. 1005, ¶¶22-25, Figs. 1-2; Sections X.A.1.b-e, *supra*.

133. I also note that Element [10F] is nearly identical to Element [1F] with the exception that Element [10F] recites that the claimed “network interface” is configured to perform the limitations recited in Element [1F]. Cooper-Cooper840 teaches that the receivers 2 and the transmitters 4 (collectively the claimed “network interface”) provide bi-directional communication with network elements 8. Ex. 1005, ¶¶22-25, Fig. 2. For the reasons I provide above with respect to Element [1F], Cooper-Cooper840 therefore comprises a network interface that teaches and is configured to perform the limitations recited in Element [10F]. *Id.*

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

134. I note that the language of dependent claim 11 is substantially similar to the language of dependent claim 2. As I describe above for Element [10E], Cooper-Cooper840’s CMTS selects a modulation order (such as 16QAM/32QAM/64QAM) based on a composite SNR-related metric for its logical channels. Section X.A.1.e, *supra*. Cooper-Cooper840 therefore teaches the additional limitations of claim 11. It is therefore my opinion that dependent claim 11 is rendered obvious by Cooper-Cooper840 for the same reasons as dependent claim 2. Section X.A.2, *supra*.

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

135. I note that the language of dependent claim 16 is substantially similar to the language of dependent claim 7, with the exception that claim 16 identifies “said processor” to make the assignments described in claim 7. Ex. 1001, 10:26-29. As I described above in Section X.A.5.a, Cooper’s CMTS comprises a processor that controls the operation of the CMTS. Ex. 1005, ¶¶22-25, Figs. 1-2. As I also described above in Section X.A.3, such operation by Cooper’s CMTS includes making the assignments described in claim 7. Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; Sections X.A.1.c and X.A.3. Cooper-Cooper840’s processor therefore “is configured to assign said plurality of cable modems among said plurality of service groups based on respective distances between said CMTS and said plurality of cable modems”, as required by claim 16. *Id.* It is therefore my opinion that claim 16 is rendered obvious for the same reasons discussed above for claim 7. Section X.A.3., *supra*.

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

136. I note that the language of dependent claim 17 is substantially similar to the language of dependent claim 8, respectively, with the exception that claim 17 identifies “said processor” to make the assignments. Ex. 1001, 10:30-34. As I discussed above in Section X.A.5.a, Cooper-Cooper840’s CMTS comprises the claimed processor. It is therefore my opinion that dependent claim 17 is rendered obvious by Cooper-Cooper840 for the same reasons as dependent claim 8. Section X.A.4, *supra*.

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

1. Independent Claims 1 and 10

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

137. 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*.

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

138. As I discussed above for Element [1B], Cooper discloses determining SNR-related metrics for a plurality of cable modems. Section X.A.1.b., *supra*. In addition, as I discussed above for Element [1C], Cooper discloses assigning cable

modems to logical channels based on a comparison between the determined SNR-related metric for each cable modem and SNR thresholds. Section X.A.1.c, *supra*. Cooper also describes optimizing physical layer communication parameters for groups of cable modems. Ex. 1005, ¶¶6, 19. Each of the logical channels in Cooper are configured so that the CMTS uses the same physical layer communication parameters (including modulation order) to communicate with all the cable modems within a service group. Ex. 1005, ¶¶19-21, 30, 36. 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 Azenkot’s teachings.

139. Azenkot teaches grouping cable modems by SNR using multiple logical channels. Ex. 1031, ¶¶7, 13, 16, 40-41, 92. Burst profiles used for communications are selected for a group based on SNR. Ex. 1031, ¶¶16, 40-41, 92-94. In my opinion, a POSITA would have understood that there are trade-offs between the robustness of a burst profile and throughput. In particular, relatively higher cable modem SNRs are required for burst profiles that support higher throughput, while more robust burst profiles that result in lower throughput are required for lower cable modem SNRs. Ex. 1031, ¶¶10, 68, 92-93, 111.

140. Azenkot additionally teaches setting a burst profile that all CMs within a group must use that (i) is tailored to the throughput abilities of the modems in a

group, and (ii) is based on the “least capable cable modem” in the group (thereby allowing for communications with the least capable cable modem). Ex. 1031, ¶¶1, 7, 13, 89. It is my opinion that a POSITA would have understood that the least capable cable modem described in Azenkot corresponds to the cable modem with the lowest SNR. Indeed, if, as a result of dynamic conditions, a cable modem in a group has an SNR that becomes too low for the burst profile being used with that group, the cable modem is moved to a different group, thus maintaining groupings so that the worst SNR in any group is still high enough to accommodate the burst profile being applied to that group.

141. It is also my opinion that a POSITA would have understood that the least capable cable modem described in Azenkot corresponds to the cable modem with the lowest SNR because Azenkot is concerned with maximizing throughput—which is limited by the SNR of a cable modem. In addition, a POSITA would also have understood that Azenkot’s disclosure of setting a burst profile based on the least capable cable modem is also a disclosure of generating a value for lowest SNR for a group of cable modems (which is required to set the burst profile). Azenkot teaches grouping by throughput capability or SNR. Ex. 1031, ¶¶2, 7. According to Azenkot, the burst profile includes modulation order (QPSK, 64 QAM, 128 QAM, etc.). Ex. 1031, ¶¶13, 68, 74.

142. In my opinion, a POSITA would have found it obvious to apply Azenkot’s teaching of determining the lowest cable modem SNR for a group of cable modems (the claimed “composite SNR-related metric based at least in part on a worst-case SNR profile”) to Cooper’s selection of the optimal physical layer communication parameters (*e.g.*, modulation order, whether or not to use differential encoding) so that optimal physical layer communication parameters can be selected that allow for communications with all cable modems in the group when the same physical layer communication parameters are used to communicate with all cable modems within a group. Like I discuss above for Element [1D] in the Cooper-Cooper840 combination, Cooper’s channel configuration screen includes a **Modulation Profile** display panel that allows the configuration of profile templates that may be assigned to an individual logical channel, thereby optimizing the specific needs of a subset of the cable modems. Ex. 1005, ¶36, Fig. 6; Section X.A.1.d, *supra*. For example, Cooper’s Figure 6 (as annotated above in Section X.A.1.d) shows that **logical channel** “1”, which is defined by **SNR thresholds**, is assigned profile “103” that specifies a maximum modulation of “16QAM” for 1.x CMs and a maximum modulation of “32QAM” for 2.0 CMs. Ex. 1006, 11-12, Fig. 3; Ex. 1005, ¶¶36-37, Fig. 6.

143. It is my further opinion that applying Azenkot’s teaching of determining the lowest cable modem SNR to Cooper’s method of configuring

Modulation Profiles for cable modem groups that were grouped by SNR would have additionally been obvious because it would have furthered Cooper's goals of "optimizing the performance of [Cooper's] network" and "optimizing physical layer configuration parameters" for CM groups. Ex. 1005, ¶¶11, 19, 39; Ex. 1031, ¶¶14-15, 18, 95, 117.

144. In particular, in my opinion a POSITA would have appreciated that selecting a modulation order (*e.g.*, 16QAM/32QAM/64QAM) for a Modulation Profile based on the lowest cable modem SNR for a group of cable modems (the claimed "worst-case SNR profile") of a cable modem group would have ensured communication with all cable modems in the group while also optimizing the network and conserving resources as described above. Cooper's CMTS (as modified by Azenkot) therefore 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 (*i.e.*, the lowest cable modem SNR) for each group of cable modems based on the sets of SNRs that Cooper's modified CMTS respectively measured for each group.

145. In my opinion, it also would have been obvious to apply Azenkot's teaching of determining the lowest cable modem SNR for a group of cable modems to Cooper in order to implement Cooper's dynamic SNR thresholds for assigning

cable modems to a logical channel. Ex. 1005, ¶30. Because “SNR parameters will vary over time because of such conditions as climate, temperature and network degradation” (Ex. 1005, ¶40), Cooper’s CMTS automatically and periodically reconfigures its logical channels, including measuring parameters such as SNR and MER for its cable modems, assigning cable modems to the logical channels, and setting SNR thresholds used to delineate the channels. *Id.*, ¶¶26-27, 30, 33, 39-40, 43, Fig. 6. Thus, it is my opinion that a POSITA would have an additional motivation to apply Azenkot’s teaching of determining the lowest cable modem SNR for a group of cable modems in order to implement Cooper’s dynamic SNR threshold to address variance in a channel’s SNR. *Id.*, ¶¶10, 13-14, 25-27, 30, 32, 42-43.

146. It is also my opinion that such a combination also would have been obvious because it would have merely been a combination of prior art elements according to known methods to yield predictable results. The prior art elements include Cooper’s CMTS that applies uniform modulation order parameters to CMs that are grouped based on having similar SNRs or MERs, and Azenkot’s teaching of determining the lowest cable modem SNR for a group of cable modems to determine which physical layer parameters to apply to the group. The known methods include programming of a CMTS. The predictable results include a CMTS that generates a

worst-case SNR-related metric for the cable modem service group and uses that metric to determine the modulation order applied to the group).

147. It is my additional opinion that the proposed combination also represents the application of a known technique to a known system ready for improvement to yield predictable results. The known technique comprises Azenkot's determination of the lowest cable modem SNR for a group of cable modems to determine which physical layer parameters to apply to the group. The known system ready for improvement comprises Cooper's system that applies uniform modulation order parameters to cable modems that are grouped based on having similar SNRs or MERs. The predictable results include an improved system that furthers Cooper's goals of "optimizing the performance of [Cooper's] network" and "optimizing physical layer configuration parameters" for cable modem groups.

148. In addition, applying Azenkot's teachings to Cooper's CMTS would have been well within the capabilities of a POSITA because it would have involved only straightforward modifications to the programming of Cooper's CMTS. Ex. 1005, ¶42; Ex. 1031, ¶17. 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.

149. It is also my opinion that Cooper-Azenkot’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” is consistent with what the ’438 patent discloses for this claim limitation. For example, the ’438 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, 4:7-17, Fig. 2B. The ’438 patent also discloses that physical layer parameters are determined based on the singular worst-case SNR for a service group. *Id.*, 5:4-18, 5:38-44.

150. I note that Cooper-Azenkot’s teaching of this limitation is also consistent with a District Court’s construction of an identical phrase that appears in the claims of a related patent (i.e., Ex. 1029, the ’682 patent) that issued from a parent application to which the ’438 patent claims priority. *See* Ex. 1017, Claim Construction Order at 53-55 (citing disclosure in the ’682 patent at 4:9-20, 5:7-12,

5:42-57, Fig. 2C, which corresponds to identical disclosure in the '438 patent at 4:7-17, 5:4-9, 5:40-55, Fig. 2C); *see also id.*, 54 (noting Patent Owner's position that "'composite' means that something is **for** more than one cable modem" and that a POSITA "would understand that the term 'composite SNR-related metric' **relates to** multiple cable modems") (emphasis added); Ex. 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 for the '682 patent alleging infringement of the claimed "composite SNR-related metric" based on a "worst case noise that is expected on" upstream and downstream channels).

151. Cooper-Azenkot therefore teaches the claimed "generating ... a composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics." Ex. 1001, 4:7-17, 5:4-18, 5:38-44; Ex. 1017, 53-55; Ex. 1018, ¶187; Ex. 1019, 8-10; Section X.A.1.d. The use by Cooper-Azenkot of the lowest SNR or MER within a cable modem group to select the physical layer parameters for that group is a "composite" SNR-related metric because it is applied to all of the cable modems within a service group. And for reasons similar to those I described above for Cooper-Cooper⁸⁴⁰, Cooper-Azenkot

also teaches that its microprocessor is configured to perform the limitations described in Element [10D]. Ex. 1001, 4:7-17, 5:4-18, 5:38-44; Ex. 1017, 53-55; Ex. 1018, ¶187; Ex. 1019, 8-10; Section X.A.5.b, *supra*. Thus, Cooper-Azenkot teaches Element [1D] and Element [10D].

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

152. For reasons similar to those I describe above for Cooper-Cooper840, it is my opinion that Cooper-Azenkot teaches Elements [1E]-[1F] and Elements [10E]-[10F]. Sections X.A.1.e-f and X.A.5.b, *supra*.

153. In particular, Cooper-Azenkot's CMTS would have similarly selected and used the modulation orders and encoding parameters for its logical channels based on the worst-case SNR-related metrics determined for the groups of cable modems assigned to the logical channels to ensure communication with all modems in the group while also optimizing the network, based on the further teachings of Cooper. Ex. 1005, ¶40; *see also* Sections X.A.1.e and X.A.5.b, *supra*. Cooper-Azenkot's CMTS also would have communicated with the cable modems connected to it using the selected modulation orders and encoding parameters. Ex. 1005, ¶¶19, 30; *see also* Sections X.A.1.f and X.A.5.b, *supra*.

2. Dependent Claims 2 and 11

154. For reasons similar to those that I describe above for Cooper-Cooper840, it is my opinion that Cooper-Azenkot teaches dependent claim 2 and

dependent claim 11. Sections X.A.2 and X.A.6, *supra*. In particular, Cooper-Azenkot's 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-Azenkot's modulation order teaches the claimed "physical layer communication parameters include one or more of: ... modulation order ...". Ex. 1001, 8:23-27.

3. Dependent Claims 7-8 and 16-17

155. For reasons similar to those that I describe above for Cooper-Cooper840, it is my opinion that Cooper-Azenkot teaches dependent claims 7-8 and dependent claims 16-17. Sections X.A.3-4 and X.A.7-8, *supra*.

156. With regard to dependent claim 7 and dependent claim 16, Cooper-Azenkot 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.7-8, *supra*. In addition, with regard to dependent claim 8 and dependent claim 17, Cooper-Azenkot 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. Ex. 1005, Abstract, ¶¶8, 21, 27-28, 37; *see also* Sections X.A.3-4 and X.A.7-8, *supra*.

C. Cooper in View of Cooper840 and Monk, and Cooper in view of Azenkot and Monk Render Claims 1-8 and 10-17 Obvious

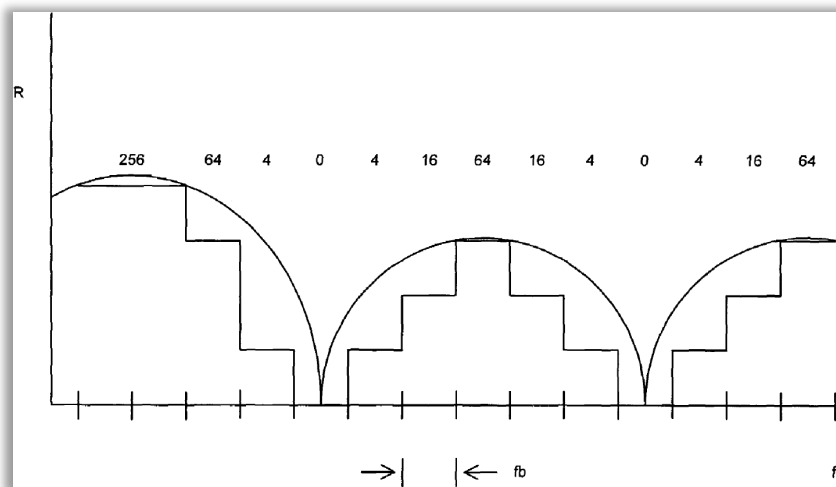
- 1. Dependent Claim 3: “The method of claim 1, wherein said CMTS uses orthogonal frequency division multiplexing (OFDM) over a plurality of subcarriers for said communicating.”**

157. As I describe above, independent claim 1 is taught by Cooper-Cooper840 and Cooper-Azenkot. Sections X.A.1 and X.B.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-Cooper840 and Cooper-Azenkot teach that the CMTS selects physical layer communication parameters and then, using those parameters, communicates with one or more cable modems. *See* Sections X.A.1.d-f and X.B.1.b-c, *supra*. Use of OFDM for such communication was ubiquitously known, and Monk is an example of a reference that discloses this feature. And as I explain below, it is my opinion that a POSITA would have found it obvious to modify each of these combinations based on the teachings in Monk.

158. Monk describes different methods of multi-carrier communication, including OFDM, that address signal impairments that restrict high bandwidth communication with cable modems in a cable network. Ex. 1015, Abstract, 1:29-31, 2:34-37, 4:25-43, 5:52-55. In one example, 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.

159. 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

160. 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.

161. In my opinion, a POSITA would have been motivated to combine the OFDM communication techniques taught by Monk with the communication techniques taught by Cooper-Cooper840's and Cooper-Azenkot's CMTS in order to provide more reliable communication and overcome signal impairments. As I discuss above for Element [1E], Cooper-Cooper840's and Cooper-Azenkot's communication techniques teach selecting encoding parameters and modulation orders for different carriers or channels based on a composite worst-case SNR-related metric. *See* Sections X.A.1.e and X.B.1.c. Monk's OFDM communication technique allows 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, and would still select encoding parameters.

162. It is also my opinion that such combinations would have been an obvious application of a known technique to a known system ready for improvement to yield predictable results. The known technique includes Monk's OFDM method. The known system ready for improvement includes Cooper-Cooper840's/Cooper-

Azenkot's CMTS and cable modem system. The predictable results include a CMTS that uses OFDM to communicate over a plurality of subcarriers that modulate on a per-subcarrier basis.

163. In my opinion, applying Monk's teachings to Cooper-Cooper840's and Cooper-Azenkot's 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-Cooper840's and Cooper-Azenkot's 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-Cooper840's and Cooper-Azenkot's CMTS as modified by Monk, therefore, teaches the claimed use of "(OFDM) over a plurality of subcarriers for said communicating."

164. Therefore, dependent claim 3 is invalid as obvious over Cooper-Cooper840-Monk and Cooper-Azenkot-Monk.

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

165. Dependent claim 3 is taught by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk. Section X.C.1, *supra*. Claim 4 depends from dependent claim 3 and includes additional requirements regarding selecting physical layer

communication parameters. Ex. 1001, claim 4. As I discuss above for dependent claim 3, Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's CMTS teaches using OFDM wherein parameters such as a particular modification scheme (*e.g.*, QAM) and encoding parameters are selected on a per-subcarrier basis depending on a worst-case SNR profile for the cable modems using that subcarrier. Section X.C.1; Ex. 1015, 7:14-16, 8:1-28, 10:55-67, Fig. 10. Cooper-Cooper840's and Cooper-Azenkot's CMTS as modified by Monk, therefore, also teaches the CMTS "selecting ... said physical layer communication parameters on a per-OFDM-subcarrier basis" as claimed.

166. Dependent claim 4, therefore, is invalid as obvious over Cooper-Cooper840-Monk and Cooper-Azenkot-Monk.

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

167. As I show above, dependent claim 4 is taught by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk. Section X.C.2, *supra*. Claim 5 depends from dependent claim 4 and includes additional requirements regarding the physical layer communication parameters. Ex. 1001, claim 5.

168. As I discuss above, Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's CMTS selects "physical layer communication parameters" on a per-OFDM-

subcarrier basis based on a composite SNR-related metric. Section X.C.2, *supra*; *see also* X.A.1.e and X.B.1.c. 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, 1 (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, 1 (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.

169. 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; Sections X.A.1.b and X.B.1.a, *supra*. Because Cooper discloses determining separate upstream and downstream SNR metrics in different frequency bands, Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's CMTS teaches selecting separate upstream and downstream "physical layer communication parameters" on a per-OFDM-subcarrier basis based on a composite upstream or downstream SNR-related metric. Thus, Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's CMTS teaches "physical layer communication parameters include one or both of: which of said OFDM subcarriers to use for transmission to said CMTS, and which of said OFDM subcarriers to use for reception of information from said CMTS" as claimed.

170. Dependent claim 5, therefore, is invalid as obvious over Cooper-Cooper840-Monk and Cooper-Azenkot-Monk.

4. Dependent Claim 6

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

171. As I show above, independent claim 1 is taught by Cooper-Cooper840 and Cooper-Azenkot. Sections X.A.1 and X.B.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.

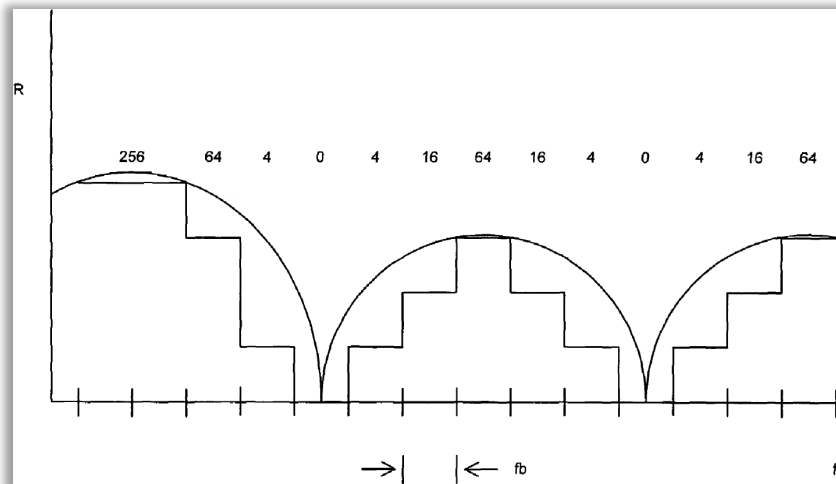
172. As I show above for Element [1C], Cooper assigns cable modems into at least four different service groups or logical channels based on comparing a modem's measured SNR-related metric to an SNR threshold. Ex. 1005, ¶¶31-33, 41, Fig. 6; Sections X.A.1.c and X.B.1.a, *supra*. Thus, Cooper-Cooper840 and Cooper-Azenkot teach at least “a first service group and a second service group” as claimed.

173. As I also show above for Element [1D], Cooper-Cooper840 and Cooper-Azenkot 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*. Cooper-Cooper840 and Cooper-Azenkot do not describe this composite SNR-related metric as a SNR versus frequency profile, but Monk's use of OFDM discloses this feature and a POSITA would have found it obvious to modify each combination based on the teachings in Monk.

174. As I describe above in Section X.C.1, Monk's use of OFDM helps networks overcome signal impairments caused by issues such as micro-reflections and impedance mismatches by allowing data bits generated at a higher rate to be distributed over many subcarriers with lower data rates, reducing the potential of interference. Ex. 1015, Abstract, 1:29-31, 2:34-37, 4:16-43, 4:60-64, 5:52-55, 6:20-

27, 7:13-9:19, Figs. 5-6, 10. Using Monk's OFDM requires dividing the communication channel between network devices (*e.g.*, CMs) into narrower channels or "bins" to transmit subcarriers and measuring the characteristics (*e.g.*, SNR) of each bin. *Id.*, 7:14-16, 8:20-28, 9:28-33; Section VIII.B. After determining the SNR for each bin, each subcarrier can be modulated independently (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, 10:2-5, 10:55-67.

175. As I show below, Monk's Figure 10 shows an example of a cable modem's SNR versus frequency profile over a channel that has been segmented into different frequency bins of width "fb" and with different QAM orders (*e.g.*, 4, 16, 64, 256) applied based on the bin's SNR. Ex. 1015, 10:55-67.



Ex. 1015, Fig. 10

176. In my opinion, a POSITA would have been motivated to combine the OFDM techniques taught by Monk with Cooper-Cooper840's/Cooper-Azenkot's CMTS to provide more reliable communication and overcome signal impairments. Ex. 1015, 4:16-43, 6:20-27, 7:36-62. As I described above in Sections X.A.1.e and X.B.1.c, Cooper-Cooper840's/Cooper-Azenkot's CMTS selects encoding parameters and modulation orders for different carriers/channels based on a composite worst-case SNR-related metric. Monk's OFDM communication technique allows for higher quality and more reliable services to the service groups by dividing 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) and would still select encoding parameters.

177. In order to utilize OFDM, a CMTS would divide each channel into frequency bins, measure and generate a composite SNR versus frequency profile for each channel, as taught by Monk. This composite SNR versus frequency profile would be based on the SNR versus frequency profile of the CM with the worst-case SNR-related metric of the service group.

178. It is my further opinion that such combinations represent an obvious application of a known technique to a known system ready for improvement to yield predictable results. The known technique includes Monk's OFDM method that

includes generating SNR versus frequency profiles for each channel for each cable modem. The known system includes Cooper-Cooper840's/Cooper-Azenkot's CMTS. The predictable results include a CMTS that uses OFDM to overcome signal impairments caused by issues such as micro-reflections and impedance mismatches and generates SNR versus frequency profiles for each channel. It is also my opinion that applying OFDM would have been well within the capabilities of a POSITA, leading to an expectation of success, as it would have only required straightforward modifications to the programming of the microprocessor in the CMTS. Ex. 1005, [0008], [0024]-[0025], [0042]; Ex. 1015, 10:22-31.

179. The combinations of Cooper-Cooper840-Monk and Cooper-Azenkot-Monk described in this section therefore teach the claimed “first composite SNR versus frequency profile” and “second composite SNR versus frequency profile” associated with their respective service group. Moreover, because these combinations also teach measuring a SNR versus frequency profile for each modem, it is my opinion that the combinations also teach “a third cable modem has a particular SNR versus frequency profile.”

180. Thus, Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach the additional requirements of Element [6A].

- g. Element [6B]: “said assigning said plurality of cable modems among said plurality of service groups comprises: assigning said third cable modem to said first service group if said particular SNR versus**

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

181. Element [6B] requires assigning the third CM to the service group whose composite SNR profile is more similar to the SNR profile of the third CM. In my opinion, a POSITA would have understood from the ’438 patent that Element [6B] requires assigning the third cable modem to the service group that has a composite SNR versus frequency profile more similar to that of the third cable modem while still allowing that third modem to communicate with the CMTS as required by Element [1F]. Ex. 1001, 5:44-55, 8:2-23, 9:9-33.

182. It is my opinion that Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach Element [6B]. As I describe above for Element [6A], Cooper-Cooper840-Monk and Cooper-Azenkot-Monk include at least a first and second service group that each have their own composite SNR versus frequency profile based on the cable modem with the worst-case SNR versus frequency profile. Section X.C.4.a, *supra*. Cooper-Cooper840-Monk and Cooper-Azenkot-Monk also teach “a third cable modem has a particular SNR versus frequency profile.” *Id.* Cooper-Cooper840-Monk and Cooper-Azenkot-Monk further teach assigning a third cable modem to the service group that has a composite SNR versus frequency

profile more similar to that of the third cable modem (as required by Element [6B]) because in Cooper, cable modems are grouped so that cable modems having similar SNR-related metrics are in the same group. Section X.A.1.d.

183. As I discussed for Elements [1D] and [1E], Cooper-Cooper840 and Cooper-Azenkot group modems with similar SNR-related metrics into service groups and set communication parameters for each service group based on the cable modem in each group having the worst SNR-related profile (i.e., meet the requirements of the composite SNR-profile for the group, which is based on the worst-case SNR profile) so that the CMTS can communicate with each cable modem. Sections X.A.1.d-e, X.B.1.b-c. In addition, as I showed for Element [6A], this also applies when using OFDM. Section X.C.4.a.

184. Accordingly, in my opinion a POSITA would understand that because Cooper-Cooper840-Monk and Cooper-Azenkot-Monk group cable modems with similar SNRs, these combinations also would assign a third cable modem to a service group that has the most similar SNR versus frequency profile while still allowing communication with the CMTS. Indeed, it is my opinion that under any reasonable construction, the proposed combinations teach Element [6B]. For example, if the first service group has a worse composite SNR versus frequency profile than that of the second service group (for example, 17-19dB vs. 22-24dB) and the third cable modem has an SNR versus frequency profile of 18dB-20dB, the third cable modem

will be assigned to the first service group. The first service group's composite SNR is more similar to the third cable modem than that of the second service group. Dependent claim 6, therefore, is invalid as obvious over Cooper-Cooper840-Monk and Cooper-Azenkot-Monk.

5. Dependent Claims 12-15

185. Dependent claim 12 is substantially similar to dependent claim 3 except that it identifies "said network interface and said plurality of cable modems" are configured to use OFDM. Ex. 1001, claim 12. As discussed, Cooper's CMTS comprises the claimed network interface that it uses to communicate with cable modems, and therefore, dependent claim 12 is rendered obvious by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk for the same reasons as claim 3. Section X.C.1, *supra*.

186. 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, claim 13. As discussed, Cooper's CMTS comprises the claimed network interface, and therefore, dependent claim 13 is rendered obvious by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk for the same reasons as claim 4. Section X.C.2, *supra*.

187. Dependent claim 14 is substantially similar to dependent claim 5. Dependent claim 14, therefore, is rendered obvious by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk for the same reasons as claim 5. Section X.C.3, *supra*.

188. Dependent claim 15 is substantially similar to dependent claim 6. Claim 15 is therefore rendered obvious by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk for the same reasons as claim 6. Section X.C.4, *supra*.

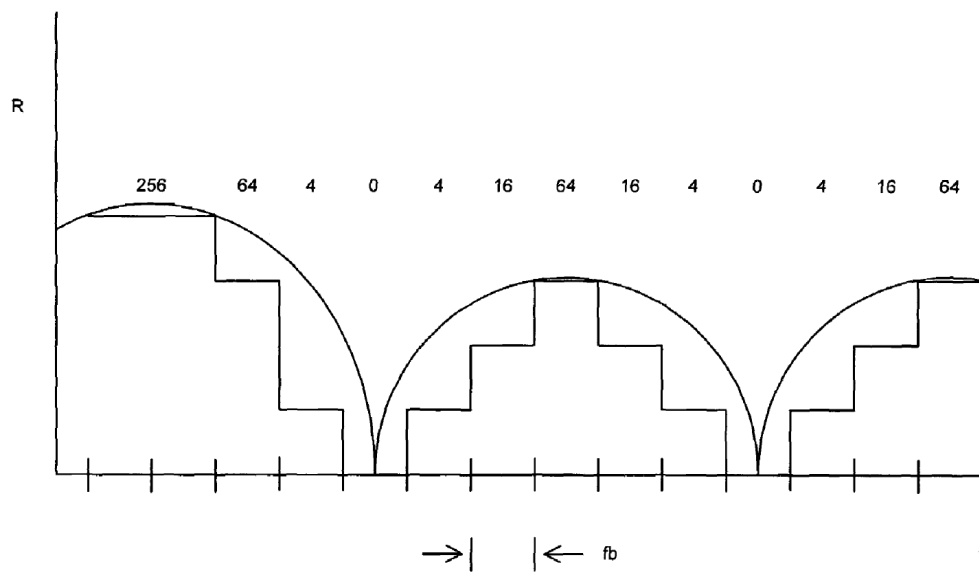
6. Claims 1-8 and 10-17

189. As I describe above in Sections X.A.1.d, X.A.5.b and X.B.1.b, Cooper-Cooper840 and Cooper-Azenkot teach Elements [1D] and [10D] by teaching a CMTS 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, X.A.5.b, and X.B.1.b.

190. If it is argued that such a “worst-case SNR profile” (as recited in Elements [1D] and [10D]) must comprise the SNR-related metric of a cable modem over a range of frequencies, and that such a feature is not taught by Cooper-Cooper840 or Cooper-Azenkot, it is my opinion that Monk discloses this feature and a POSITA would have found it obvious to modify Cooper-Cooper840 and Cooper-Azenkot to include this feature for the reasons I provide above for Element [6A]. Section X.C.4.a.

191. Specifically, as I explain above, Cooper-Cooper840-Monk and Cooper-Azenkot-Monk generate a composite SNR-related metric based at least in part on a

“worst-case SNR profile” that comprises the SNR-related metric of a cable modem over a range of frequencies. Section X.C.4.a; Ex. 1015, 10:55-67, Fig. 10. For example, Monk’s Figure 10 (shown below) shows an example of a cable modem’s SNR versus frequency profile over a channel that has been segmented into different frequency bins of bandwidth “fb” with different QAM orders (*e.g.*, 4/16/64/256) applied based on the bin’s SNR. *Id.*



Ex. 1015, Fig. 10

192. For the reasons I provide above for Element [6A], it is my opinion that a POSITA would have been motivated to combine this OFDM technique taught by Monk with Cooper-Cooper840’s/Cooper-Azenkot’s CMTS to provide more reliable communication and overcome signal impairments. Ex. 1015, 4:16-43, 6:20-27, 7:36-62.

193. It is also my opinion that such combinations represent an obvious application of a known technique to a known system ready for improvement to yield

predictable results. The known technique includes Monk's OFDM method that includes generating an SNR versus frequency profile for a cable modem over a range of frequencies. The known system includes Cooper-Cooper840's/Cooper-Azenkot's CMTS. The predictable results include a CMTS that uses OFDM to overcome signal impairments caused by issues such as micro-reflections and impedance mismatches and generates SNR versus frequency profiles for each channel. Moreover, applying OFDM would have been well within the capabilities of a POSITA for the reasons I provide above for Element [6A]. Section X.C.4.a; Ex. 1005, [0008], [0024]-[0025], [0042]; Ex. 1015, 10:22-31.

194. Therefore, if it is argued that the combinations of Cooper-Cooper840 and Cooper-Azenkot I describe above in Sections X.A.1, X.A.5 and X.B.1 do not teach Elements [1D] and [10D], Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach Elements [1D] and [10D] for this alternative reason. And for reasons similar to those I describe above for Cooper-Cooper840 and Cooper-Azenkot, the combinations of Cooper-Cooper840-Monk and Cooper-Azenkot-Monk also teach Elements [1A]-[1C] and [1E]-[1F] and render claim 1 obvious. Sections X.A.1.a-c, X.A.1.e-f, X.B.1.a, and X.B.1.c.

195. In addition, for reasons similar to those I provide above for Cooper-Cooper840 and Cooper-Azenkot, the combinations of Cooper-Cooper840-Monk

and Cooper-Azenkot-Monk also teach claim 2-8 and 10-17, thus rendering each of those claims obvious. Sections X.A.2-8, X.B.2-3, and X.C.1-5.

D. Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437 Render Claims 9 and 18 Obvious

196. Independent claim 1 is taught by Cooper-Cooper840 and Cooper-Azenkot. Sections X.A.1 and X.B.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 said plurality of cable modems, 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 of said plurality of cable modems.

Ex. 1001, claim 9.

197. As I discuss above for Element [1B], Cooper-Cooper840 and Cooper-Azenkot 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, *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 Monk and Cooper⁴³⁷.

198. 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, 8:1-11, 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. 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 '438 patent, acknowledges that determining an SNR profile from a known signal was well known in the art. Ex. 1015, 10:2-5.

199. In my opinion, a POSITA would have found it obvious to transmit a probe message to each cable modem (the claimed "transmitting a probe message to each said plurality of cable modems") and to receive a reporting message including SNR-related metric raw data or a bit loading profile (the claimed "receiving a metric

reporting message from each of said plurality of cable modems”) as taught by Monk in order to implement Cooper’s disclosure of measuring an SNR-related metric at each of the cable modems 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. It is my further opinion that a POSITA would have further found it obvious to measure at the cable modems to distribute processing requirements among the cable modems, thereby limiting processing required by the CMTS.

200. It is also my opinion that incorporating the use of Monk’s probe messages and reporting messages into Cooper-Cooper840 and Cooper-Azenkot 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 Cooper-Cooper840’s and Cooper-Azenkot’s CMTS 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.

201. It is my further opinion that applying Monk’s teachings to Cooper-Cooper840’s and Cooper-Azenkot’s CMTS would have been well within the capabilities of a POSITA as it would have only required straightforward

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.

202. 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. Cooper437, however, does. Cooper437 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, 1:62-2:5, 3:47-50, Fig. 1. For example, Cooper437 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, Abstract, 1:62-65, 3:47-50, 8:11-29, 8:60-9:5, 10:56-11:60, Figs. 1, 3-4.

203. 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, Cooper437'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.

204. In my opinion, 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 Cooper437, so that Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's CMTS can send customized probe messages to specific cable modems or service groups to conduct specific testing to determine the SNR-related metric of specific service groups or at specific frequencies and report back. *See* Ex. 1016, 8:9-64, 10:56-11:28, 11:30-60. Such a modification would allow a CMTS to more quickly identify groups of modems or frequencies that have had a change in their SNR-related metric.

205. It is also my opinion that modifying the probe message to identify a measurement mode (the claimed "instructions for measuring a metric") and a reporting mode (the claimed "instructions for ... reporting said measured metric") would have been obvious because such a modification would have been nothing more than combining prior art elements according to known methods to yield predictable results. The prior art elements include Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's probe message as well as Cooper437's measurement mode and reporting mode. The known methods include modifying the contents of a probe

message. 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

206. In my opinion, applying Cooper437's teachings to Cooper-Cooper840-Monk's and Cooper-Azenkot-Monk's CMTS would have been well within the capabilities of a POSITA as it would have only required straightforward modifications to the programming of the microprocessor in the CMTS. It is also my opinion that a POSITA would have had 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.

207. It is therefore my opinion that Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437 render claim 9 invalid as obvious.

208. The language of dependent claim 18 is substantially similar to the language of dependent claim 9. It is therefore my opinion that Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437 render claim 18 invalid as obvious for the same reasons as claim 9. Section X.D.1, *supra*.

209. In addition, for the reasons I provide above in Section X.C.6, if it is asserted that the "worst-case SNR profile" recited in Elements [1D] and [10D] must

comprise the SNR-related metric of a cable modem over a range of frequencies, it is my opinion that Monk discloses this feature and that a POSITA would have found it obvious to modify Cooper-Cooper840 and Cooper-Azenkot to include this feature. Sections X.C.4.a and X.C.6. In my opinion, for the same reasons it would have been obvious to modify Cooper-Cooper840 and Cooper-Azenkot to include this feature, it would have been obvious to similarly modify Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper47 to include this feature. *Id.* Therefore, for this alternative reason, Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437 render claims 9 and 18 obvious. *Id.*

E. Cooper-Cooper840 (claims 1-2, 7-8, 10-11, 16-17), Cooper-Azenkot (claims 1-2, 7-8, 10-11, 16-17), Cooper-Cooper840-Monk (claims 1-8, 10-17), Cooper-Azenkot-Monk (claims 1-8, 10-17), Cooper-Cooper840-Monk-Cooper437 (claims 9, 18) and Cooper-Azenkot-Monk-Cooper437 (claims 9, 18), In Further View of Currivan Render Claims 1-18 Obvious

210. The combinations I describe above teach Elements [1E] and [10E] by teaching a CMTS selecting network communication parameters for a group of modems based on a worst-case SNR-related metric for a service group of modems. Sections X.A-D, *supra*. The network communication parameters include a modulation order and encoding parameters. In the event that it is asserted that the combinations described above do not teach selecting “physical layer communication parameters” as recited in Elements [1E] and [10E], it is my opinion that Currivan

discloses this feature and that a POSITA would have found it obvious to further modify the combinations based on the additional teachings in Currivan.

211. As I described above, Cooper (as modified by Cooper840 or Azenkot) discloses the CMTS using the composite SNR-related metric to select a modulation order and encoding parameters based on the composite SNR-related metric. Sections X.A.1.d-e, X.B.1.b-c, *supra*. Cooper also teaches that a primary goal of the logical channel assignment is to optimize system performance, which includes maximum number of network elements supported and ease of manageability from the service provider perspective. Ex. 1005, ¶39.

212. Currivan similarly discloses a cable modem system in which a CMTS segregates cable modems into multiple groups. Ex. 1028, ¶¶26, 161, 192, claim 1, claim 16. The Currivan CMTS selects a modulation order (also referred to in Currivan as modulation density) for each group based on a measured SNR. Ex. 1028, ¶¶34, 79, 157, 182. Currivan also describes the relationships between SNR and modulation order and transmit power (the physical layer communication parameters). Ex. 1028, ¶¶67, 157-158. Currivan specifically teaches increasing SNR by increasing transmit power to support a higher modulation order. Ex. 1028, ¶¶20, 151, 157-158, 177, 200. It was known in the art that higher modulation orders require higher SNRs and have higher throughput. Ex. 1028, ¶¶18, 65, 158, 170, 182.

213. It is my opinion that, in view of the teachings in Currivan, a POSITA would have found it obvious to configure Cooper's CMTS (as modified by Cooper840 or Azenkot) to further select a higher transmit power for a service group based on the composite SNR-related metric to support a higher modulation order to increase the throughput for that service group. Ex. 1028, ¶¶18, 20, 65, 151, 157-158, 170, 177, 182, 200; Sections X.A.1.d-e, X.B.1.b-c, *supra*.

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

215. It is my further opinion that it would have been well within the capabilities of a POSITA to apply Currivan's teachings to Cooper's CMTS (as modified by Cooper840 or Azenkot) because it would have involved straightforward modifications to the programming of the CMTS. I note that Cooper describes network element 8 including an attenuator 320 which is controlled to attenuate signals so that they are transmitted with a desired power level, which is consistent

with my understanding that programming a CMTS to instruct a cable modem to use a particular power level was well within the skill level of someone skilled in the art. Ex. 1005, ¶25.

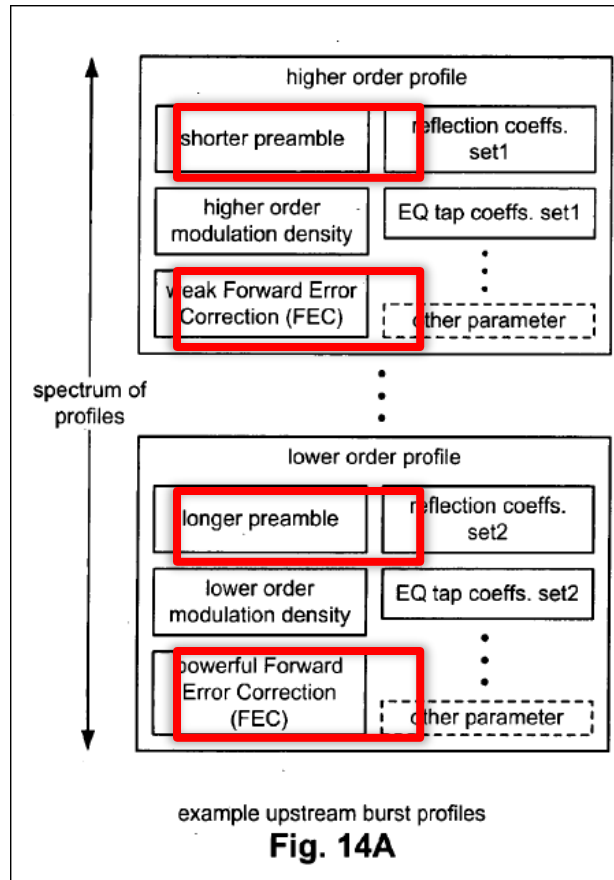
216. Currivan also teaches another power modification procedure. The additional power modification procedure includes increasing the transmit power per code word while reducing the number of codes transmitted to increase the SNR to support a higher modulation order. Ex. 1028, ¶¶67-69, 142, 151-152, 157, 169, 176-177, 182.

217. In light of such additional teachings in Currivan, it is my opinion that a POSITA also would have found it obvious to configure Cooper's CMTS (as modified by Cooper⁸⁴⁰ or Azenkot) to increase the transmit power per code word—while reducing the number of codes transmitted for a service group—in order to increase the SNR and allow one of the service groups to communicate at a higher modulation order. It is also my opinion that such a modification would have been obvious because it would have furthered Cooper's goal of optimizing system performance, such as by reducing the number of modulation orders that the CMTS is required to support and would ease manageability from the service provider perspective. Ex. 1005, ¶39.

218. It is my further opinion that such a combination also would have been obvious because it would have merely been a combination of prior art elements

according to known methods to yield predictable results. The prior art elements are Cooper's CMTS—as modified by Cooper840 or Azenkot—and Currivan's method of increasing the transmit power per code word while reducing the number of codes transmitted. The known method is programming a CMTS to instruct a cable modem service group to increase transmit power per code word while reducing the number of codes transmitted for a service group. The predictable results are a system that includes a service group that supports a higher modulation order to reduce the number of modulation orders that the CMTS is required to support. In my opinion applying Currivan's teachings to Cooper's CMTS (as modified by Cooper840 or Azenkot) would have been well within the capabilities of a POSITA because it would have involved straightforward modifications to the programming of the CMTS to select a modulation scheme and instruct a cable modem service group accordingly.

219. Currivan also teaches selecting the additional physical layer communication parameters of forward error correction and preamble length. Ex. 1028, ¶¶155-156, 161-162, 175, Fig. 14A. Figure 14A (reproduced below) illustrates a spectrum of burst profiles that include such physical layer communication parameters. Ex. 1028, ¶¶161-163.



Ex. 1028, Fig. 14A (annotated)

220. In Currivan the burst profiles are selected by the CMTS and assigned to cable modems based on the SNR of the communication channel from the cable modems to the CMTS. Ex. 1028, ¶¶34, 79, 176, 182, 192. The lower order profile that is shown in Figure 14A is used when a channel may be corrupted to ensure that communication take place. Ex. 1028, ¶163. Figure 14A shows the higher order profile utilizing shorter preambles and weaker FEC. Ex. 1028, ¶¶161-162, Fig. 14A. In my opinion a POSITA would have understood that there were trade-offs between the amount of processing required and robustness of the communications and

preamble lengths and FEC strengths that are selected to ensure communication in view of the SNR of the communication channel from the CMs to the CMTS. Ex. 1028, ¶¶153-157, 162-163, claim 9.

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

222. Such a combination also would have been obvious because it would have merely been a combination of prior art elements according to known methods to yield predictable results. The prior art elements are Cooper's CMTS—as modified by Cooper840 or Azenkot—and Currivan's method of selecting preamble length and FEC strength based on a channel's SNR. The known method is programming a CMTS to instruct a cable modem service group to use a preamble length and FEC strength based on a channel's SNR. The predictable results are a system that optimizes the processing required and robustness of the communications in view of various SNR levels. It is also my opinion that applying Currivan's teachings to Cooper's CMTS (as modified by Cooper840 or Azenkot) would have been well within the capabilities of a POSITA because it would have involved

straightforward modifications to the programming of the CMTS to select preamble lengths and FEC strengths and instruct a cable modem service group accordingly.

XI. CONCLUSION

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



Date: December 6, 2024

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XII. CLAIM LISTING APPENDIX

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

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

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

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

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

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