

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

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

Petition 1 of 3

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EXHIBITS

Ex. 1001:	U.S. Patent No. 9,866,438 (“the ’438 patent”)
Ex. 1002:	Expert Declaration of Sayfe Kiaei
Ex. 1003:	Curriculum Vitae of Sayfe Kiaei
Ex. 1004:	Certified Prosecution History of the ’438 patent
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Ex. 1007:	Reserved
Ex. 1008:	Reserved
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Ex. 1014:	Reserved
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, <i>Entropic Comms., LLC v. Charter Comms., Inc.</i> , Case No. 2:22-CV-00125-JRG (E.D. Tex.)
Ex. 1018:	Rebuttal Expert Report of John Holobinko Regarding Validity of U.S. Patent Nos. 8,284,690 and 10,135,682, <i>Entropic Comms., LLC v. Charter Comms., Inc.</i> , Case No. 2:22-CV-00125-JRG (E.D. Tex.)

- Ex. 1019: Exhibit F, U.S. Patent No. 10,135,682 Exemplary Infringement Chart, *Entropic Comms., LLC v. Charter Comms., Inc.*, Case No. 2:22-CV-00125-JRG (E.D. Tex.)
- Ex. 1020: U.S. Pub. No. 2010/0061235 (“Pai”)
- Ex. 1021: Data-Over-Cable Interface Specifications, Radio Frequency Interface Specification, SP-RFII01-970326
- Ex. 1022: Data-Over-Cable Service Interface Specifications, DOCSIS 1.1, Radio Frequency Interface Specification, CM-SP-RFIV1.1-C01-050907
- Ex. 1023: Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIV2.0-C02-090422
- Ex. 1024: U.S. Pub. 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. Pub. No. 2005/0097617 (“Curri van”)
- Ex. 1029: U.S. Patent No. 10,135,682 (“the ’682 patent”)
- Ex. 1030: U.S. Pub. No. 2008/0291840 (“Cooper840”)
- Ex. 1031: U.S. Pub. No. 2005/0122996 (“Azenkot”)
- Ex. 1032: Reserved
- 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”)

MANDATORY NOTICES

Real Parties in Interest (37 C.F.R. §42.8(b)(1))

The real parties-in-interest for this petition are (i) Comcast Corporation, (ii) Comcast Cable Communications, LLC, and (iii) Comcast Cable Communications Management, LLC. No unnamed entity is funding, controlling, or directing this Petition for *inter partes* review (IPR) of U.S. Patent No. 9,866,438 (“the ’438 patent”), or otherwise has an opportunity to control or direct this Petition or Petitioner’s participation in any resulting IPR.

Related Matters (37 C.F.R. §42.8(b)(2))

Office Proceedings

This is the first of three petitions for *inter partes* review filed by Petitioner against the ’438 patent. Petitioner has previously filed petitions for *inter partes* review against related U.S. Patent No. 10,135,682 (“the ’682 patent”). The IPRs against the ’682 patent are assigned case numbers: IPR2024-00444 and IPR2024-00445. The Board denied institution of those IPRs for the ’682 patent, and Petitioner has filed a Request for Director Review of the decision denying institution for IPR2024-00445. This Petition relies on prior art (*e.g.*, Cooper840 and Azenkot) that was not relied on in the IPRs for the ’682 patent.

No prior Office proceedings (*e.g.*, *inter partes* review, post-grant review, or covered business method) have been filed against the ’438 patent.

This is the first of three petitions for *inter partes* review filed by Petitioner against the '438 patent.

Litigation Matters

Patent Owner has sought leave to assert the '438 patent in *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"). These cases have been consolidated and remain pending. The related '682 patent has been asserted in the CA litigation.

The related '682 patent was also asserted in *Entropic Communications, LLC v. Charter Communications, Inc.*, No. 2:22-cv-00125-JRG (E.D. Tex. filed Apr. 27, 2022) ("TX litigation"), which was dismissed on December 10, 2023.

Continuity

According to the Office's records, the '438 patent is a continuation of application No.15/228,703, filed on Aug. 4, 2016, now Pat. No. 9,577,886, which is a continuation of application No. 13/948,444, filed on Jul. 23, 2013, now Pat. No. 9,419,858, which claims the benefit of Provisional application No. 61/674,742, filed on Jul. 23, 2012. The '438 patent issued from U.S. patent application Ser. No. 15/434,673 ("the '673 application") filed on February 16, 2017. The '682 patent is a continuation of the '673 application.

Lead and Back-Up Counsel (37 C.F.R. §42.8(b)(3))

Petitioner designates counsel listed below. A power of attorney for counsel is being concurrently filed.

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I. INTRODUCTION

Comcast Cable Communications, LLC (“Petitioner”) petitions for *inter partes* review and cancellation of claims 1-18 of U.S. Patent No. 9,866,438 (“the ’438 patent”) (Ex. 1001).

II. SUMMARY OF ARGUMENT

The ’438 patent describes a well-known system for managing “service groups” of cable modems within a cable television network. The system includes a cable modem termination system (CMTS) that determines signal-to-noise ratios (SNRs) for cable modems (CMs). The CMs are assigned to service groups based on the SNRs. The system determines “a worst-case SNR profile” used to generate a “composite SNR related metric” that the CMTS uses to select physical layer communication parameters (*e.g.*, modulation order) for each service group. In other words, modems with similar SNRs are grouped, and communication parameters of all the modems in a particular group are determined based on the modem having the worst SNR in the group. The Examiner believed this feature (and only this feature) to be missing from the prior art.

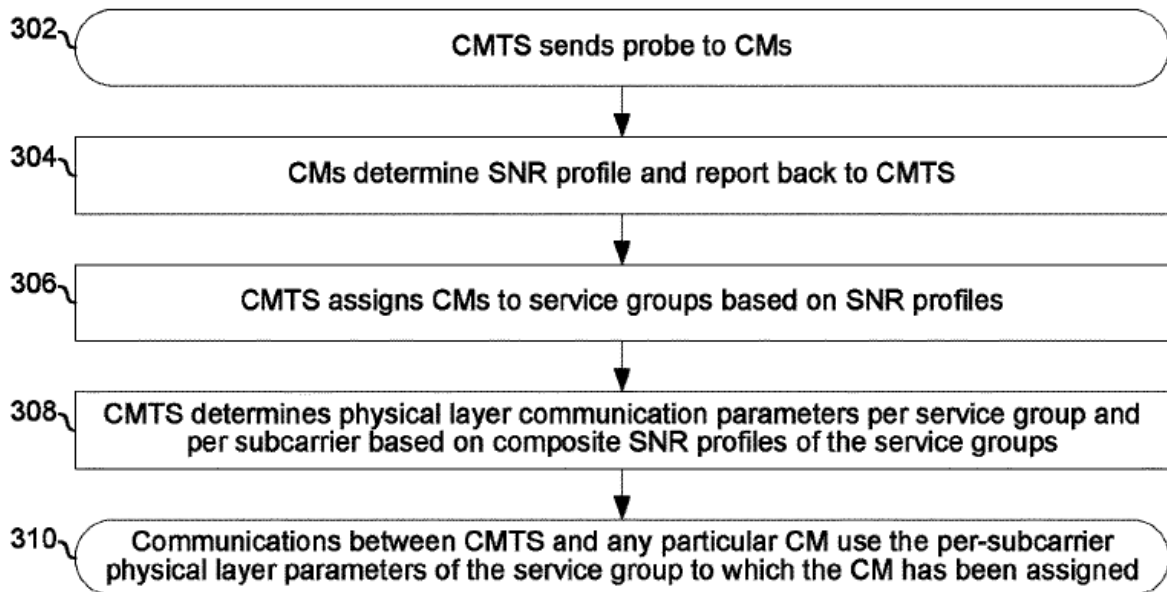
However, all of the ’438 patent claims are rendered obvious by prior art that was not considered by the Examiner, including prior art disclosing systems that determine a worst-case SNR for a group of modems and use the worst-case SNR to determine communication parameters for the modems in the group (*e.g.*, Ex. 1030).

Accordingly, claims 1-18 of the '438 patent should be cancelled.

III. OVERVIEW OF THE '438 PATENT

A. Brief Description

The '438 patent relates to service group management in a cable television network. Ex. 1001, 1:48-50. An exemplary process for grouping CMs is shown in Figure 3A below.



Ex. 1001, Fig. 3A

Each of a plurality of CMs determines an SNR profile and reports it to a CMTS. *Id.*, 4:22-27, 5:26-35. The '438 patent describes an SNR profile, consistently with its ordinary usage, 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. The CMTS

then assigns the CMs to service groups based on the SNR profiles. *Id.*, 4:49-53, 5:35-37, 6:44-7:4, Abstract. A service group is simply a group of CMs 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 communications. *Id.*, 4:37-53, 5:38-48, Abstract. These parameters include well-known encoding and modulation parameters, such as modulation type and modulation order. *Id.*, 4:53-64; *see also* Ex. 1002, ¶¶45-47.

B. Prosecution History

The application that led to the '438 patent was filed on February 16, 2017. Ex. 1001, 1-2.

All of the proposed claims were rejected for nonstatutory double patenting over claims 1-18 of U.S. Patent No. 9,577,886, and claims 1-18 of U.S. Patent No. 9,419,858. 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. *Id.*, 75-93.

The Applicant filed a Terminal Disclaimer and amended 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.” *Id.*, 105, 107-108 (emphasis in original), 112.

The Examiner subsequently issued a Notice of Allowance. *Id.*, 152-154; Ex. 1002, ¶¶48-51.

C. Earliest Priority Date

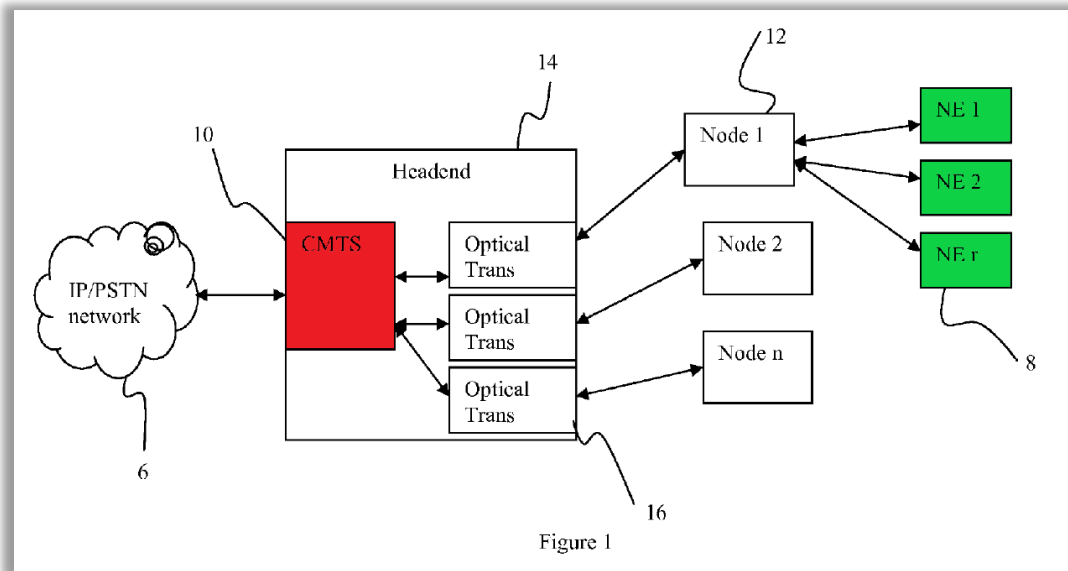
The earliest possible priority date for the '438 patent claims is July 23, 2012, the filing date of U.S. Provisional Application No. 61/674,742. All references relied on herein are prior art to that date. Ex. 1002, ¶52.

IV. PRIOR ART

A. Cooper

Cooper is a U.S. Published Application published September 27, 2007. Ex. 1005. Cooper is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1001, 1-2.

Like the '438 patent, Cooper describes a cable system that measures network parameters, such as a CM's SNR, and uses those parameters to reconfigure logical channels (*i.e.*, group cable modems to a particular channel). Ex. 1005, [0002], [0007]-[0010], [0017], [0030]-[0031]; Ex. 1002, ¶¶65-67.



Ex. 1005, Fig. 1 (annotated)

As shown above 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, [0022], Fig. 1. CMTS 10 resides at a headend 14, which includes transceivers 16 that communicate with the CMs. Ex. 1005, [0003], [0022]. The CMTS 10 measures network parameters for communications with the CMs. Ex. 1005, Abstract, [0026]-[0027], [0030], Figs. 4-5. The network parameters include upstream or downstream modulation error ratio (MER), upstream or downstream SNR, upstream or downstream microreflections, upstream transmit level, and downstream receive power level. Ex. 1005, Abstract. Using these measurements, CMs are grouped based upon performance similarities. Ex. 1005, [0019]. Cooper explains that “[t]hese groupings may then be used to configure logical channels and

subsequently the assignment of [cable modems] to these logical channels.” Ex. 1005, [0019].

B. Cooper840

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

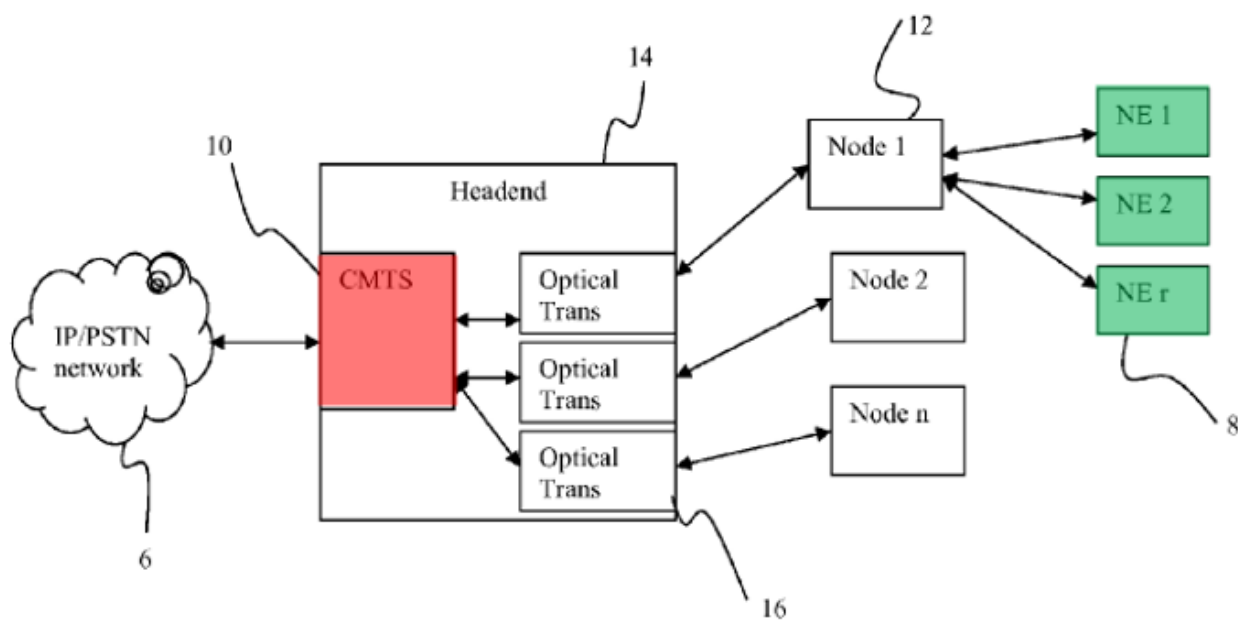


Figure 1

Ex. 1030, Fig. 1

Cooper840 discloses a network that includes a CMTS 10 (red) and multiple CMs 8 (green). Ex. 1030, [0020], Fig. 1 (reproduced above). As with Cooper and the '438 patent, in Cooper840 the CMs are sorted based on SNR. Ex. 1030, [0009]-[0011], [0029]-[0030], Fig. 5 (element S3). And, like the '438 patent, Cooper840's CMTS uses the lowest SNR for a group of CMs when selecting common modulation

parameters to be used by the CMs within the group. Ex. 1030, [0028], [0031] (“[i]deally, we want to set the modulation profile as a function of the lowest MER in the network element pool”), [0034], Fig. 1 (reproduced above); Ex. 1002, ¶¶68-70. 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, [0006], [0028], [0032].

C. Azenkot

Azenkot is a U.S. Published Application published June 9, 2005. Ex. 1031. 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.

Azenkot, similar to Cooper840, teaches that it was known to set parameters of a common burst profile used for communications by multiple CMs based on the least capable CM (*i.e.*, the CM with the lowest SNR). Ex. 1031, [0001], [0007], [0068], [0092]-[0094]; Ex. 1002, ¶¶71-73. Specifically, Azenkot describes a process for grouping CMs by modulation profile or throughput ability into different logical groups. Ex. 1031, Abstract, [0007], [0092]-[0094]. Each logical group is commanded to transmit upstream with a burst profile set to effectively use the throughput ability of the worst-performing CM. *Id.* In one embodiment, Azenkot specifically groups CMs by SNR. Ex. 1031, [0007], [0013], [0016], [0040]-[0041], [0092]. 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, [0016], [0040]-[0041], [0092]-[0094]. Ex. 1002, ¶73.

D. Monk

Monk is a U.S. Patent filed November 12, 2007 and granted on August 11, 2009. Ex. 1015. Monk is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1001, 1-2.

Monk uses orthogonal frequency division multiplexing (OFDM) to address signal impairments that restrict high bandwidth communication with CMs 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. A frequency 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 helps networks overcome signal impairments caused by issues such as micro-reflections and impedance mismatches. Ex. 1015, 4:16-43, 6:20-27, 7:36-62.

E. Cooper437

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

Cooper437 shows that it was known to use CM probe messages that include instructions for measuring noise and reporting the noise to a CMTS. Ex. 1016, 8:11-29, 8:60-9:5, 10:56-11:28, Table 1. In Cooper437, a CMTS initiates noise signal power measurements by transmitting a message to CMs 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. Cooper437 further discloses that, after a CM receives the message, the CM 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. *Id.*, 10:53-11:28, Table 1; *see also* Ex. 1002, ¶¶77-80.

F. Currivan

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

Currivan shows that it was known for a CMTS to segregate CMs into groups and select physical layer communication parameters for each group. Ex. 1028, [0017], [0026]. The physical layer communication parameters are based on an SNR metric and include: transmit power for a service group, transmit power per code word, strength of forward error correction, and length of preambles. Ex. 1028, [0017], [0026], [0065]-[0068], [0156]-[0157], Fig. 14A; Ex. 1002, ¶¶81-82.

V. IDENTIFICATION OF CHALLENGE PURSUANT TO 37 C.F.R. §42.104(b)

A. Grounds on Which Claims are Challenged

Petitioner requests review of claims 1-18 on the following grounds, all based on 35 U.S.C. §103.

Grounds	References	Claims Challenged
A	Cooper-Cooper840	1-2, 7-8, 10-11, 16-17
B	Cooper-Azenkot	1-2, 7-8, 10-11, 16-17
C-D	Cooper-Cooper840-Monk and Cooper-Azenkot-Monk	1-8, 10-17
E-F	Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk- Cooper437	9, 18
G	Cooper-Cooper840-Currivan	1-2, 7-8, 10-11, 16-17
H	Cooper-Azenkot-Currivan	1-2, 7-8, 10-11, 16-17
I-J	Cooper-Cooper840-Monk-Currivan and Cooper-Azenkot-Monk-Currivan	3-6, 12-15
K-L	Cooper-Cooper840-Monk- Cooper437-Currivan and Cooper- Azenkot-Monk-Cooper437-Currivan	9, 18

B. 314(a) Discretion Does Not Apply

The *Fintiv* factors as set forth in the Director's June 21, 2022 Guidance Memorandum do not warrant discretionary denial.

Factor one appears neutral. The PTAB has instituted IPR on seven of the eight patents originally asserted in the District Court in case no. 2:23-cv-01050, and Petitioner is now filing IPR petitions challenging a patent that Patent Owner seeks to add to the case. Petitioner has also requested a stay, as final written decisions on IPRs instituted in Petitioner's favor would resolve the majority of the litigation.

Factor two favors institution. Petitioner has filed a motion to dismiss the District Court case, Patent Owner has filed motions for leave to file amended complaints, and Petitioner will renew its Motion to Dismiss in order to seek dismissal of the operative complaint. In addition, no schedule beyond claim construction has been entered, and the Court has not set a trial date.

Factor three favors institution. To date, the investment by the District Court has been limited to considering motions to dismiss on the pleadings and hearing arguments on claim construction. The Court has not yet heard claim construction arguments on the '438 patent, and there is presently no schedule in place for claim construction proceedings on the '438 patent.

Factor four strongly favors institution. The petition challenges all claims in the '438 patent while Patent Owner seeks to assert only claims 1-5 and 9 in the District Court.

Factor five does not warrant denial as Petitioner is a defendant in the District Court case.

Factor six favors institution. Petitioner presents compelling unpatentability challenges that merit institution, relying on prior art that was never discussed and arguments that were never presented or were overlooked during prosecution.

C. 325(d) Discretion Does Not Apply

Considering the two-part framework discussed in *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GMBH*, IPR2019-01469, Paper 6, *8-9 (PTAB Feb. 13, 2020), the Board should not exercise its §325(d) discretion to deny institution. First, the grounds raised herein are not the same or substantially the same as the art and arguments raised during prosecution (step one of *Advanced Bionics*). The Examiner did not consider at least Cooper and Cooper840. Cooper and Cooper840 are also not cumulative of the references considered during prosecution.

Second, if it is asserted that the art or arguments are similar, the Examiner materially erred (i) by not applying the prior art relied on herein, and (ii) by failing to recognize that (as described below) the prior art taught the claim element added by amendment. *See* Section III.B, *supra*; *Advanced Bionics*, at 8-10, n.9.

D. Level of Ordinary Skill

A person of ordinary skill in the art (“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. Ex. 1002, ¶¶38-43. Additional education may substitute for professional experience, and significant work experience may substitute for formal education. *Id.*, ¶41. Petitioner’s expert, Sayfe Kiaei, at least meets the level of skill of a POSITA. *Id.*, ¶42; *see also id.*, ¶¶1-37, 53-64.

E. Claim Construction

All claim terms herein should be given their ordinary and customary meaning to a POSITA as they would be given in a civil action under 35 U.S.C. §282(b).¹ Ex. 1002, ¶44. 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.

Petitioner does not contend that the claims include means-plus-function limitations.

¹ The ’438 patent suggests the term “signal-to-noise (SNR) related metric” at least includes SNR (*see* Ex. 1001, 3:52-61), but Petitioner reserves the right to argue in other proceedings that the outer bounds of this term are unclear.

VI. SPECIFIC GROUNDS FOR UNPATENTABILITY

A. Ground A: Claims 1-2, 7-8, 10-11, and 16-17 are Rendered Obvious by Cooper-Cooper840

1. Independent Claim 1

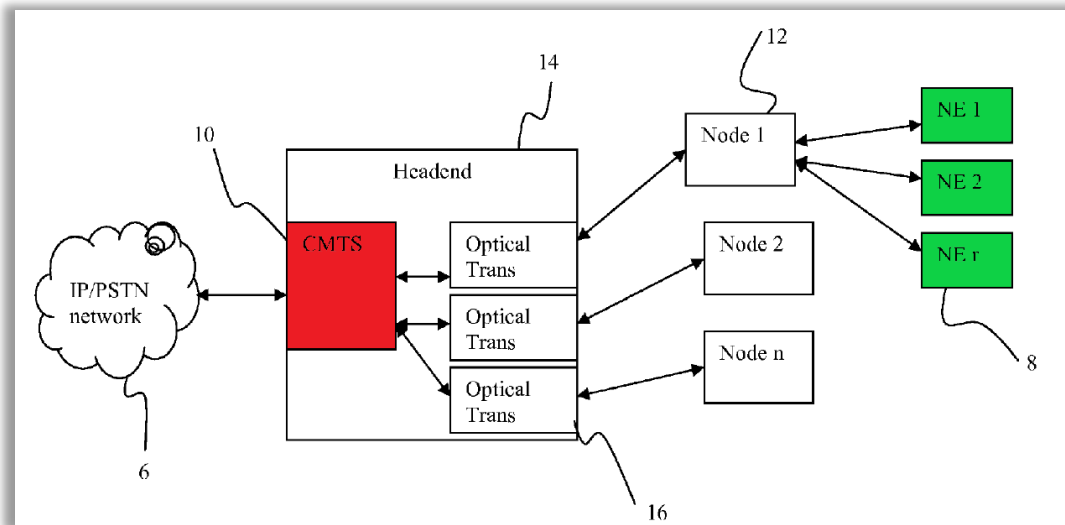
a. [1A] “A method comprising:”

To the extent the preamble [1A]² is limiting, Cooper-Cooper840 teaches the claimed method for the reasons set forth below. Ex. 1002, ¶83.

b. [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;”

Cooper discloses [1B]. Ex. 1002, ¶¶84-89. Cooper is “directed toward grouping network elements according to certain parameters to configure logical channels in a network.” Ex. 1005, [0002]. In Figure 1, Cooper discloses a network in which multiple network elements 8 (**green**, which include CMs) are connected to CMTS 10 (**red**) via nodes 12. Ex. 1005, [0022], Fig. 1.

² Claim limitations are labelled in the Claims Listing Appendix.

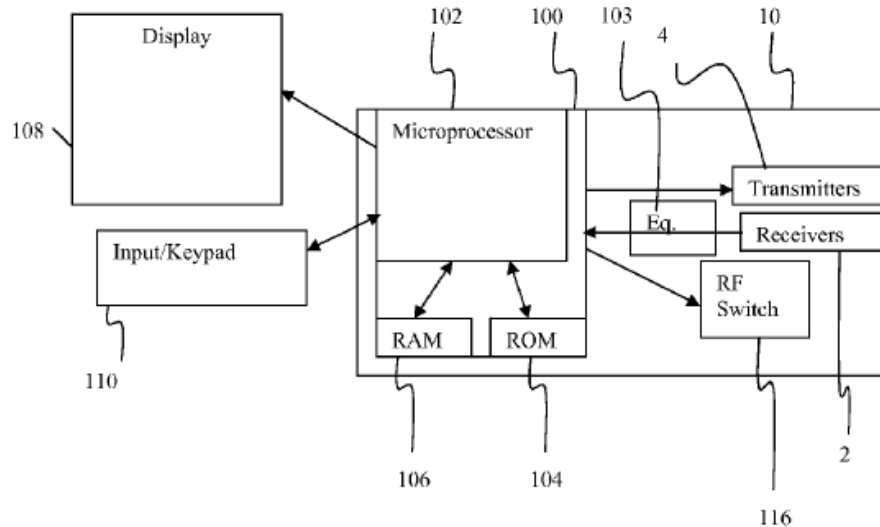


Ex. 1005, Fig. 1 (annotated)

CMTS 10 resides at headend 14, which includes transceivers that communicate with the network elements by receiving upstream communications from the network elements and sending (*i.e.*, serving) downstream communications to the network elements (claimed “plurality of cable modems served by said CMTS”). *Id.*, [0003], [0022]-[0025]; Ex. 1002, ¶¶84-85. Cooper’s CMTS also meets the tentative construction of “CMTS” in the CA litigation (Ex. 1034, 17-21) 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 opposed to being decentralized). Ex. 1005, [0003], [0022]-[0025], Figs. 1-2; Ex. 1002, ¶86.

As illustrated below 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, [0022]-[0023], Fig. 2. Using “measurements, made at the

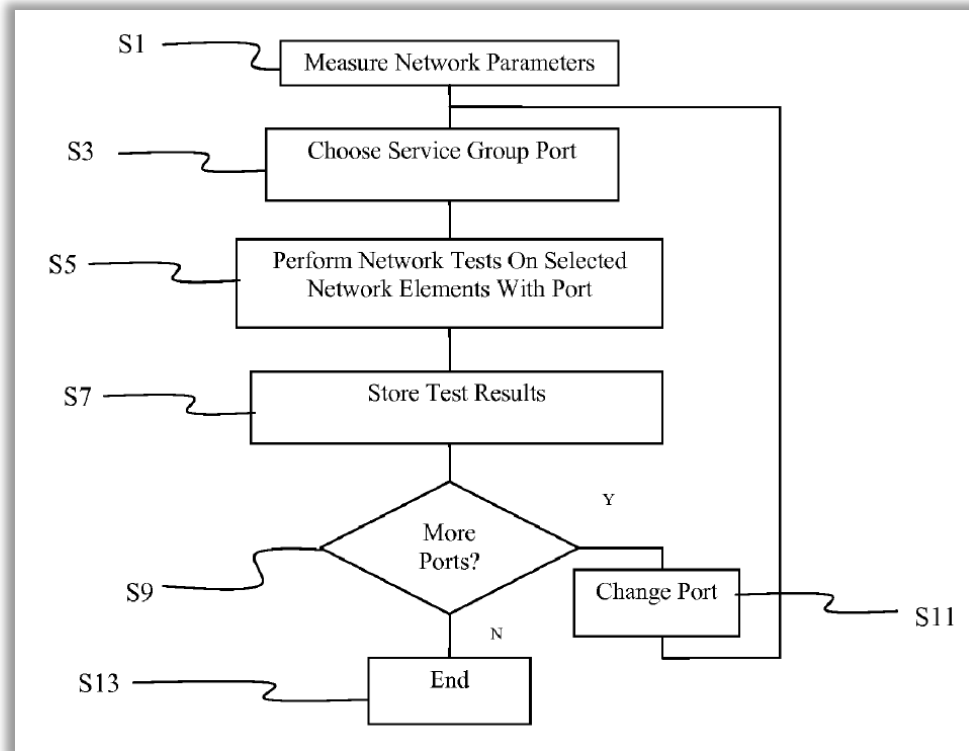
headend, via a CMTS device,” the CMTS microprocessor is “configured to determine network parameters” associated with selected cable modems (claimed “determining, by a ... CMTS, for a plurality of cable modems ...”) in order to assign the cable modems to logical channel. Ex. 1005, [0007]-[0008].



Ex. 1005, Fig. 2

More particularly, the system optimizes network communications based on these network parameter measurements, which can be performed at the CMTS or at each of the plurality of CMs. Ex. 1005, [0007]-[0008], [0011]; Ex. 1002, ¶87. For example, referring to Figure 4 below, Cooper discloses initiating the measurement process (S1), which begins by choosing a service group port (*e.g.*, a transceiver at the headend servicing a group of CMs) (S3), and performing tests on CMs connected with the selected port (S5). Ex. 1005, [0016], [0022]-[0023], [0026]-[0027], [0029], Fig. 4; Ex. 1002, ¶87. This testing involves the CMTS determining network

parameters for a plurality of CMs connected to the selected port. Ex. 1005, [0007]-[0008], [0026]-[0028].



Ex. 1005, Fig. 4

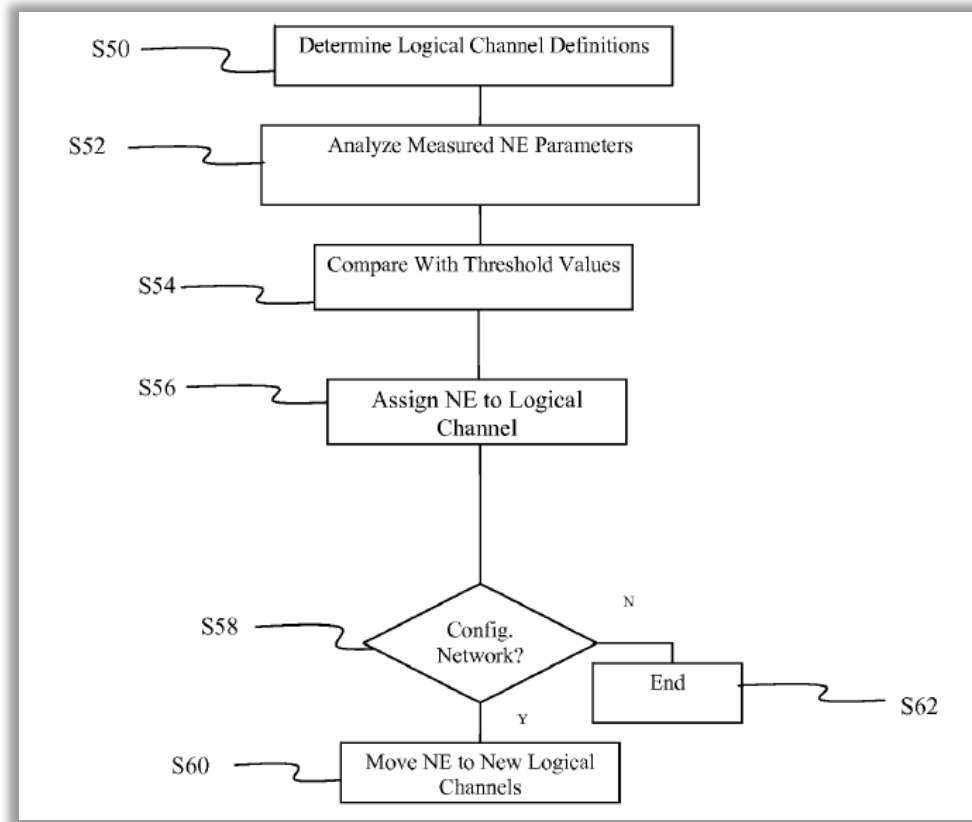
This testing includes determining “upstream or downstream modulation error ratio (MER) [or] upstream or downstream signal to noise ratio (SNR).” *Id.*, [0008], [0027]; Ex. 1002, ¶88. Modulation error ratio and SNR are both ratios that consider noise and indicate signal quality and are each independently an “SNR-related metric”. Ex. 1030, [0004]; Ex. 1034, 23-24; Ex. 1202, ¶88. Cooper thus discloses a CMTS determining SNR-related metrics for a plurality of CMs served by the 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”). Ex. 1002, ¶¶87-89.

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

Cooper discloses [1C]. *Id.*, ¶¶90-99. In contrast to manual processes for assigning CMs to logical channels, 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, [0006]-[0007]; *see also* Abstract. Specifically, after determining SNRs or MERs for the CMs, as described above for [1B], Cooper’s CMTS assigns groups of CMs to particular logical channels based on a comparison with SNR thresholds. *Id.*, [0002], [0006]-[0011], [0019], [0026]-[0027], [0030]-[0033], [0039]-[0040], [0043]; Ex. 1002, ¶¶90-92. CMs with common performance parameters (*e.g.*, similar SNRs) are grouped together. Ex. 1005, [0019], [0030], [0033], [0039]. These groupings have many benefits, including optimizing efficiency and throughput because, *e.g.*, physical layer configuration parameters can be optimized to each CM grouping. *Id.*

As shown below in Figure 5, Cooper analyzes the parameters measured for each CM and then assigns them to logical channels based on a comparison between their measured parameters and respective thresholds, which are predetermined or dynamically determined. Ex. 1005, [0008], [0030], Fig. 5; Ex. 1002, ¶93.



Ex. 1005, Fig. 5

For example, Figure 6 (which corresponds to Figure 3³ below) includes a list of **modems** identified by their respective MAC addresses, a list of corresponding **SNR measurements**, and a list of three **SNR thresholds** used to delineate four **logical channels** numbered 0-3. Ex. 1006, 11 (Figure 3); Ex. 1005, [0032]-[0033], [0041], Fig. 6.

³ Figure 3 in U.S. Provisional Patent Application No. 60/785,647 (Ex. 1006, 11), which Cooper incorporates by reference, is a higher-quality version of the Channel Configuration Window illustrated in Cooper's Figure 6.

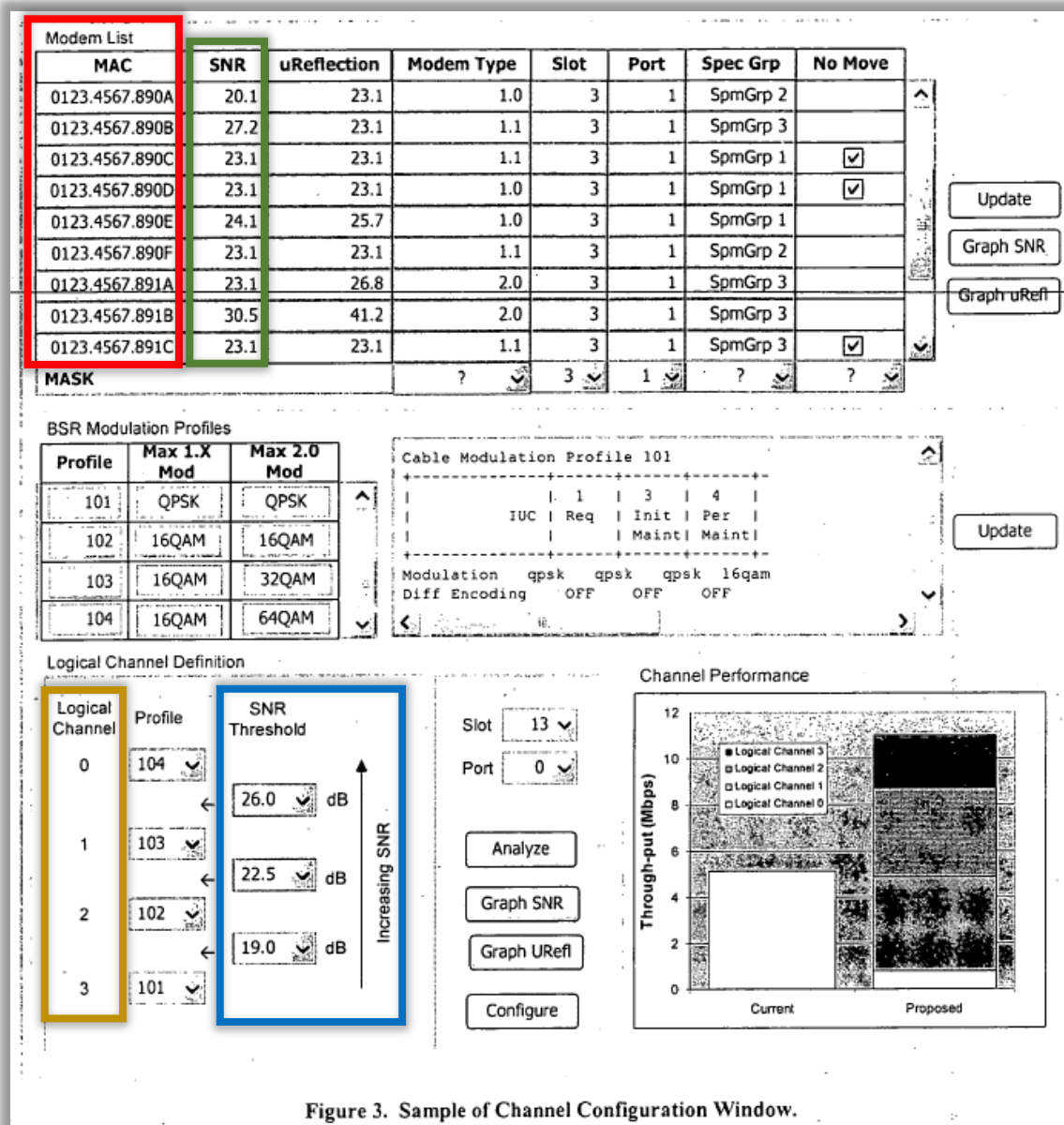


Figure 3. Sample of Channel Configuration Window.

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

As illustrated above, Cooper's process of assigning each CM to a logical channel (*i.e.*, one of channels "0", "1", "2" and "3") is based on comparing its respective SNR-related metric measurement to SNR thresholds. Ex. 1006, 11; Ex. 1005, [0030]-[0033], Fig. 6; Ex. 1002, ¶¶94-95. Each group of CMs in a logical channel is a claimed "service group", and there are a plurality of such groups in

Cooper. Ex. 1002, ¶¶96-97; Ex. 1005, [0026]-[0027] (describing the process as encompassing a “service group”). This is consistent with term’s plain meaning and the ’438 patent’s disclosure for this limitation. Ex. 1002, ¶97.

In sum, the assignment by Cooper’s CMTS (claimed “assigning, by said CMTS,”) of CMs (claimed “plurality of cable modems”) to a particular logical channel based on their SNR or MER measurements (claimed “based on said plurality of SNR-related metrics”) results in CMs that are grouped by logical channel (claimed “assigning ... among a plurality of service groups”), which is consistent with the ’438 patent’s disclosure and the plain and ordinary meaning of “service groups” as recited in [1C]. Ex. 1002, ¶¶97-99; Ex. 1001, 2:22-25, 5:35-37, 6:19-21, 6:40-7:21, Figs. 3A-3B, 4A-4B; Ex. 1017, 55-57 (construing the term “service group[s]” in related U.S. Patent No. 10,135,682—“the ’682 patent”— as having its plain meaning based on disclosure in the ’682 patent that corresponds to identical disclosure in the ’438 patent at Ex. 1001, 2:22-25 and 6:37-39); 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

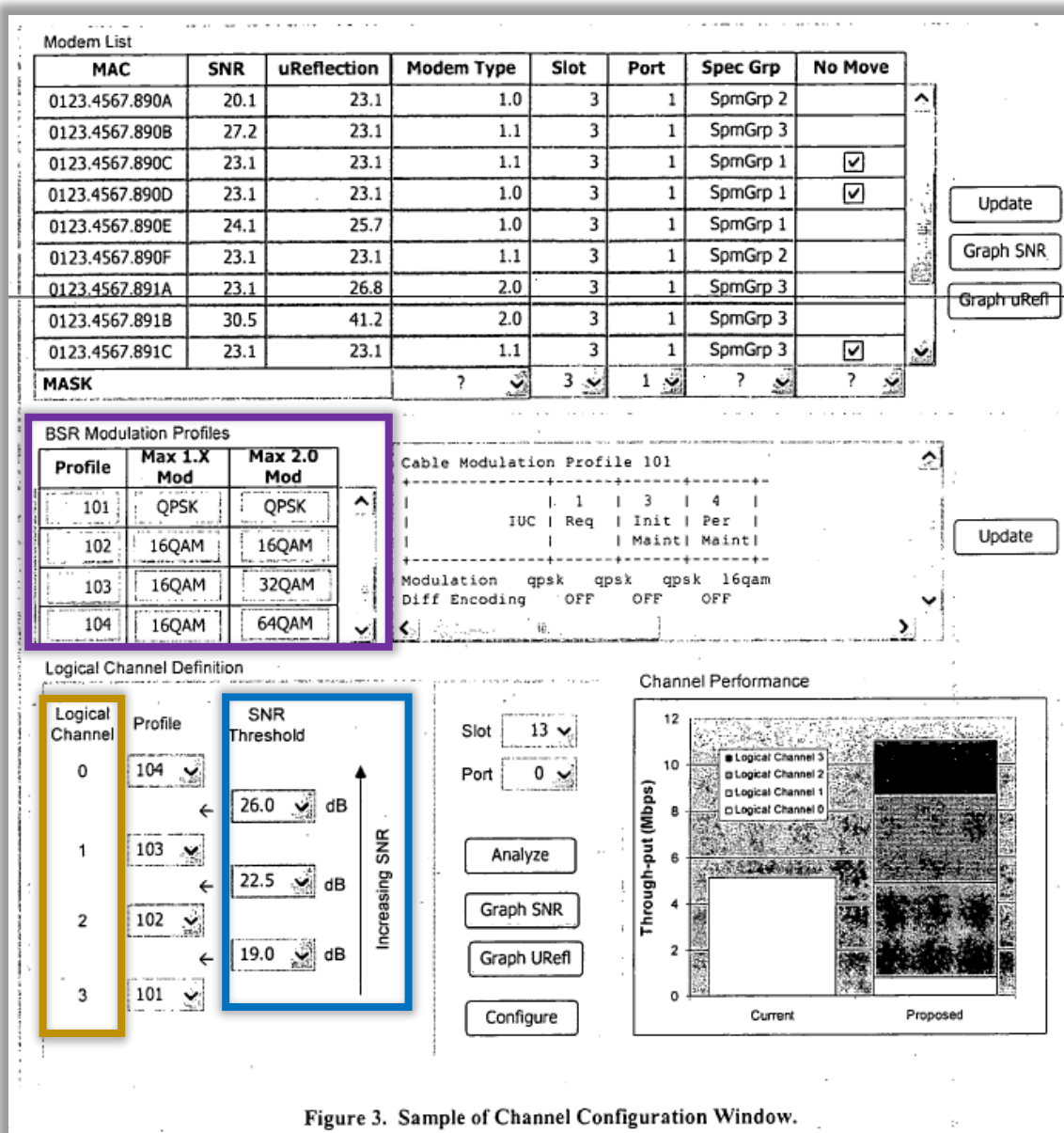
Owner's infringement contentions alleging infringement based on organizing cable modems into groups). Therefore, Cooper discloses [1C].

- d. [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;”**

As shown above, Cooper's CMTS determines SNR-related metrics for a plurality of CMs. Section VI.A.1.b. The CMTS also groups CMs and assigns them to logical channels based on a comparison between the determined SNR or MER for each CM and SNR thresholds; CMs with similar SNRs or MERs are grouped together. Sections VI.A.1.b-c. Grouping CMs in this manner has the benefit of allowing the CMTS to optimize the physical layer configuration parameters used for communications with each group. Ex. 1005, [0006], [0019]. Each of the logical channels in Cooper is configured so that the CMTS uses the same physical layer configuration parameters (including modulation order) to communicate with all the CMs within a service group. Ex. 1005, [0019]-[0021], [0030], [0036]; Ex. 1002, ¶100. And as further described below for [1E], the CMTS executes an algorithm to automatically select configuration parameters. Section VI.A.1.e; Ex. 1005, [0030], [0031]-[0032], [0042], Figs. 2, 5-6.

Cooper also determines multiple physical layer communication parameters for each service group. As shown below, Cooper's channel configuration screen

displays **Modulation Profiles** that include channel configuration parameters, such as modulation orders (*e.g.*, QPSK, 16QAM, etc.) and whether to use differential encoding. These profile templates (*e.g.*, Profile 101, Profile 102, etc.) are applied to individual logical channels, thereby optimizing the specific needs of the CMs assigned to that channel. Ex. 1005, [0036], Fig. 6; Ex. 1002, ¶103.



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

For example, Figure 6 shows that **logical channel “1”**, which is defined by **SNR thresholds** (in this case, SNRs between 22.5 and 26.0 db), 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, [0036]-[0037], Fig. 6; Ex. 1002, ¶104.

Although Cooper does not expressly disclose its CMTS determining a “worst-case” SNR for each group of CMs assigned to a logical channel, a POSITA would have found it obvious to do so in view of Cooper840’s teachings. Ex. 1002, ¶100.

Cooper840 discloses a network that includes a CMTS and a multiple CMs. Ex. 1030, [0020], Fig. 1. Ex. 1002, ¶101. The respective illustrations and disclosures in Cooper and Cooper840 describing the network and its logical architecture are nearly the same. *E.g., compare* Ex. 1005, [0022]-[0025], Figs. 1-3 to Ex. 1030, [0020]-[0023], [0027], Figs. 1-2, 4; Ex. 1002, ¶101. Cooper840, like Cooper, groups CMs based on SNR. Ex. 1030, [0009]-[0011], [0020], [0028]-[0030], Fig. 5 (element S3). In Cooper840, the modulation parameters for communication with each group of CMs, such as modulation order, are controlled, and Cooper840 teaches that “[i]deally, we want to set the modulation profile as a function of the lowest MER in the network element pool.” Ex. 1030, [0031], [0006], [0028], [0032]; Ex. 1002, ¶101. Cooper840 discloses that CMs can be grouped by either modulation error ratio (MER) or SNR. Ex. 1030, [0009]-[0011], [0020],

[0028]-[0030], Fig. 5 (element S3). 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, [0004]; Ex. 1002, ¶101.

A POSITA would have understood from Cooper840 that setting the modulation profile as a function of the lowest SNR or MER is ideal because such a setting ensures that all of the network elements can pass data on the channel (*i.e.*, no CM in a group has an SNR too low for the modulation order selected for that group). Ex. 1030, [0005]-[0006], [0032]; Ex. 1002, ¶101.

Cooper840 thus teaches a POSITA to determine the lowest SNR or MER for CMs 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. A POSITA would have been motivated to apply this teaching to Cooper’s algorithm (executed at the CMTS) that selects physical layer communication parameters (*e.g.*, modulation order and whether to use differential encoding) because it ensures that all of the CM’s can pass data on the channel. Ex. 1030, [0005]-[0006], [0032]; Ex. 1002, ¶¶102-103. Applying Cooper840’s teaching in this manner also 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, [0011], [0019], [0039]; Ex. 1002, ¶¶105-106.

In addition, applying Cooper840's teaching to Cooper would also help to implement Cooper's dynamic SNR thresholds for assigning CMs to a logical channel. Ex. 1002, ¶107; Ex. 1005, [0030]. Because "SNR parameters will vary over time because of such conditions as climate, temperature and network degradation," (Ex. 1005, [0040]), Cooper's CMTS automatically and periodically reconfigures its logical channels, including measuring parameters such as SNR and MER for its CMs, assigning CMs to the logical channels, and setting SNR thresholds used to delineate the channels. Ex. 1005, [0026]-[0027], [0030], [0033], [0039]-[0040], [0043], Fig. 6. Thus, a POSITA would have an additional motivation to apply Cooper840's teaching of determining the lowest SNR or MER of a CM in a service group to select modulation parameters for the service group in order to implement Cooper's dynamic SNR threshold to address variance in a channel's SNR. Ex. 1002, ¶107.

The proposed combination also represents a combination of prior art elements (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 CM in a service group to select modulation parameters for the service group) according to known methods (programming of a CMTS) to yield predictable results (a CMTS that generates a worst-case SNR-related metric for the CM service group).

and uses that metric to determine the communication parameters—including modulation order—applied to the group). Ex. 1002, ¶108.

The proposed combination further represents the application of a known technique (Cooper840's use of the lowest SNR of a CM in a service group to select modulation parameters for the service group) to a known system ready for improvement (Cooper's system that applies uniform modulation order parameters to CMs that are grouped based on having similar SNRs) to yield predictable results (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). Ex. 1002, ¶109. Moreover, applying Cooper840'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. *Id.*, ¶¶110-111; Ex. 1005, [0042]; Ex. 1030, [0021].

Cooper's CMTS (as modified by Cooper840) 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." Ex. 1002, ¶111. The use by Cooper-Cooper840 of the lowest SNR or MER within a cable modem group to select the physical layer parameters for that group is a "composite" SNR-related metric because it is applied to all of the cable modems within a service

group. *Id.*, ¶111. This is consistent with the '438 patent's disclosure. Ex. 1002, ¶112. For example, the '438 patent discloses that a worst-case SNR profile simply includes multiple performance metric measurements (*e.g.*, SNRs) for the cable modems of a particular service group. Ex. 1001, 4:7-17, Fig. 2B. The '438 patent also teaches that physical layer parameters are determined based on the singular worst-case SNR for a service group. *Id.*, 5:4-18, 5:38-44.

Cooper-Cooper⁸⁴⁰'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); Ex. 1002, ¶¶113-114.

If it is asserted that the “worst-case SNR profile” must comprise the SNR-related metric of a CM over a range of frequencies, this feature is also taught by Cooper-Cooper840. 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. 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. Ex. 1002, ¶¶109-110.

Therefore, Cooper-Cooper840 teaches [1D].

- e. [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”**

As described above for [1D], Cooper-Cooper840 determines the lowest SNR or MER of a CM in a service group and uses that information to select the modulation parameters used to communicate with the service group. Section VI.A.1.d; Ex. 1030, [0006], [0020], [0028] [0031], [0032]. As also described above,

Cooper's channel configuration screen displays a **Modulation Profile display panel** 1004 and an **expanded detail window** 1009 that include channel configuration parameters, such as modulation orders (*e.g.*, QPSK, 16QAM, etc.) and whether to use differential encoding. The parameters are applied to individual logical channels, thereby optimizing the specific needs of the CM groups (the claimed "plurality of service groups"). Section VI.A.1.d; Ex. 1005, [0036], Fig. 6; Ex. 1006, 11, Fig. 3; Ex. 1002, ¶115.

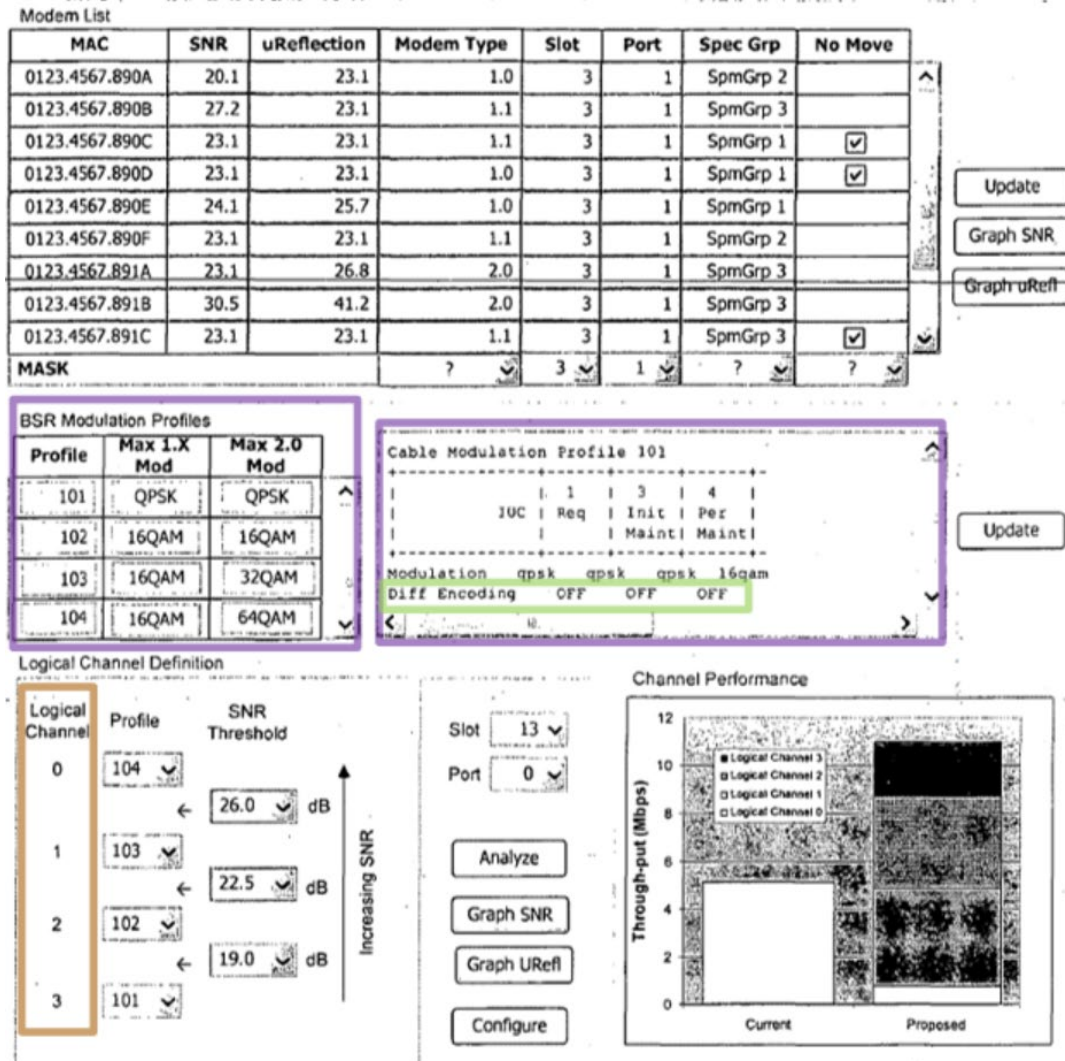


Figure 3. Sample of Channel Configuration Window.

Ex. 1006, 11, Fig. 3 (annotated); Ex. 1005, Fig. 6

As illustrated above, various different modulation profile parameters may be selected and used for communicating with the CMs assigned to each **logical channel** (e.g., logical channel 3). Ex. 1005, [0036], Fig. 6; Ex. 1006, 11, Fig. 3. For example, as shown in the **Modulation Profile display panel** and the **expanded detail window** (which in this example shows expanded details for “Modulation Profile

101”), 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, [0036], Fig. 6; Ex. 1006, 11, Fig. 3; Ex. 1002, ¶116. Cooper further discloses that each CM includes a processor that controls the pre-equalization parameters and preamble lengths of communications sent by the CM in accordance with instructions selected and sent by the CMTS based on a measured SNR. Ex. 1005, [0017], [0025], [0027], [0030], [0040], [0042], Figs. 2-3, 5-6; Ex. 1002, ¶117.

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 based on said composite SNR-related metric.” Ex. 1002, ¶117; *see also* Section VI.A.1.d. In the Cooper-Cooper840 system, these parameters are selected for each group based on the lowest SNR or MER of any CM within that group. *Id.* In this respect, Cooper-Cooper840 is very similar to the ’438 patent’s embodiment. For example, the ’438 patent describes that “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, 5. 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). Ex. 1002, ¶117. Thus, Cooper discloses the same types of “physical layer communication parameters” described in the ’438 patent. *Id.*, ¶117.

Finally, Cooper discloses that the process described above of selecting physical layer configuration parameters may be performed by the CMTS’s microprocessor. For example, Cooper describes an automated process whereby the 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, [0030], [0042], Figs. 5-6. Based on this optimization process, the CMTS’s processor is able to determine the optimal value for thresholds to isolate the various logical channels and “the associated channel profile configuration (parameters)” for each logical channel. *Id.*, [0030], [0042], Figs. 1-2, 5-6; Ex. 1002, ¶118. Cooper also contemplates automating its logical channel configuration, and discloses that the CMTS may also rerun these processes at regular intervals (*e.g.*, daily, weekly, monthly, yearly). Ex. 1005, Abstract, [0030], [0040], [0043].

Thus, Cooper (and therefore Cooper-Cooper840) teaches a CMTS selecting modulation orders (*e.g.*, QPSK, 16QAM, etc.), determining whether to use differential encoding, and setting preamble length and pre-equalization parameters for its modulation profiles all based on a worst-case SNR metric determined for a

group of CMs as part of its logical channel configuration. Ex. 1002, ¶119. Accordingly, Cooper-Cooper840 teaches the CMTS “selecting ... physical layer communication parameters [(i.e., the 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.” *Id.*, ¶¶119-120.

f. [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.”

Cooper-Cooper840 teaches [1F]. *Id.*, ¶¶121-122. As shown above for [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 each of its logical channels based on the claimed composite SNR-related metric that is based on a worst-case SNR-related metric in each channel. Sections VI.A.1.d-e. Cooper-Cooper840’s CMTS then uses the selected modulation orders and encoding parameters to communicate with the connected CMs in each respective logical channel. Ex. 1005, [0019], [0030]; Ex. 1002, ¶¶121-122.

Accordingly, Cooper-Cooper840 teaches “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.” Cooper-Cooper840 renders claim 1 obvious.

2. Dependent Claim 2

Claim 2 depends from claim 1 and further requires “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.”

As shown above for [1E], Cooper-Cooper840’s CMTS selects a modulation order (*e.g.*, 16QAM/32QAM/64QAM) based on a composite SNR-related metric for its logical channels. Section VI.A.1.e. Accordingly, Cooper-Cooper840 teaches the additional limitations of claim 2. Ex. 1002, ¶123.

3. Dependent Claim 7

Claim 7 depends from claim 1 and further requires “assigning said plurality of cable modems ... based on distances between said CMTS and said plurality of cable modems.”

As described above for [1C], Cooper’s CMTS assigns CMs to logical channels (claimed “plurality of service groups”) based on a comparison between the determined SNR-related metric for each CM and SNR thresholds. Section VI.A.1.c. The CMTS also determines the location of CMs in a cable network and assigns the CMs to service groups based on the additional factor of the location of the CM

(claimed “assigning said cable modems among said plurality of service groups based on respective distances between said CMTS and said cable modems”). Ex. 1005, Abstract, [0008], [0021], [0027]-[0028], [0037]; Ex. 1002, ¶125; Section VI.A.1.c. Accordingly, Cooper-Cooper840 teaches the additional limitations of claim 7. Ex. 1002, ¶¶124-126.

4. Dependent Claim 8

Claim 8 depends from claim 1 and further requires “assigning any particular one of said plurality of cable modems ... based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.”

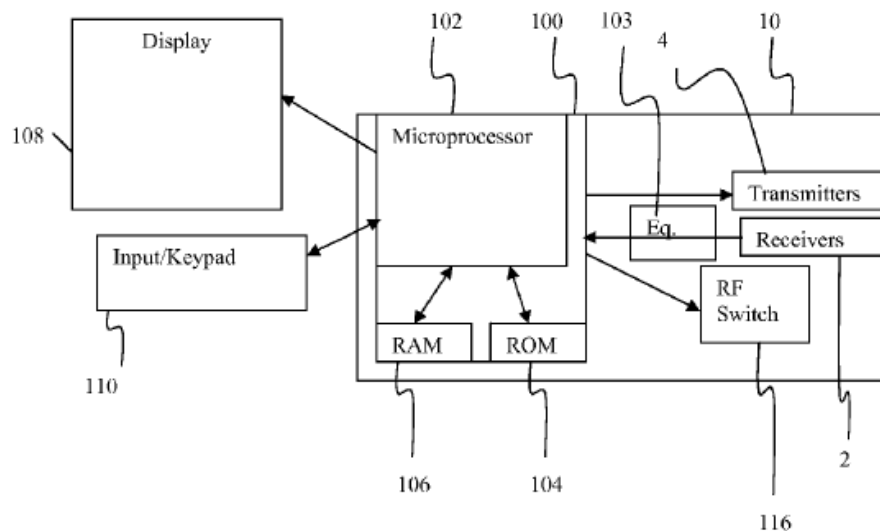
As described above for [1C], Cooper’s CMTS assigns CMs to logical channels (claimed “plurality of service groups”) based on a comparison between the determined SNR-related metric for each CM and SNR thresholds. Section VI.A.1.c. Cooper further discloses assigning CMs to service groups based at least in part on amplifier cascade depth (claimed “assigning any particular one of said cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems”). Ex. 1005, Abstract, [0008], [0021], [0027]-[0028], [0037]; Ex. 1002, ¶128; Section VI.A.1.c. Accordingly, Cooper-Cooper840 teaches the additional limitations of claim 8. Ex. 1002, ¶¶127-129.

5. Independent Claim 10

Claim 10 is a system claim with limitations similar to that of method claim 1.

a. [10A]

Cooper's "network" described above in [1B] discloses a "system" as recited in [10A]. Section VI.A.1.b; Ex. 1005, [0022], Figs. 1-2; Ex. 1002, ¶¶130-131. Referring to Figure 2 below, CMTS 10 comprises circuitry that includes: (i) a microprocessor 102 (claimed "circuitry ... comprising a ... processor") that receives instructions and data from ROM 104/RAM 106 and controls the operation of the CMTS, and (ii) transmitters 4 and receivers 2 (claimed "circuitry ... comprising a network interface") that provide bi-directional communication with network elements 8. Ex. 1005, [0022]-[0023], Figs. 1-2.



Ex. 1005, Fig. 2

Therefore, Cooper-Cooper840 teaches [10A].

b. [10B]-[10F]

Elements [10B]-[10E] are nearly identical to [1B]-[1E], except [10B]-[10E] recite that the “processor” in the CMTS “is configured to” perform the limitations recited in [1B]-[1E]. Ex. 1002, ¶132. Cooper-Cooper840 teaches that microprocessor 102 in CMTS 10 is configured to perform the limitations described in [1B]-[1E]. *Id.*; Sections VI.A.1.b-e; Ex. 1005, [0022]-[0025], Figs. 1-2. Accordingly, for the reasons set forth in [1B]-[1E], Cooper-Cooper840’s microprocessor 102 teaches and is configured to perform the limitations recited in [10B]-[10E]. Sections VI.A.1.b-e; Ex. 1005, [0022]-[0025], Figs. 1-2; Ex. 1002, ¶132.

Element [10F] is nearly identical to [1F], except [10F] recites that the claimed “network interface” is configured to perform the limitations described in [1F]. Ex. 1002, ¶133. Cooper-Cooper840 teaches that transmitters 4/receivers 2 (claimed “network interface”) provide bi-directional communication with network elements 8. Ex. 1005, [0022]-[0025], Fig. 2. Accordingly, as explained in [1F], Cooper-Cooper840 comprises a network interface configured to perform the limitations recited in [10F]. *Id.*; Section VI.A.1.f.

Cooper-Cooper840 therefore renders claim 10 obvious.

6. Dependent Claim 11

Claim 11 depends from claim 10 and further requires “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.”

As shown above for [1E] and [10E], Cooper-Cooper840’s CMTS selects a modulation order (*e.g.*, 16QAM/32QAM/64QAM) based on a composite SNR-related metric for its logical channels. Sections VI.A.1.e, VI.A.5.b. Accordingly, Cooper-Cooper840 teaches the additional limitations of claim 11. Ex. 1002, ¶134.

7. Dependent Claim 16

Claim 16 depends from claim 10 and further requires “wherein said processor is configured to assign said plurality of cable modems ... based on distances between said CMTS and said plurality of cable modems.”

Claims 16 is substantially similar to claim 7, except that claim 16 identifies “said processor” to make the assignments described in claim 7. Ex. 1001, 10:26-29. As discussed above in Section VI.A.5.a, Cooper’s CMTS comprises a processor that controls the operation of the CMTS. Ex. 1005, [0022]-[0025], Figs. 1-2; Ex. 1002, ¶135. And as discussed above in Section VI.A.3, such operation by the CMTS includes making the assignments described in claim 7. Ex. 1005, Abstract, [0008], [0021], [0027]-[0028], [0037]; Ex. 1002, ¶135; Sections VI.A.1.c, VI.A.3. Thus,

Cooper-Cooper840's processor "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. Ex. 1002, ¶135. Accordingly, claim 16 is rendered obvious for the same reasons discussed above for claim 7. *Id.*; Section VI.A.3.

8. Dependent Claim 17

Claim 17 depends from claim 10 and further requires "wherein said processor is configured to assign said plurality of cable modems ... based on a branch further branch amplifier that serves each of said plurality of cable modems."

Claim 17 is substantially similar to claim 8, except that claim 17 identifies "said processor" to make the assignments. As discussed in Section VI.A.5.a, Cooper's CMTS comprises the claimed processor, and therefore, claim 17 is rendered obvious for the same reasons discussed above for claim 8. Section VI.A.4; Ex. 1002, ¶136.

B. Ground B: Claims 1-2, 7-8, 10-11, and 16-17 are Rendered Obvious by Cooper-Azenkot

1. Independent Claims 1 and 10

a. [1A]-[1C]/[10A]-[10C]

For the reasons described above in Sections VI.A.1.a-c and VI.A.5.a-b, Cooper discloses [1A]-[1C] and [10A]-[10C]. Ex. 1002, ¶137.

b. [1D]/[10D]

As shown above in Section VI.A.1.b, Cooper's CMTS determines SNR-related metrics for a plurality of CMs. Section VI.A.1.b. And as discussed in Section VI.A.1.c, the CMTS optimizes network communications by assigning CMs to logical channels based on a comparison between the determined SNR-related metric for each CM and SNR thresholds wherein CMs having similar SNRs or MERs are assigned to the same channel. Section VI.A.1.c. Cooper also describes optimizing physical layer communication parameters for groups of cable modems. Ex. 1005, [0006], [0019]. Each of the logical channels is configured so that the CMTS uses the same physical layer communication parameters (including modulation order) to communicate with all the CMs within a service group. Ex. 1005, [0019]-[0021], [0030], [0036]; Ex. 1002, ¶138. And as further described for [1E], the CMTS executes an algorithm to automatically select configuration parameters. Section VI.A.1.e, *supra*; Section VI.B.1.c, *infra*; Ex. 1005, [0030], [0031]-[0032], [0042], Figs. 2, 5-6.

In addition, as set forth in Section VI.A.1.d, 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 CMs. Ex. 1005, [0036], Fig. 6; Ex. 1002, ¶103. For example, Cooper's Figure 6 (as annotated above in Section

VI.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, [0036]-[0037], Fig. 6; Ex. 1002, ¶104.

Although Cooper does not explicitly disclose determining a “worst-case” SNR for each group of CMs assigned to a logical channel, a POSITA would have found it obvious to do so in view of Azenkot’s teachings. Ex. 1002, ¶¶138-151.

Azenkot, like Cooper, uses a CMTS to group cable modems by SNR into logical channels. Ex. 1031, [0007], [0013], [0016], [0040]-[0041], [0092]. Burst profiles used to communicate with each CM group are then selected such that CMs with higher SNRs receive higher-throughput communications based on SNR. Ex. 1031, [0016], [0040]-[0041], [0092]-[0094]. A POSITA would have understood that there are trade-offs between the robustness of a burst profile and throughput. Ex. 1002, ¶139. In particular, relatively higher CM SNRs are required for burst profiles that support higher throughput, while more robust burst profiles that result in lower throughput are required for lower CM SNRs. Ex. 1031, [0010], [0068], [0092]-[0093], [0111]; Ex. 1002, ¶139.

Azenkot additionally sets 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 CM). Ex. 1031, [0001], [0007], [0013], [0089]. A POSITA would have understood that the least capable CM described in Azenkot corresponds to the CM with the lowest SNR. Ex. 1002, ¶140. Indeed, if, as a result of dynamic conditions, a CM in a group has an SNR that becomes too low for the burst profile being used with that group, the CM 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. Ex. 1002, ¶140. A POSITA would also have understood that Azenkot’s disclosure of setting a burst profile based on the least capable CM is also a disclosure of generating a value for lowest SNR for a group of CMs (which is required to set the burst profile). Ex. 1002, ¶141. In Azenkot, the burst profile includes modulation order (QPSK, 64 QAM, 128 QAM, etc.). Ex. 1031, [0013], [0068], [0074].

Azenkot thus teaches that the CMTS should determine the lowest CM SNR for a group of CMs (the claimed “composite SNR-related metric based at least in part on a worst-case SNR profile”) and to use that to select modulation parameters, such as modulation order, for the service group. A POSITA would have been motivated to apply this teaching to Cooper’s algorithm (executed at the CMTS) that selects physical layer communication parameters, *e.g.*, modulation order and whether to use differential encoding, because it ensures that all of the CM’s can pass data on the channel. Ex. 1031, [0001], [0007], [0013], [0089]; Ex. 1002, ¶144.

Applying Azenkot's teaching in this manner also 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, [0011], [0019], [0039]; Ex. 1031, [0014]-[0015], [0018], [0095], [0117]; Ex. 1002, ¶¶143-145

In addition, applying Azenkot's teaching to Cooper would also help to implement Cooper's dynamic SNR thresholds for assigning CMs to a logical channel. *Id.*, ¶145; Ex. 1005, [0030]. Because "SNR parameters will vary over time because of such conditions as climate, temperature and network degradation," (Ex. 1005, [0040]), Cooper's CMTS automatically and periodically reconfigures its logical channels, including measuring parameters such as SNR and MER for its CMs, assigning CMs to the logical channels, and setting SNR thresholds used to delineate the channels. Ex. 1005, [0026]-[0027], [0030], [0033], [0039]-[0040], [0043], Fig. 6. Thus, a POSITA would have an additional motivation to apply Azenkot's teaching of determining the lowest CM SNR for a group of CMs in order to implement Cooper's dynamic SNR threshold to address variance in a channel's SNR. *Id.*, [0010], [0013]-[0014], [0025]-[0027], [0030], [0032], [0042]-[0043]; Ex. 1002, ¶145.

The proposed combination represents a combination of prior art elements (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 CM SNR for a group of CMs to determine which physical layer parameters to apply to the group) according to known methods (programming of a CMTS) to yield predictable results (a CMTS that generates a worst-case SNR-related metric for the CM service group and uses that metric to determine the modulation order applied to the group). Ex. 1002, ¶146.

The proposed combination also represents the application of a known technique (Azenkot's determination of the lowest CM SNR for a group of CMs to determine which physical layer parameters to apply to the group) to a known system ready for improvement (Cooper's system that applies uniform modulation order parameters to CMs that are grouped based on having similar SNRs or MERs) to yield predictable results (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). Ex. 1002, ¶147. Moreover, 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. *Id.*, ¶148; Ex. 1005, [0042]; Ex. 1031, [0017].

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.” Ex. 1002, ¶151. 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. *Id.*, ¶151.

This is consistent with the ’438 patent’s disclosures. Ex. 1002, ¶149. 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.

Further, 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); Ex. 1002, ¶150.

Accordingly, Cooper-Azenkot teaches [1D]. Ex. 1002, ¶151. And for reasons similar to those described above for Cooper-Cooper840, Cooper-Azenkot also teaches that its microprocessor is configured to perform the limitations described in [10D]. *Id.*; Section VI.A.5.b.

c. [1E]-[1F]/[10E]-[10F]

For reasons similar to those described for Cooper-Cooper840, Cooper-Azenkot teaches [1E]-[1F]/[10E]-[10F]. 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 CMs 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, [0019], [0030]; Ex. 1031,

[0007], [0013], [0016], [0040]-[0041], [0092]; Ex. 1002, ¶152; Sections VI.A.1.e-f, VI.A.5.b.

Cooper-Azenkot's CMTS also would have communicated with the CMs connected to it using the selected modulation order and encoding parameters. Ex. 1002, ¶153; Sections VI.A.1.f, VI.A.5.b.

Cooper-Azenkot therefore teaches [1E]-[1F]/[10E]-[10F] and renders claims 1 and 10 obvious. Ex. 1002, ¶153.

2. Dependent Claims 2 and 11

For reasons similar to those described above for Cooper-Cooper840, Cooper-Azenkot teaches dependent claims 2 and 11. Sections VI.A.2 and VI.A.6. In particular, Cooper-Azenkot's CMTS selects a modulation order (*e.g.*, 16QAM/32QAM/64QAM) based on a composite SNR for its logical channels. Section VI.B.1.c.

Accordingly, Cooper-Azenkot teaches the additional limitations of claims 2 and 11 and renders them obvious. *Id.*; Ex. 1002, ¶154.

3. Dependent Claims 7-8 and 16-17

Cooper-Azenkot teaches dependent claims 7/16 and 8/17 based on the additional teachings of Cooper as set forth above in Sections VI.A.3-4 and VI.A.7-8. Cooper's teachings of the additional limitations of these claims applies to Cooper-Azenkot for the same reasons they apply to Cooper-Cooper840. In particular, with

regard to claims 7 and 16, Cooper-Azenkot teaches a CMTS comprising a processor configured to assign CMs among a plurality of service groups based at least in part on distances between the CMTS and CMs. Ex. 1005, Abstract, [0008], [0021], [0027]-[0028], [0037]; Ex. 1002, ¶¶155-156; Sections VI.A.3, VI.A.7. In addition, with regard to claims 8 and 17, Cooper-Azenkot teaches a CMTS comprising a processor configured to assign a CM to a service group based at least in part on which of a plurality of branch amplifiers is upstream of the CM. Ex. 1005, Abstract, [0008], [0021], [0027]-[0028], [0037]; Ex. 1002, ¶¶155-156; Sections VI.A.4, VI.A.8.

Accordingly, Cooper-Azenkot renders claims 7-8 and 16-17 obvious.

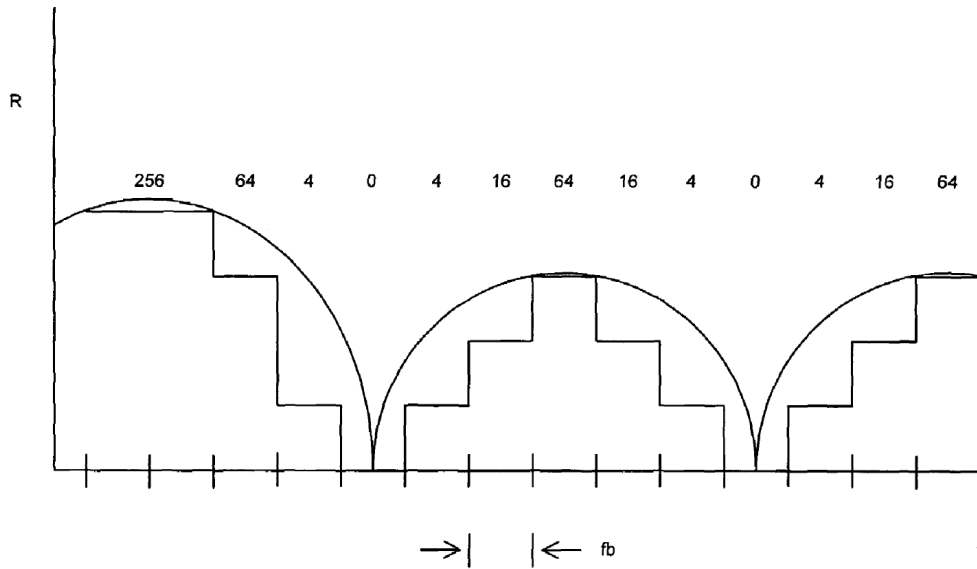
C. Grounds C-D: Claims 1-8 and 10-17 are Rendered Obvious by Cooper-Cooper840-Monk and Cooper-Azenkot-Monk

1. Dependent Claims 3 and 12

Claim 3 depends from claim 1 and requires orthogonal frequency division multiplexing (OFDM) communication. As discussed above in Sections VI.A.1.d-f and VI.B.1.b-c, Cooper-Cooper840 and Cooper-Azenkot teach that the CMTS selects physical layer communication parameters (*i.e.*, a modulation order and encoding parameters) that are used to communicate with one or more CMs in a particular service group. Use of OFDM for such communication was ubiquitously known, and, *e.g.*, Monk discloses this feature. A POSITA would have found it obvious to use OFDM in these combinations, as taught by Monk. Ex. 1002, ¶157.

Monk discloses different methods of multi-carrier communication, including OFDM, that address signal impairments that restrict high bandwidth communication with CMs 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. Specifically, Monk discloses dividing a frequency bandwidth into narrower channels or “bins” to transmit subcarriers. *Id.*, 7:14-16, 8:20-28; Ex. 1002, ¶158; *see also id.*, ¶¶58-60. 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, 10:55-67; Ex. 1002, ¶158.

For example, Monk’s Figure 10 (below) shows an OFDM waveform in which the different subcarriers that correspond to frequency bins with a bandwidth of “fb” are encoded with different QAM orders (*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. 1002, ¶159.



Ex. 1015, Fig. 10

OFDM helps networks overcome signal impairments caused by issues such as micro-reflections and impedance mismatches. Ex. 1015, 4:16-43, 6:20-27, 7:36-62. For example, OFDM allows data bits generated at a higher rate to be distributed over many subcarriers with lower data rates, reducing the potential of interference. *Id.*, 7:36-50; Ex. 1002, ¶160.

A POSITA would have been motivated to combine the OFDM communication techniques taught by Monk with Cooper-Cooper840's/Cooper-Azenkot's CMTS in order to provide more reliable communication and overcome signal impairments. Ex. 1015, 4:16-43, 6:20-27, 7:36-62; Ex. 1002, ¶161. As discussed in Sections VI.A.1.e and VI.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 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 SNR) and would still select encoding parameters. Ex. 1002, ¶161.

Such combinations represent an obvious application of a known technique (Monk's OFDM method) to a known system ready for improvement (Cooper-Cooper840's/Cooper-Azenkot's CMTS and CM system) to yield predictable results (a CMTS that uses OFDM to communicate over a plurality of subcarriers that modulate on a per-subcarrier basis). *Id.*, ¶162. Moreover, 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. *Id.*, ¶163; Ex. 1005, [0008], [0024]-[0025], [0042]; Ex. 1015, 10:22-31.

Thus, Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach the claimed use of "(OFDM) over a plurality of subcarriers for said communicating" and these combinations render claim 3 obvious. Ex. 1002, ¶¶163-164. Claim 12 is substantially similar to claim 3 except that it identifies "said network interface and said plurality of cable modems" are configured to use OFDM. Ex. 1001, 9:39-42. As discussed above in Section VI.A.5.a, Cooper's CMTS comprises the claimed

network interface that it uses to communicate with CMs, and therefore, claim 12 is rendered obvious for the same reasons discussed in this section. Ex. 1002, ¶185.

2. Dependent Claims 4 and 13

Claim 4 depends from claim 3 and requires the CMTS to select parameters on a per-OFDM-subcarrier basis. As discussed in Section VI.C.1, Cooper-Cooper840-Monk's/Cooper-Azenkot-Monk's CMTS uses OFDM wherein parameters such as a particular modulation order and other encoding parameters are selected on a per-subcarrier basis depending on a worst-case SNR profile for the CM's using that subcarrier. Ex. 1015, 7:14-16, 8:1-28, 10:55-67, Fig. 10; Ex. 1002, ¶165. Thus, Cooper-Cooper840-Monk's/Cooper-Azenkot-Monk's CMTS teaches the CMTS "selecting ... said physical layer communication parameters on a per-OFDM-subcarrier basis." Ex. 1002, ¶¶165-166.

Accordingly, claim 4 is invalid as obvious over Cooper-Cooper840-Monk and Cooper-Azenkot-Monk. *Id.* Claim 13 is substantially similar to claim 4 except that it identifies "said network interface" is configurable on a per-OFDM-subcarrier basis. Ex. 1001, 9:43-46. As discussed above in Section VI.A.5.a, Cooper's CMTS comprises the claimed network interface, and therefore, claim 13 is rendered obvious for the same reasons discussed in this section. Ex. 1002, ¶186.

3. Dependent Claims 5 and 14

Claim 5 depends from claim 4 and requires that the parameters include the selection of an OFDM subcarrier for ingoing and outgoing communications. As discussed in Sections VI.C.1-2, Cooper-Cooper840-Monk's/Cooper-Azenkot-Monk's CMTS selects "physical layer communication parameters" on a per-OFDM-subcarrier basis based on a composite SNR-related metric. *See also* Sections VI.A.1.e and VI.B.1.c. In addition, Cooper 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, [0005]-[0006], [0008], [0011], [0020]-[0021], [0027]; Ex. 1021, 1-3, 7-9; Ex. 1022, 1, 7-10; Ex. 1023, 1-3, 25-27; Ex. 1002, ¶¶167-169. This is consistent with Monk's disclosure, which also discloses different frequency bands used for upstream and downstream signals. Ex. 1015, 5:66-6:5, Fig. 4; Ex. 1002, ¶¶168-169.

And as discussed above in Sections VI.A.1.b and VI.B.1.a, 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, [0008], [0027]; Ex. 1002, ¶169. Because Cooper discloses determining separate upstream and downstream SNR metrics in different frequency bands, in the proposed combinations, the CMTS selects separate upstream and

downstream “physical layer communication parameters” on a per-OFDM-subcarrier basis based on a composite upstream or downstream SNR-related metric. Ex. 1002, ¶169. Thus, Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach the additional limitations in claim 5 and render claim 5 obvious. *Id.*, ¶170. Claim 14 is substantially similar to claim 5, and is therefore rendered obvious for the same reasons. *Id.*, ¶187.

4. Dependent Claims 6 and 15

a. [6A]

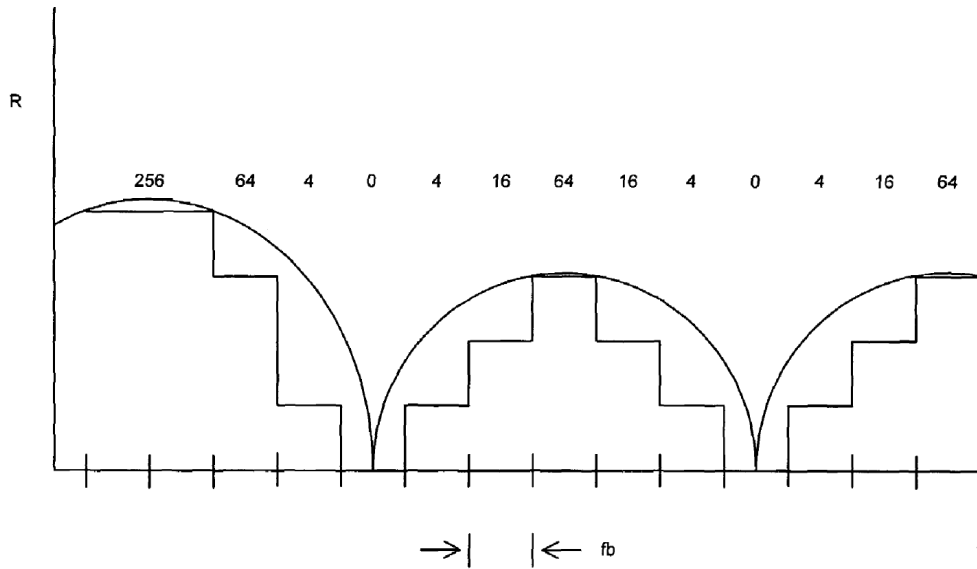
Claim 6 depends from claim 1. As shown in Sections VI.A.1.c and VI.B.1.a, Cooper (in each proposed combination) assigns cable modems into at least four different service groups or logical channels based on comparing a modem’s measured SNR-related metric to an SNR threshold. Ex. 1005, [0031]-[0033], [0041], Fig. 6. Thus, Cooper-Cooper840/Cooper-Azenkot teach at least “a first service group and a second service group.” Ex. 1002, ¶¶171-172.

And as shown in Sections VI.A.1.d and VI.B.1.b, Cooper-Cooper840/Cooper-Azenkot teach generating a composite SNR-related metric for each service group based at least in part on a worst-case SNR profile. 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. Ex. 1002, ¶173.

As discussed in Section VI.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; Ex. 1002, ¶174. 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. Ex. 1015, 7:14-16, 8:20-28, 9:28-33; Ex. 1002, ¶174; *see also id.*, ¶¶58-60. 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; Ex. 1002, ¶174.

Monk's Figure 10 (below) shows an example of a CM'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. Ex. 1002, ¶175; Ex. 1015, 10:55-67.



Ex. 1015, Fig. 10

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; Ex. 1002, ¶176. As discussed in Sections VI.A.1.e and VI.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. Ex. 1002, ¶¶176-177. 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. Ex. 1002, ¶177. 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. *Id.*

Such combinations represent an obvious application of a known technique (Monk's OFDM method that includes generating SNR versus frequency profiles for each channel for each CM) to a known system ready for improvement (Cooper-Cooper840's/Cooper-Azenkot's CMTS) to yield predictable results (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). *Id.*, ¶178. Moreover, 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. *Id.*, ¶178; Ex. 1005, [0008], [0024]-[0025], [0042]; Ex. 1015, 10:22-31.

In sum, the combinations of Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach the claimed "first composite SNR versus frequency profile" and "second composite SNR versus frequency profile" associated with their respective service group. Ex. 1002, ¶¶179-180. Further, because these combinations also teach measuring a SNR versus frequency profile for each modem, they also teach "a third cable modem has a particular SNR versus frequency profile." *Id.*

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

b. [6B]

Element [6B] requires assigning the third CM to the service group whose composite SNR profile is more similar to the SNR profile of the third CM. A POSITA would have understood from the '438 patent that [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 [1F]. Ex. 1002, ¶181; Ex. 1001, 5:44055, 8:2-23, 9:9-33.

Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach [6B]. As discussed for [6A], the proposed combinations include at least a first and second service group that each have their own composite SNR versus frequency profile based on the CM with the worst-case SNR versus frequency profile. Section VI.C.4.a. They also teach “a third cable modem has a particular SNR versus frequency profile.” *Id.* They assign 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 [6B]—because in Cooper, CMs are grouped so that CMs having similar SNR-related metrics are in the same group. Section VI.A.1.d; Ex. 1002, ¶182.

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 CM 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 CM, as discussed for [1D] and [1E]. Sections VI.A.1.d-e, VI.B.1.b-c; Ex. 1002, ¶183. Further, as highlighted in [6A], this likewise applies when using OFDM. *Id.*

Thus, a POSITA would understand that because Cooper-Cooper840-Monk and Cooper-Azenkot-Monk group CMs with similar SNR versus frequency profiles, 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. Ex. 1002, ¶184.

Indeed, under any reasonable construction, the proposed combinations teach [6B]. *Id.* For example, if the first service group has a worse composite SNR versus frequency profile than that of the second service group (*e.g.*, 17-19dB vs. 22-24dB) and the third CM has an SNR versus frequency profile of 18dB-20dB, the third CM will be assigned to the first service group. The first service group's composite SNR is more similar to the third CM than that of the second service group. *Id.*

Therefore, claim 6 is invalid as obvious over Cooper-Cooper840-Monk and Cooper-Azenkot-Monk. *Id.* Claim 15 is substantially similar to claim 6, and claim 15 is therefore rendered obvious for the same reasons. *Id.*, ¶188.

5. Claims 1-8, 10-17

As shown above in Sections VI.A.1.d and VI.B.1.b, Cooper-Cooper840/Cooper-Azenkot teach [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 VI.A.1.d, VI.B.1.b. If it is asserted that such a “worst-case SNR profile” (as recited in [1D] and [10D]) must comprise the SNR-related metric of a CM over a range of frequencies, and that such a feature is not taught by Cooper-Cooper840 or Cooper-Azenkot, 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 described above for [6A]. Section VI.C.4.a; Ex. 1002, ¶¶189-190.

In particular, as described 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 CM over a range of frequencies. Section VI.C.4.a; Ex. 1015, 10:55-67, Fig. 10; Ex. 1002, ¶191. For example, Monk’s Figure 10 shows an example of a CM’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. Ex. 1002, ¶191; Ex. 1015, 10:55-67, Fig. 10. For the reasons described above for [6A], 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; Ex. 1002, ¶192.

In addition, such combinations represent an obvious application of a known technique (Monk’s OFDM method that includes generating an SNR versus frequency profile for a CM over a range of frequencies) to a known system ready for improvement (Cooper-Cooper840’s/Cooper-Azenkot’s CMTS) to yield predictable results (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). Ex. 1002, ¶193. Moreover, applying OFDM would have been well within the capabilities of a POSITA for the reasons described above for [6A]. Section VI.C.4.a; Ex. 1002, ¶193; Ex. 1005, [0008], [0024]-[0025], [0042]; Ex. 1015, 10:22-31.

Accordingly, if it is asserted that the combinations of Cooper-Cooper840 and Cooper-Azenkot described above in Sections VI.A.1 and VI.B.1 do not teach [1D], Cooper-Cooper840-Monk and Cooper-Azenkot-Monk teach [1D] for this alternative reason. And for reasons similar to those described above for Cooper-Cooper840 and

Cooper-Azenkot, the combinations of Cooper-Cooper840-Monk and Cooper-Azenkot-Monk also teach [1A]-[1C] and [1E]-[1F] and render claim 1 obvious. Sections VI.A.1.a-c, VI.A.1.e-f, VI.B.1.a, and VI.B.1.c; Ex. 1002, ¶194.

Further, for reasons similar to those described 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 VI.A.2-8, VI.B.2-3, and VI.C.1-4; Ex. 1002, ¶195.

D. Grounds E-F: Claims 9 and 18 are Rendered Obvious By Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437

Claim 9 depends from claim 1 and requires the CMTS to (i) send a message instructing the CMs to measure a metric and report the result and (ii) receive back a message reporting the measurements. As discussed above in Sections VI.A.1.b and VI.B.1.a, Cooper-Cooper840 and Cooper-Azenkot determine an SNR-related metric for each CM served by the CMTS based on a measurement at either the CMTS or the CM. *See* Ex. 1005, [0007]-[0008], [0011]. However, these combinations do not specifically teach a probe message instructing the CMs to measure the SNR-related metric and report the measured metric back to the CMTS. Ex. 1002, ¶¶196-197. Such a probe message is taught by Monk and Cooper437. *Id.*

Monk applies 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. Higher SNR channels can support higher modulation orders through bit loading (*e.g.*, 16-

QAM/64-QAM/256-QAM), while lower SNR channels may use a different modulation scheme such as QPSK. *Id.*, 4:55-59, 8:1-10, 9:9-11, 10:58-62; Ex. 1002, ¶198. To determine the SNR of a channel, a sending node transmits a probe message having a predetermined data sequence to a receiving device, which analyzes the probe message for impairment. Ex. 1015, Abstract, 4:44-59, 9:28-41. The receiving device sends the results of the analysis back to the sending device as either raw data or a bit loading profile for the sending device to determine the transmission parameters. *Id.*, 9:41-50; Ex. 1002, ¶198.

A POSITA would have found it obvious to transmit a probe message to each of the CMs (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 (claimed “receiving a metric reporting message from each of said plurality of cable modems”) as taught by Monk in order to implement Cooper’s measurement of an SNR-related metric at each of the CMs and reporting it back to the CMTS. Ex. 1005, [0011]; Ex. 1015, 4:44-59, 8:4-5, 9:9-11, 9:26-41, 10:60-62, Abstract; Ex. 1002, ¶199. A POSITA would have further found it obvious to measure at the CMs to distribute processing requirements among multiple CMs, thus limiting processing required by the CMTS. Ex. 1002, ¶199.

Incorporating the use of Monk’s probe messages and reporting messages into Cooper-Cooper840’s/Cooper-Azenkot’s CMTS also would have been obvious

because such an implementation would have merely been a combination of prior art elements (Cooper-Cooper840's/Cooper-Azenkot's CMTS that oversees the measurement of SNR-related metrics, and the probe and reporting messages of Monk that allow for the measurement of SNR) according to known methods (programming the CMTS to send probe messages and receive reporting messages that provide an analysis of a channel's SNR) to yield predictable results (a system that uses probe messages and reporting messages to have CMs rather than a CMTS measure the SNR of a channel). *Id.*, ¶200.

Further, applying Monk's additional teachings to Cooper-Cooper840's/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 and was a well-known technique, leading to an expectation of success. *Id.*, ¶201; Ex. 1005, [0008], [0024]-[0025], [0042]; Ex. 1015, 10:22-31.

Monk's probe message does not explicitly include instructions for measuring a metric and reporting said measured metric back to the CMTS, but Cooper437 teaches this. Ex. 1002, ¶202. Cooper437 discloses a method for a CMTS to ask for and receive specific noise signal power measurements from CMs in its network. *Id.*; Ex. 1016, Abstract, 1:62-65, 3:47-50, Fig. 1. The CMTS initiates these measurements by transmitting to CMs 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 (“The request to the cable modems 100 may include a specification of the test time window for the requested power measurements by the identified cable modems 100 and may further specify the protocol of the test.”), 10:56-11:60, Figs. 1, 3-4.

After receiving the probe message, a CM performs the specified measurements, and then sends back a report of the measurements (which may be raw measured data). *Id.*, 10:56-11:28, 11:30-60; Ex. 1002, ¶203. 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, 11:30-60; Ex. 1002, ¶203.

A POSITA would have found it obvious to modify Monk’s probe message (which already initiates the measurement of channel characteristics) to identify a measurement mode and reporting mode, as taught by Cooper437, so that Cooper-Cooper840-Monk’s/Cooper-Azenkot-Monk’s CMTS can send customized probe messages to specific CMs or service groups to conduct specific testing to determine the SNR-related metric of specific service groups or at specific frequencies and report back. Ex. 1002, ¶204; 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 metrics. Ex. 1002, ¶204.

Moreover, modifying the probe message to identify a measurement mode (claimed “instructions for measuring a metric”) and a reporting mode (claimed “instructions for ... reporting said measured metric”) also would have been obvious because such a modification would have been nothing more than combining prior art elements (Cooper-Cooper840-Monk’s/Cooper-Azenkot-Monk’s probe message and Cooper437’s probe messages having measurement and reporting instructions) according to known methods (modifying the contents of probe messages) to yield predictable results (a CMTS that uses probe messages that include instructions for measurement and reporting of SNR-related metrics). *Id.*, ¶205.

Applying Cooper437’s teachings to Cooper-Cooper840-Monk’s/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, leading to an expectation of success. *Id.*, ¶¶206-207; Ex. 1005, [0008], [0020]-[0021], [0024]-[0025], [0027], [0042]; Ex. 1016, 5:3-14, 7:6-22.

Accordingly, Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437 render claim 9 obvious. Ex. 1002, ¶207. Claim 18 is substantially similar to claim 9, and is therefore rendered obvious for the same reasons. *Id.*, ¶208.

Further, for the reasons described above in Section VI.C.5, if it is asserted that the “worst-case SNR profile” recited in [1D] and [10D] must comprise the SNR-related metric of a CM over a range of frequencies, Monk discloses this feature and a POSITA would have found it obvious to modify Cooper-Cooper840 and Cooper-Azenkot to include this feature. Section VI.C.4.a; Ex. 1002, ¶209. 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. Ex. 1002, ¶209. Therefore, for this alternative reason, Cooper-Cooper840-Monk-Cooper437 and Cooper-Azenkot-Monk-Cooper437 render claims 9 and 18 obvious. *Id.*

E. Grounds G-L: Claims 1-18 are Rendered Obvious by 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

The combinations described above in Grounds A-F teach [1E] and [10E] by teaching a CMTS selecting network communication parameters (*i.e.*, modulation order and encoding parameters) for a group of modems based on a worst-case SNR-related metric for a service group of modems. Sections VI.A-D. If it is asserted that those combinations do not teach selecting multiple “physical layer communication parameters” as recited in [1E] and [10E], Currivan discloses this feature and a

POSITA would have found it obvious to further modify the combinations based on the additional teachings in Currivan. Ex. 1002, ¶¶210-222.

As described above, the CMTS in Cooper (as modified by Cooper840 and Azenkot) selects network communication parameters based on the composite SNR-related metric. Sections VI.A.1.d-e, VI.B.1.b-c. Grouping CMs by SNR optimizes system performance, which includes maximum number of network elements supported and the ease of manageability from the service provider perspective. Ex. 1005, [0039].

Currivan similarly discloses a CMTS that groups CMs. Ex. 1028, [0026], [0161], [0192], claims 1, 16. The CMTS selects a modulation order (also referred to in Currivan as modulation density) for each group based on a measured SNR. *Id.*, [0034], [0079], [0157], [0182]; Ex. 1002, ¶212. Currivan describes the relationship between SNR and the physical layer communication parameters of modulation order and transmit power. *Id.*, [0067], [0157]-[0158]. In particular, Currivan increases SNR by increasing transmit power to support a higher modulation order. *Id.*, [0020], [0151], [0157]-[0158], [0177], [0200]. Higher modulation orders have higher throughput. *Id.*, [0018], [0065], [0158], [0170], [0182]; Ex. 1002, ¶212.

In light of such teachings, 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 and increase throughput, as taught by Currivan. Ex. 1028, [0018], [0020], [0065], [0151], [0157]-[0158], [0170], [0177], [0182], [0200]; Ex. 1002, ¶213; Sections VI.A.1.d-e, VI.B.1.b-c.

Such combinations also would have been obvious because they would have merely been a combination of prior art elements (Cooper's CMTS—as modified by Cooper840 or Azenkot—and Currivan's method of increasing CM transmit power for a service group) according to known methods (programming a CMTS to instruct a CM service group to increase transmit power level) to yield predictable results (a system that supports a higher modulation order and increased throughput). Ex. 1002, ¶214. 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. *Id.*, ¶215; Ex. 1005, [0025].

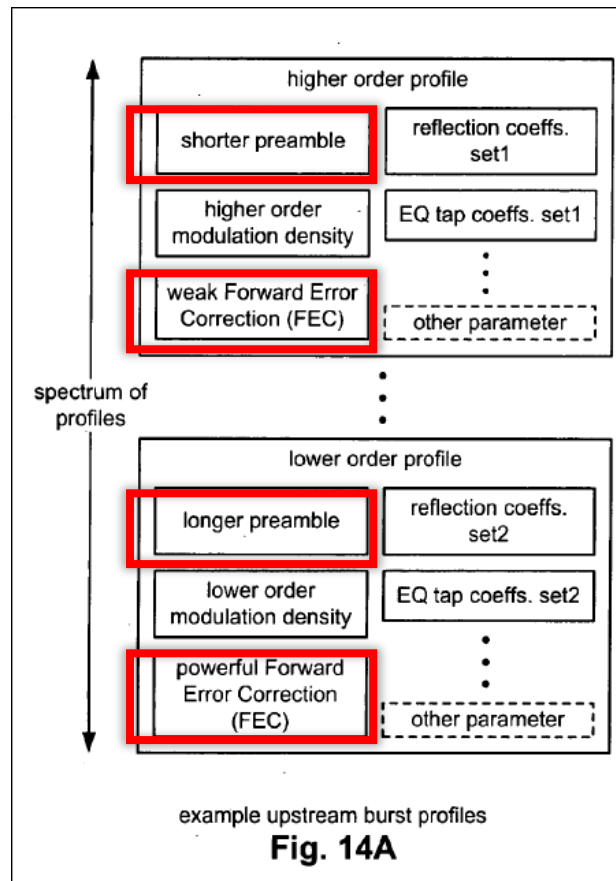
Currivan teaches another power modification procedure that includes increasing the transmit power per code word while reducing the number of codes transmitted to increase the SNR to support a higher modulation order. Ex. 1028, [0067]-[0069], [0142], [0151]-[0152], [0157], [0169], [0176]-[0177], [0182]; Ex. 1002, ¶216.

In light of such additional teachings in Currivan, 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. Ex. 1002, ¶217. Such combinations would have been obvious because they 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. *Id.*; Ex. 1005, [0039].

Such combinations also would have been obvious because they would have merely been a combination of prior art elements (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) according to known methods (programming a CMTS to instruct a CM service group to increase transmit power per code word while reducing the number of codes transmitted for a service group) to yield predictable results (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). Ex. 1002, ¶218. 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 CM service group accordingly. *Id.*

Finally, Currivan also teaches selecting the additional physical layer communication parameters of strength of forward error correction and length of preambles. Ex. 1028, [0155]-[0156], [0161]-[0162], [0175], Fig. 14A. Figure 14A (reproduced below) shows a spectrum of burst profiles that include such physical layer communication parameters. *Id.*, [0161]-[0163]; Ex. 1002, ¶219.



Ex. 1028, Fig. 14A (annotated)

The burst profiles are selected by the CMTS and assigned to CMs based on the SNR of the communication channel from the CMs to the CMTS. Ex. 1028, [0034], [0079], [0176], [0182], [0192]. The lower order profile shown in Figure

14A is used when a channel may be corrupted to ensure that communication take place. *Id.*, [0163]. As further shown in Figure 14A, the higher order profile utilizes shorter preambles and weaker FEC. *Id.*, [0161]-[0162], Fig. 14A. 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. *Id.*, [0153]-[0157], [0162]-[0163], claim 9; Ex. 1002, ¶¶219-220.

In light of such further teachings in Currivan, 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. Ex. 1002, ¶221.

Such combinations also would have been obvious because they would have merely been a combination of prior art elements (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) according to known methods (programming a CMTS to instruct a CM service group to use a preamble length and FEC strength based on a channel's SNR) to yield predictable results (a system that

optimizes the processing required and robustness of the communications in view of various SNR levels). *Id.*, ¶222. 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 CM service group accordingly. *Id.*

VII. GROUNDS FOR STANDING & FEE PAYMENT

Petitioner certifies that the ’438 patent is available for, and Petitioner is not barred or estopped from requesting, review.

The undersigned authorizes the charge of any required fees to Deposit Account No. 19-0733.

VIII. CONCLUSION

Review should be instituted and claims 1-18 canceled.

Dated: December 6, 2024

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CERTIFICATION UNDER 37 CFR §42.24(d)

Under the provisions of 37 CFR §42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for Inter Partes Review totals 13,946, which is less than the 14,000 allowed under 37 CFR § 42.24(a)(1)(i). This total includes 13,946 words as counted by the Word Count feature of Microsoft Word and 0 words used in annotations.

Pursuant to 37 C.F.R. §42.24(a)(1), this count does not include the table of contents, the table of authorities, mandatory notices under §42.8, the certificate of service, this certification of word count, the claims listing appendix, or appendix of exhibits.

BANNER & WITCOFF, LTD

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.105, I hereby certify that I caused a true and correct copy of this Petition for *Inter Partes* Review in connection with U.S. Patent No. 9,866,438 and supporting evidence to be served via FedEx Priority Overnight on December 6, 2024, on the following:

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Dated: December 6, 2024

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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 of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems.
Claim 9	

Designation	Claim Language
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 type, modulation order, forward error correction (FEC) type, and FEC code rate.
Claim 12	

Designation	Claim Language
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	
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	

Designation	Claim Language
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.