

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

Patent No. 9,866,438
Filing Date: February 16, 2017
Issue Date: January 9, 2018

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

Inter Partes Review No.: IPR2025-00184

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

Petition 2 of 3

TABLE OF CONTENTS

MANDATORY NOTICES	1
I. INTRODUCTION	4
II. SUMMARY OF ARGUMENT	4
III. OVERVIEW OF THE '438 PATENT	5
A. Brief Description	5
B. Prosecution History	6
C. Earliest Priority Date	7
IV. PRIOR ART	7
A. Prodan	7
B. Cooper840	8
C. Azenkot	9
D. Monk	10
E. Cooper	11
F. Cooper437	12
G. Jalali	12
H. Pai	13
I. Currivan	13
V. IDENTIFICATION OF CHALLENGE PURSUANT TO 37 C.F.R. §42.104(b)	14
A. Grounds on Which Claims are Challenged	14
B. 314(a) Discretion Does Not Apply	15
C. 325(d) Discretion Does Not Apply	16
D. Level of Ordinary Skill	17
E. Claim Construction	18
VI. SPECIFIC GROUNDS FOR UNPATENTABILITY	18
A. Ground A: Claims 1-2 and 6 Are Rendered Obvious By Prodan-Cooper840	18
1. Independent Claim 1	19

2.	Dependent Claim 2	31
3.	Dependent Claim 6	32
B.	Ground B: Claims 1-2 and 6 Are Rendered Obvious By Prodan-Azenkot.....	35
1.	Independent Claim 1	35
2.	Dependent Claim 2	40
3.	Dependent Claim 6	40
C.	Grounds C-D: Claims 3-5 Are Rendered Obvious By Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali	43
1.	Dependent Claim 3	43
2.	Dependent Claim 4	46
3.	Dependent Claim 5	48
D.	Grounds E-F: Claims 7-8 are Rendered Obvious by Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper.....	49
E.	Grounds G-H: Claim 9 Is Rendered Obvious by Prodan-Cooper840-Monk-Cooper437 and Prodan-Azenkot-Monk-Cooper437	52
F.	Grounds I-J: Claims 10-11 and 15 Are Rendered Obvious by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai	57
1.	Independent Claim 10	57
2.	Dependent Claim 11	61
3.	Dependent Claim 15	61
G.	Grounds K-L: Claims 12-14 Are Rendered Obvious by Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali	62
1.	Dependent Claim 12	62
2.	Dependent Claim 13	63
3.	Dependent Claim 14	63
H.	Grounds M-N: Claims 16-17 Are Rendered Obvious by Prodan-Cooper840-Pai-Cooper and Prodan-Azenkot-Pai-Cooper.....	64
I.	Grounds O-P: Claim 18 Is Rendered Obvious by Prodan-Cooper840-Pai-Monk-Cooper437 and Prodan-Azenkot-Pai-Monk-Cooper437	65

J.	Grounds Q-FF: Claims 1-18 are Rendered Obvious by Prodan-Cooper840 (claims 1-2, 6), Prodan-Azenkot (claims 1-2, 6), Prodan-Cooper840-Jalali (claims 3-5), Prodan-Azenkot-Jalali (claims 3-5), Prodan-Cooper840-Cooper (claims 7-8), Prodan-Azenkot-Cooper (claims 7-8), Prodan-Cooper840-Monk-Cooper437 (claim 9), Prodan-Azenkot-Monk-Cooper437 (claim 9), Prodan-Cooper840-Pai (claims 10-11, 15), Prodan-Azenkot-Pai (claims 10-11, 15), Prodan-Cooper840-Pai-Jalali (claims 12-14), Prodan-Azenkot-Pai-Jalali (claims 12-14), Prodan-Cooper840-Pai-Cooper (claims 16-17), Prodan-Azenkot-Pai-Cooper (claims 16-17), Prodan-Cooper840-Pai-Monk-Cooper437 (claim 18), Prodan-Azenkot-Pai-Monk-Cooper437 (claim 18), in further view of Currivan.....	66
VII.	GROUND FOR STANDING & FEE PAYMENT.....	72
VIII.	CONCLUSION.....	73
	CERTIFICATION UNDER 37 CFR §42.24(d)	74
	CERTIFICATE OF SERVICE	75
	CLAIM LISTING APPENDIX	76

EXHIBITS

Ex. 1101:	U.S. Patent No. 9,866,438 (“the ’438 patent”)
Ex. 1102:	Expert Declaration of Sayfe Kiaei
Ex. 1103:	Curriculum Vitae of Sayfe Kiaei
Ex. 1104:	Certified Prosecution History of the ’438 patent
Ex. 1105:	U.S. Pub. No. 2007/0223512 (“Cooper”)
Ex. 1106:	Reserved
Ex. 1107:	Reserved
Ex. 1108:	Reserved
Ex. 1109:	Reserved
Ex. 1110:	Reserved
Ex. 1111:	U.S. Pub. No. 2012/0269242 (“Prodan”)
Ex. 1112:	U.S. Patent No. 10,084,538 (“Nielsen”)
Ex. 1113:	U.S. Pub. No. 2013/0004179 (“Nielsen179”)
Ex. 1114:	U.S. Patent No. 6,952,454 (“Jalali”)
Ex. 1115:	U.S. Patent No. 7,573,822 (“Monk”)
Ex. 1116:	U.S. Patent No. 6,772,437 (“Cooper437”)
Ex. 1117:	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. 1118:	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. 1119: 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. 1120: U.S. Pub. No. 2010/0061235 (“Pai”)
- Ex. 1121: Data-Over-Cable Interface Specifications, Radio Frequency Interface Specification, SP-RFII01-970326
- Ex. 1122: Data-Over-Cable Service Interface Specifications, DOCSIS 1.1, Radio Frequency Interface Specification, CM-SP-RFIV1.1-C01-050907
- Ex. 1123: Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIV2.0-C02-090422
- Ex. 1124: U.S. Pub. No. 2007/0171994 (“Parker”)
- Ex. 1125: U.S. Patent No. 8,503,546 (“Ashrafi”)
- Ex. 1126: Tanenbaum, “Computer Networks,” 4th ed. (2003)
- Ex. 1127: Driscoll, “Next Generation IPTV Services and Technologies” (2008)
- Ex. 1128: U.S. Pub. No. 2005/0097617 (“Currihan”)
- Ex. 1129: U.S. Patent No. 10,135,682 (“the ’682 patent”)
- Ex. 1130: U.S. Pub. No. 2008/0291840 (“Cooper840”)
- Ex. 1131: U.S. Pub. No. 2005/0122996 (“Azenkot”)
- Ex. 1132: Reserved
- Ex. 1133: ITU-T J.222.1, *Series J: Cable Networks and Transmission of Television, Sound Programme and Other Multimedia Signals* (Jul. 2007)

Ex. 1134: “[Tentative] Claim Construction Order,” *Entropic Communications, LLC v. Comcast Corporation*, No. 2:23-cv-01050 (C.D. Cal. filed Feb. 10, 2023) and *Entropic Communications, LLC v. Cox Communications, Inc.*, No. 2-23-cv-01049 (C.D. Cal. filed Feb. 10, 2023) (collectively, “CA litigation”)

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 second 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 second 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. 1101).

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.

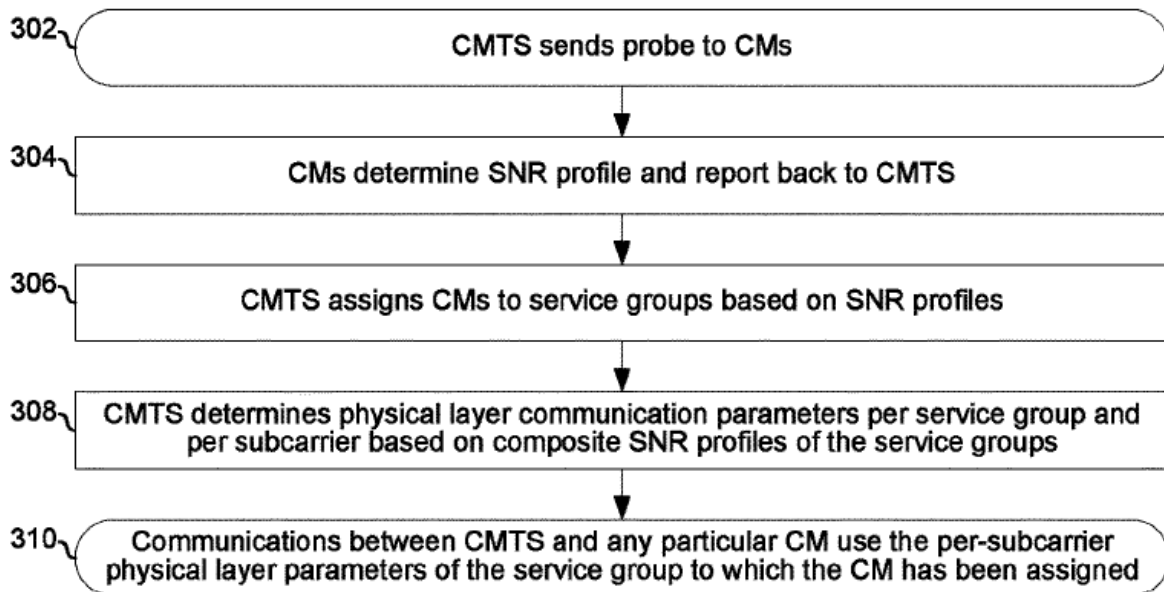
However, all of the ’438 patent claims are rendered obvious by prior art that was not considered by the Examiner, including prior art disclosing systems that determine a worst-case SNR for a group of modems and use the worst-case SNR to determine communication parameters for the modems in the group (*e.g.*, Ex. 1130).

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. 1101, 1:48-50. An exemplary process for grouping CMs is shown in Figure 3A below.



Ex. 1101, Fig. 3A

Each of a plurality of CMs determines its 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; Ex. 1102, ¶ 47.

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.*, Abstract, 4:37-53, 5:38-48. These parameters include encoding and modulation parameters, such as modulation type and modulation order. *Id.*, 4:53-64; *see also* Ex. 1102, ¶¶45-47.

B. Prosecution History

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

All of the proposed claims were rejected on the ground of nonstatutory double patenting as being unpatentable 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. 1104, 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 No. 2009/0219856 to Richardson. *Id.*, 75-93. According to the Examiner, Prodan discloses nearly all of the features of claims 1 and 10, including a CMTS that selects “physical layer communication parameters” (*i.e.*, a modulation scheme and

frequency spectrum) to be used for communicating with groups of CMs. *Id.*, 75-76, 79-81.

The Applicant responded to the rejections by filing a Terminal Disclaimer and amending both independent claims to require that the composite SNR-related metric is based “at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups.” Ex. 1104, 105, 107-108 (emphasis in original), 112. The Examiner subsequently issued a Notice of Allowance. *Id.*, 152-154; *see also* Ex. 1102, ¶¶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. Ex. 1102, ¶52. All references relied on herein are prior art to that date.

IV. PRIOR ART

A. Prodan

Prodan (Ex. 1111) is a U.S. Patent Application Publication filed on December 30, 2011 and published October 25, 2012. Prodan is prior art under pre-AIA 35 U.S.C. § 102(e). Prodan was considered during prosecution. Ex. 1101, 1-2.

Prodan, like the ’438 patent, discloses a cable TV system in which CMs are assigned to groups and all CMs within a group use a common modulation scheme. Ex. 1111, [0044], Fig. 4; Ex. 1102, ¶76. Doing so beneficially reduces power consumption. Ex. 1111, Abstract, [0007]. In particular, Prodan’s CMs may be

grouped based on SNR data—such as signal strength versus frequency profiles—measured either at the headend or at a CMTS located between the headend and the CMs. *Id.* Prodan’s CMTS assigns each of the CMs in a group a respective frequency allocation and/or modulation scheme based on the determined SNR profiles of the CMs within that group. *Id.*, [0045]; *see also* Ex. 1102, ¶¶75-76.

B. Cooper840

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

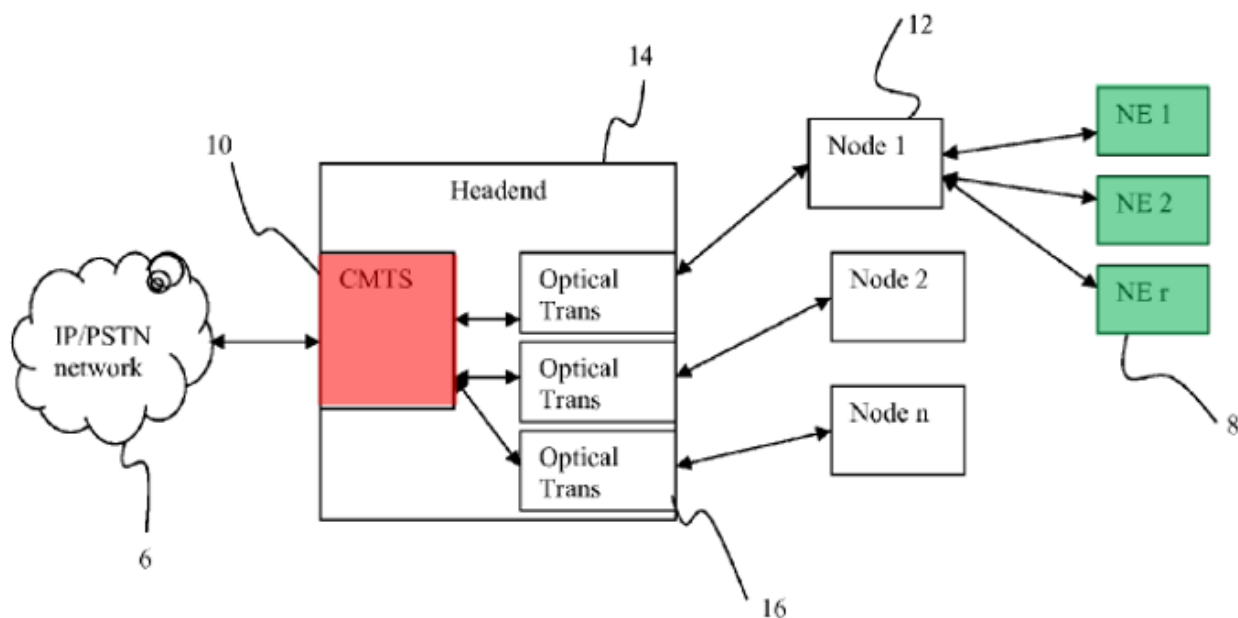


Figure 1
Ex. 1130, Fig. 1

Cooper840 discloses a network that includes a CMTS 10 (red) and multiple CMs 8 (green). Ex. 1130, [0020], Fig. 1 (reproduced above). Ex. 1102, ¶70. As

with Prodan and the '438 patent, cable modems are sorted based on SNR. Ex. 1130, [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. 1130, [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. 1102, ¶¶69-71. 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. 1130, [0006], [0028], [0032].

C. Azenkot

Azenkot (Ex. 1131) is a U.S. Patent Application Publication published June 9, 2005. Azenkot is prior art under pre-AIA 35 U.S.C. § 102(b). Ex. 1102, ¶72. Azenkot was cited during prosecution, but not applied in any rejection during prosecution. Ex. 1101, 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. 1131, [0001], [0007], [0068], [0092]-[0094]; Ex. 1102, ¶73. Specifically, Azenkot describes a process for grouping cable modems by type/modulation profile and/or throughput ability into different logical groups. Ex. 1131, Abstract, [0007]. Each logical group is

commanded to transmit upstream with a burst profile set to effectively use the throughput ability of the cable modem. *Id.* In one embodiment, Azenkot specifically teaches grouping cable modems by SNR using multiple logical channels. Ex. 1131, [0007], [0013], [0016], [0040]-[0041], [0092]. Burst profiles used for communications are 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. 1131, [0016], [0040]-[0041], [0092]-[0094]; Ex. 1102, ¶74.

D. Monk

Monk (Ex. 1115) is a U.S. Patent filed November 12, 2007 and granted on August 11, 2009. Monk is prior art under pre-AIA 35 U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 1-2; Ex. 1102, ¶81.

Monk shows that it was known to send a probe message to CMs when determining the SNR of a channel and the corresponding modulation schemes to be used with that channel. Ex. 1115, Abstract, 4:44-59, 9:28-41. In particular, a sending node transmits a probe message having a predetermined data sequence to a CM, which then analyzes the probe message for impairment at each frequency. Ex. 1115, 4:44-59, 9:28-41, Abstract. The CM then sends the results of the analysis back to the sending device, as either raw data or a bit loading profile for the sending device to modify the transmission parameters. Ex. 1115, 9:42-50; Ex. 1102, ¶82.

Like the art described above, Monk's method of communication applies different modulation schemes based on a communication channel's SNR. Ex. 1115, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11; Ex. 1102, ¶83. For example, Monk teaches that higher SNR channels can support higher modulation orders through bit loading (*e.g.*, 16-QAM, 64-QAM and 256-QAM), while lower SNR channels may use a different modulation scheme such as QPSK. *Id.*, 4:55-59, 8:1-11, 9:9-11, 10:58-62.

E. Cooper

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

Cooper shows that it was known to group CMs by location in a cable network when selecting common physical layer communication parameters for use by all CMs within the group. Ex. 1105, [0002], [0007]-[0010], [0019], [0026]-[0027], [0030]-[0033], [0039]-[0040], [0043]; Ex. 1102, ¶66. Cooper's CMTS determines the locations of CMs in a cable network and assigns the CMs to service groups based at least in part on the location of the CM (*e.g.*, its distance from the CMTS or from an upstream amplifier). Ex. 1105, Abstract, [0008], [0021], [0027]-[0028], [0037]; Ex. 1102, ¶¶65-68.

F. Cooper437

Cooper437 (Ex. 1116) is a U.S. Patent filed July 28, 1999 and granted on August 3, 2004. Cooper437 is prior art under pre-AIA U.S.C. § 102(b) and was not considered during prosecution. Ex. 1101, 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. 1116, 8:9-29, 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. 1116, 8:9-29, 8:60-9:5, 10:56-11:28, Table 1. 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.*, 10:56-11:28, Table 1; *see also* Ex. 1102, ¶¶84-86.

G. Jalali

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

Jalali discloses a method of transmitting and receiving multiple types of services (*e.g.*, video, voice) along multiple carriers using orthogonal frequency division multiplexing (OFDM). Ex. 1114, Abstract, 3:1-4, 3:29-49, 5:41-6:13, 7:66-

8:3, 25:62-26:17, Fig. 1. Jalali's communication system provides the flexibility for data to be transmitted through multiple sub-channels and/or multiple time slots, achieving both high performance and high efficiency. *Id.*, 14:20-60, 15:26-35; *see also* Ex. 1102, ¶¶77-80.

H. Pai

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

Pai shows that it was known to implement a cable network's CMTS with a processor and a network interface in order to control operations of the CMTS and to communicate with other network devices. Ex. 1120, [0179]-[0181], Abstract, [0028]-[0031], Fig. 6; Ex. 1102, ¶¶87-89.

I. Currivan

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

Currivan shows that it was known for a CMTS to segregate CMs into groups and select various physical layer communication parameters for each group. Ex. 1128, [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. 1128, [0017], [0026], [0065]-[0068], [0156]-[0157], Fig. 14A; Ex. 1102, ¶¶90-91.

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 §103.

Grounds	References	Claims Challenged
A	Prodan-Cooper840	1-2, 6
B	Prodan-Azenkot	1-2, 6
C-D	Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali	3-5
E-F	Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper	7-8
G-H	Prodan-Cooper840-Monk-Cooper437 and Prodan-Azenkot-Monk-Cooper437	9
I-J	Prodan-Cooper840-Pai and Prodan-Azenkot-Pai	10-11, 15
K-L	Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali	12-14
M-N	Prodan-Cooper840-Pai-Cooper and Prodan-Azenkot-Pai-Cooper	16-17
O-P	Prodan-Cooper840-Pai-Monk-Cooper437 and Prodan-Azenkot-Pai-Monk-Cooper437	18

Q-FF	Each of the combinations identified above in Grounds A-P, in further view of Curriuan	Claims 1-18 (as listed above in Grounds A-P)
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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. While Prodan was considered, the Prodan-Cooper840 and Prodan-Azenkot combinations were not considered, and Cooper840 and Azenkot include the worst-case SNR profile

limitation the Examiner found missing from the prior art. Exs. 1130-1131. Cooper and Cooper⁸⁴⁰ are 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 (a “POSITA”) at the time of the alleged invention would have had at least a degree in computer or electrical engineering, computer science, information systems, or a similar discipline, along with at least three-to-four years of experience with the design and/or implementation of network-based content delivery systems, such as cable systems and Internet video streaming. Ex. 1102, ¶¶38-43. Additional education may substitute for professional experience, and significant work experience may substitute for formal education. Ex. 1102, ¶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. 1102, ¶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. 1134, pp. 17-21, 25.

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

VI. SPECIFIC GROUNDS FOR UNPATENTABILITY

A. Ground A: Claims 1-2 and 6 Are Rendered Obvious By Prodan-Cooper840

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

¹ The ’438 patent suggests the term “signal-to-noise (SNR) related metric” at least includes SNR (*see* Ex. 1101, 3:52-61), but Petitioner reserves the right to argue in other proceedings that the outer bounds of this term are unclear.

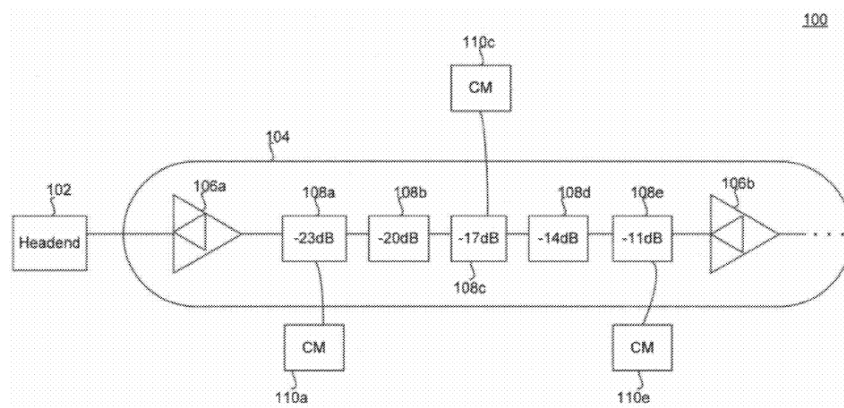
1. Independent Claim 1

a. Element [1A]

To the extent the preamble [1A]² is limiting, Prodan-Cooper840 teaches the claimed method for the reasons set forth below. Ex. 1102, ¶¶92.

b. Element [1B]

Prodan discloses Element [1B]. Ex. 1102, ¶¶93-95. As illustrated below in Figure 1, Prodan discloses a network of CMs 110a/110c/110e connected to headend 102. Ex. 1111, [0016], Fig. 1.



Ex. 1111, Fig. 1

A CMTS (claimed “cable modem termination system”) sits between the CMs and headend 102. *Id.*, [0032]. The CMTS measures the signal strength versus frequency profiles, including SNR versus frequency profiles (claimed “signal-to-noise ratio (SNR) related metric”), of connected CMs. *Id.*, [0025], [0032], [0044], claims 4-5, Fig. 4. Prodan’s CMTS also meets the tentative construction of “CMTS”

² Claim limitations are labelled in the Claims Listing Appendix.

in the CA litigation (Ex. 1134, 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. 1111, [0032], [0043]-[0044], Figs. 1 and 6; Ex. 1102, ¶93.

In particular, Prodan shows headend 102 at a point where a hybrid-fiber coaxial (HFC) network 104 that connects CMs 110a, 110c and 110e terminates. Ex. 1111, [0016]-[0017], Fig. 1. Prodan further describes a CMTS positioned between the headend 102 and the HFC 104. Ex. 1111, [0032], [0043]-[0044], claim 4; Ex. 1102, ¶93. Prodan describes the CMTS performing various processes. *Id.*, [0032], [0048], Fig 6. A POSITA would therefore have understood Prodan as disclosing a CMTS that includes hardware and accompanying software for performing the disclosed processes. Ex. 1102, ¶93. Prodan thus discloses “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.” *Id.*, ¶94.

To the extent it is asserted that Prodan does not disclose a CMTS comprising hardware and accompanying software, Cooper840 discloses this feature and a POSITA would have found it obvious to implement Prodan's CMTS to include this feature. In particular, similar to Prodan, Cooper840 discloses a network that includes a CMTS and multiple CMs that are grouped based on SNR. Ex. 1130,

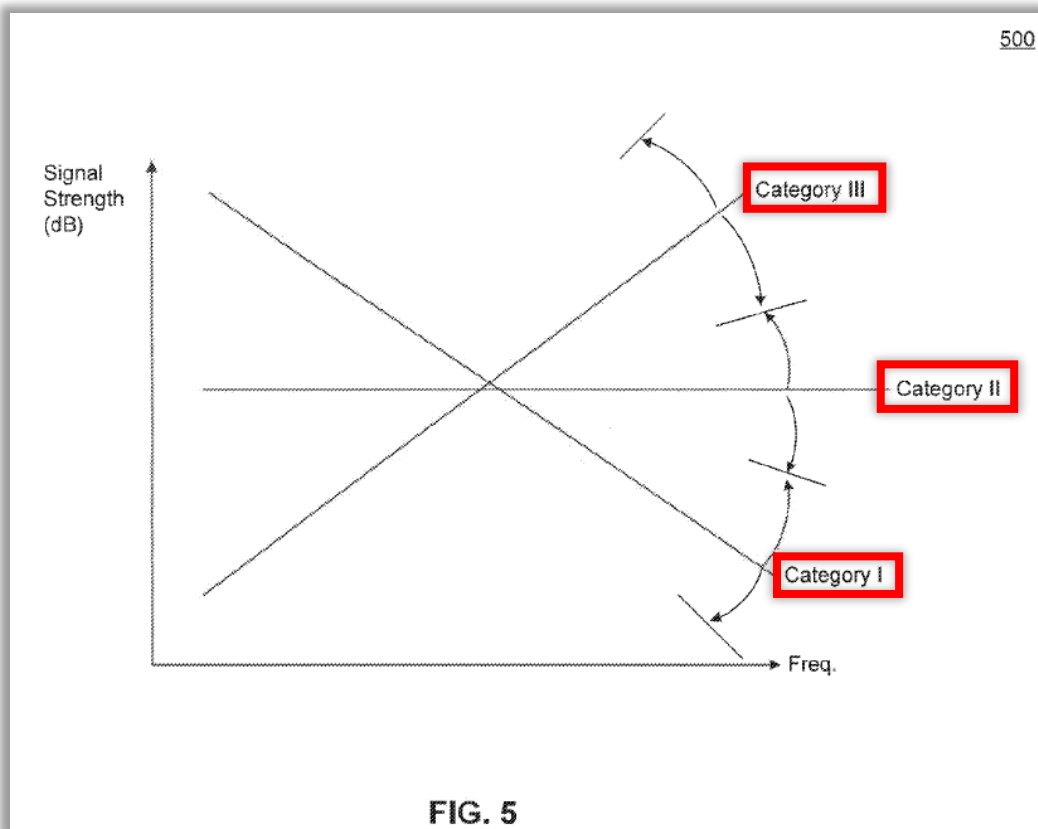
[0009]-[0011], [0020], [0028]-[0030], Fig. 1, Fig. 2, Fig. 5 (step S3). Cooper840 teaches that the CMTS comprises hardware and accompanying software. *Id.*, [0021], [0040], Fig. 2. A POSITA would have been motivated to implement Prodan's CMTS with hardware and accompanying software because it would allow for efficient modification of the processes performed by the CMTS by simply modifying the software. Ex. 1102, ¶95. Thus, it would have been obvious to implement Prodan's CMTS with hardware and accompanying software to allow for efficient modification of the processes performed by the CMTS. Ex. 1102, ¶95.

It also would have been obvious to implement Prodan's CMTS with hardware and accompanying software, as taught by Cooper840, because implementing a CMTS with hardware and accompanying software would have simply involved choosing from a finite number of identified, predictable solutions (a CMTS implemented with hardware, software, or hardware and accompanying software), with a reasonable expectation of success. Ex. 1102, ¶95.

c. Element [1C]

Prodan discloses Element [1C]. Ex. 1102, ¶¶96-100. Prodan teaches that its CMTS assigns CMs into different categories based on the CMs' SNR versus frequency profiles. Ex. 1111, [0032], [0034], [0044]-[0045], Fig. 4; Ex. 1102, ¶96. As illustrated below in Figure 5, Prodan's CMTS analyzes the signal strength versus frequency profile measured for each of the connected CMs and then assigns them to

one of three groups (*i.e.*, Category I, II, or III) based on this profile. Ex. 1111, [0032], [0034], Fig. 5. While Figure 5 refers to signal strength, Prodan discloses measuring and categorizing based on SNR versus frequency profiles, and that SNR is associated with signal strength. For instance, Prodan expressly discloses that Figure 2 (which similar to Figure 5 refers to “Signal Strength”) “shows example [SNR] versus frequency profiles of different CMs in a cable network.” *Id.*, [0025]-[0026], [0032], [0045], [0047], Fig. 2, claim 5; Ex. 1102, ¶¶96-97.



Ex. 1111, Fig. 5 (annotated)

Prodan further explains that the SNR-related information is used to allocate frequency bands and/or assign modulation schemes to the CMs. Ex. 1111, [0034],

[0045]-[0046]. Thus, the groups of CMs that result from Prodan's assignment of each CM according to its SNR-frequency profile satisfies the plain and ordinary meaning of "service group" as recited in Element [1C] and is consistent with the '438 patent's disclosure. Ex. 1102, ¶¶98-99; Ex. 1101, 2:22-25, 5:35-37, 6:19-21, 6:40-7:21, Figs. 3A-3B, 4A-4B; *see also* Ex. 1117, 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. 1101, 2:22-25 and 6:37-39); Ex. 1118, ¶¶145 (Patent Owner's expert explaining that the '682 patent defines "service group" to include "groupings of cable modems"), 146 (Patent Owner's expert explaining that "a 'service group' is a group or cluster of cable modems" with reference to Patent Owner's infringement contentions), 148 (Patent Owner's expert describing a "service group" as a "conceptual" grouping of cable modems); Ex. 1119, 6-7 (Patent Owner's infringement contentions alleging infringement based on organizing cable modems into groups).

In sum, by the CMTS assigning the CMs to the different groups based on SNR-frequency profile, Prodan discloses "assigning, by said CMTS, said plurality of cable modems among a plurality of service groups based on said plurality of SNR-related metrics." Ex. 1102, ¶¶97-100.

d. Element [1D]

As shown above for Element [1C], Prodan discloses that its CMTS assigns each CM into a service group category based on the measured SNR versus frequency profiles of the CMs. Section VI.A.1.c, *supra*. Although Prodan does not expressly disclose “generating ... a composite SNR-related metric based at least in part on a worst-case SNR profile,” a POSITA would have found it obvious to do so in view of Cooper840’s teachings. Ex. 1102, ¶¶101-110.

As described above for Element [1B], Cooper840 discloses a network that includes a CMTS and a multiple CMs. Ex. 1130, [0020], Fig. 1. Cooper840, like Prodan, groups CMs based on SNR. Ex. 1130, [0009]-[0011], [0020], [0028]-[0030], Fig. 5 (step 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. 1130, [0031], [0006], [0028], [0032]; Ex. 1102, ¶102. Cooper840 discloses that CMs can be grouped by either modulation error ratio (MER) or SNR. Ex. 1130, [0009]-[0011], [0020], [0028]-[0030], Fig. 5 (element S3); Ex. 1102, ¶102. Modulation error ratio and SNR are both ratios that consider noise and indicate signal quality and are each independently an SNR related metric. Ex. 1130, [0004]; Ex. 1102, ¶102.

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. 1130, [0005]-[0006], [0031]-[0032]; Ex. 1102, ¶102.

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 the process used by Prodan’s CMTS to assign each CM into different categories, thus ensuring that all of the CM’s can pass data on the channel. Ex. 1130, [0005]-[0006], [0032]; Ex. 1102, ¶103. This is fully consistent with and supportive of Prodan’s teaching that its CMTS may optimize modulation schemes, which would include a modulation order, according to a “minimum required SNR.” Ex. 1111, [0028]-[0029], [0034], [0039], [0047], Fig. 5; Ex. 1113, [0051]; Ex. 1102, ¶103.

In addition, Prodan explains that its process of the CMTS grouping CMs into service group categories “address[es] the problem of allocation of frequency bands to [cable modems] in a cable network as an optimization problem having known fixed constraints (*e.g.*, maximum cable modem transmit power, minimum required

signal strength at headend, etc.) and an objective function (*e.g.*, overall power utilization in the network, variance in signal strength among CMs at the headend, etc.) to minimize/maximize.” Ex. 1111, [0029]. Prodan further explains that its process “makes optimizing frequency allocation more tractable as an optimization problem and more manageable by a flow scheduler.” Ex. 1111, [0034].

Applying Cooper840’s teachings as set forth above furthers these goals of Prodan. In particular, a POSITA, equipped with Cooper840’s teachings of determining the lowest SNR or MER of a CM in a service group in order to select modulation parameters for the service group, would have recognized that configuring Prodan’s modulation schemes based on the worst-case SNR or MER determined for each of Prodan’s cable modem service group categories would have furthered Prodan’s goals of optimizing “one or more performance parameters (*e.g.*, power utilization, SNR levels, transmit powers, throughput network load, etc.)” in a cable modem network. Ex. 1111, [0028], [0039], [0047]; Ex. 1102, ¶¶104-105.

Such a combination also would have been obvious because it combines prior art elements (Prodan’s CMTS that applies frequency allocation and modulation order parameters to CMs that are grouped based on their SNR characteristics, and Cooper840’s teaching of determining the lowest MER or SNR 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 metric for a CM service group that is based on the measured individual SNRs of the CMs in that group). Ex. 1102, ¶¶106-107.

The proposed combination also 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 (Prodan's system that that applies frequency allocation and modulation order parameters to CMs that are grouped based on a comparison of their SNR characteristics) to yield predictable results (an improved system that furthers Prodan's goals of optimizing "one or more performance parameters (*e.g.*, power utilization, SNR levels, transmit powers, throughput network load, etc.)" in a cable modem network and ensures that each CM in a service group can pass data). Ex. 1102, ¶107. Moreover, Applying Cooper840's teachings to Prodan's CMTS would have been well within the capabilities of a POSITA because it would have involved only straightforward modifications to the programming of Prodan's CMTS. *Id.*, ¶107; Ex. 1111, [0047].

Prodan's CMTS (as modified by Cooper840) therefore teaches the claimed "generating ... for each one of said plurality of service groups, a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics corresponding to said one of said plurality of service groups." Ex. 1102, ¶108. The use by Prodan-Cooper840 of the lowest SNR or MER within a cable

modem group to select the physical layer parameters for that group is a “composite” SNR-related metric because it is applied to all of the cable modems within a service group. *Id.*, ¶108.

Finally, Prodan-Cooper840’s teaching of the claimed “composite SNR-related metric based at least in part on a worst-case SNR profile of said plurality of SNR-related metrics” is consistent with what the ’438 patent discloses for the claimed “composite SNR-related metric.” Ex. 1102, ¶108. 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. 1101, 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. Ex. 1101, 5:38-44.

Prodan-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. 1129, “the ’682 patent”) that issued from a continuation of the ’438 patent. *See* Ex. 1117, 53-55 (citing disclosure in the ’682 patent at 4:9-20, 5:7-12, 5:42-57, Fig. 2C, which corresponds to identical disclosure in the ’438 patent at 4:7-17, 5:4-9, 5:40-55, Fig. 2C); *see also id.*, 54 (noting Patent Owner’s position that “‘composite’ means that something is **for** more than one cable modem” and that a POSITA “would understand that the term ‘composite SNR-related metric’ **relates**

to multiple cable modems”) (emphasis added); Ex. 1118, ¶187 (Patent Owner’s expert explaining that the ’682 patent’s “specification describes that examples of a ‘worst-case SNR profile’ is the SNR profile related to a cable modem or group of cable modems, indicating their worst-case performance metrics” and citing the ’682 patent at 4:9-20, 5:7-12); Ex. 1119, 8-10 (Patent Owner’s infringement contentions alleging infringement of the claimed “composite SNR-related metric” based on a “worst case noise that is expected on” upstream and downstream channels); Ex. 1102, ¶¶109-110.

Therefore, Prodan-Cooper840 teaches Element [1D].

e. Element [1E]

Prodan-Cooper840 teaches Element [1E]. Ex. 1102, ¶¶111-116. As shown above for Element [1D], Prodan-Cooper840’s CMTS generates a composite SNR versus frequency profile for each service group based on the worst-case SNR profile of the service group. Section VI.A.1.d, *supra*. As also discussed, Prodan-Cooper840’s CMTS assigns/selects a “frequency allocation scheme” and a “modulation scheme” (which a POSITA would recognize includes a modulation order) for each service group based on the composite SNR profile. Ex. 1111, [0034], [0044]-[0045], [0047], Fig. 4; Ex. 1130, [0028], [0032]; Ex. 1113, [0051]; Ex. 1102, ¶¶113-116; Section VI.A.1.d, *supra*.

The “modulation scheme” (*e.g.*, modulation order) and “frequency allocation scheme” parameters thus 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. 1102, ¶112; *see also* Ex. 1104, 76; Section VI.A.1.d, *supra*. Such teachings in Prodan (as modified by Cooper840) are similar to the ’438 patent’s disclosure for this limitation. Ex. 1102, ¶112. For example, the ’438 patent explains that “physical layer communication parameters” encompasses numerous parameters, including “modulation type,” “modulation order,” “modulation parameters” and “timeslot duration.” Ex. 1101, Abstract, 4:53-64, claims 2, 5. Indeed, during prosecution the Examiner found that Prodan’s “modulation scheme” and “frequency spectrum”/“frequency allocation scheme” parameters were “physical layer communication parameters” as described in the ’438 patent (and Applicant did not specifically dispute this finding). Ex. 1104, 76, 128-130. The Examiner’s finding is consistent with a POSITA’s understanding that Prodan’s “modulation scheme” and “frequency allocation scheme” parameters were examples of “physical layer communication parameters” as described in the ’438 patent. Ex. 1102, ¶112; Ex. 1111, [0034], [0044]-[0045], [0047], Fig. 4.

Accordingly, Prodan-Cooper840 teaches “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”. Ex. 1102, ¶¶113-116.

f. Element [1F]

As shown above for Element [1E], Prodan-Cooper840’s CMTS selects and assigns frequency allocations and a modulation scheme that is used to communicate with each group of CMs, based on a composite SNR versus frequency profile. Section VI.A.1.e, *supra*. Prodan-Cooper840 uses the selected frequency allocation and modulation schemes for communication. Ex. 1111, [0017]-[0019], [0041], [0045]. This communication is consistent with the ’438 patent’s disclosure for the communicating step of Element [1F], which encompasses either or both upstream and downstream communications. Ex. 1101, claims 4-5; Ex. 1102, ¶¶117-119.

Thus, Prodan-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.” Ex. 1102, ¶¶118-120. Prodan-Cooper840 therefore renders claim 1 obvious. Ex. 1102, ¶121.

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.” Ex. 1101, 8:23-27.

As shown above for Element [1E], Prodan-Cooper840’s CMTS selects a modulation scheme, which includes a modulation order, for each CM service group category. Section VI.A.1.e; Ex. 1102, ¶122. Therefore, claim 2 is invalid as obvious over Prodan-Cooper840. Ex. 1102, ¶122.

3. Dependent Claim 6

a. Element [6A]

Claim 6 depends from claim 1. As shown above for Element [1C], Prodan assigns CMs into at least three different service group categories based on the CM’s SNR versus frequency profile. Ex. 1111, [0034], [0044], Fig. 5; Section VI.A.1.c, *supra*. Thus, Prodan teaches at least “a first service group and a second service group.” Ex. 1102, ¶124. And as shown above for Element [1D], Prodan-Cooper840 teaches generating a composite SNR profile for each CM service group based on the worst-case SNR profile of the service group (claimed “first service group [having] a first composite SNR versus frequency profile, said second service group [having] a second composite SNR versus frequency profile.”). Section VI.A.1.d; Ex. 1102, ¶124.

As also shown above, Prodan discloses measuring each individual CM's SNR versus frequency profiles, thus disclosing "a third cable modem [with] a particular SNR versus frequency profile." Ex. 1102, ¶¶123-125; Section VI.A.1.b, *supra*.

b. Element [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. 1102, ¶126; Ex. 1101, 5:44-55, 8:2-23, 9:9-33.

Prodan-Cooper840 teaches element [6B]. As discussed above for Element [6A], Prodan-Cooper840 teaches at least a first and second CM service group having respective composite SNR versus frequency profiles. Section VI.A.3.a, *supra*. Prodan-Cooper840 also teaches "a third cable modem has a particular SNR versus frequency profile." *Id.* In addition, Prodan-Cooper840 teaches assigning the third CM to a service group having a composite SNR versus frequency profile most similar to the particular SNR versus frequency profile of the third CM—as required by Element [6B]—because when a new CM connects to the network in Prodan, the CMTS measures its SNR versus frequency profile and assigns the new CM to the

service group with the closest composite SNR versus frequency profile in order to achieve Prodan's goal of optimizing network resources. Ex. 1102, ¶126; Ex. 1111, [0028]-[0031], [0034], [0038]-[0039], [0041], [0044]-[0047], Figs. 4, 5.

Specifically, Prodan-Cooper840 groups modems with similar SNR versus frequency profiles into service groups and selects communication parameters for each service group based on the worst-case SNR-related profile of a CM in a service group so that the CMTS can communicate with each CM, as discussed for elements [1D] and [1E]. Sections VI.A.1.d-e; Ex. 1102, ¶127.

Thus, a POSITA would understand that because Prodan-Cooper840 groups CMs with similar SNR versus frequency profiles, Prodan-Cooper840 would also assign a third cable modem to a service group that has the most similar SNR versus frequency profile while still allowing communication with the CMTS. Ex. 1102, ¶127.

Indeed, under any reasonable construction, Prodan-Cooper840 teaches element [6B]. Ex. 1102, ¶127. For example, if the first service group has a worse composite SNR versus frequency profile than that of the second service group, and the third CM has an SNR versus frequency profile between the profiles of the first service group and the second service group, the third CM will be assigned to the first service group. The first service group's composite SNR is more similar to the third CM than that of the second service group. Ex. 1102, ¶127.

Accordingly, Prodan-Cooper⁸⁴⁰ teaches Element [6B], and claim 6 is therefore invalid as obvious over Prodan-Cooper⁸⁴⁰. Ex. 1102, ¶128.

B. Ground B: Claims 1-2 and 6 Are Rendered Obvious By Prodan-Azenkot

1. Independent Claim 1

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

For the reasons described in Sections VI.A.1.a-c, Prodan discloses Elements [1A]-[1C]. *Id.*, ¶129; Sections VI.A.1.a-c, *supra*.

To the extent it is asserted that Prodan does not disclose a CMTS comprising hardware and accompanying software, Azenkot discloses this feature and a POSITA would have found it obvious to implement Prodan to include this feature. In particular, Azenkot teaches a system that includes a CMTS and multiple CMs that are grouped by SNR using multiple logical channels. Ex. 1131, [0007], [0013], [0016], [0040]-[0041], [0092]. Azenkot teaches that the CMTS comprises hardware and accompanying software. Ex. 1131, [0150] (referencing hardware controlled by control logic), Fig. 6. A POSITA would have been motivated to implement Prodan's CMTS with hardware and accompanying software because it would allow for efficient modification of the processes performed by the CMTS by simply modifying the software. Ex. 1102, ¶129. Thus, it would have been obvious to implement Prodan's CMTS with hardware and accompanying software to allow for efficient modification of the processes performed by the CMTS. *Id.*

It also would have been obvious to implement Prodan's CMTS with hardware and accompanying software, as taught by Azenkot, because implementing a CMTS with hardware and accompanying software would have simply involved choosing from a finite number of identified, predictable solutions (a CMTS implemented with hardware, software, or hardware and accompanying software), with a reasonable expectation of success. *Id.*

b. Element [1D]

As discussed above in Section VI.A.1.c, Prodan discloses that its CMTS assigns each of the CMs into a service group category based on the respective SNR versus frequency profiles of the CMs. Although Prodan does not explicitly teach determining a "worst case" SNR for such groups of CMs, a POSITA would have found it obvious to do so in view of Azenkot's teachings. Ex. 1102, ¶130.

As described above for Element [1B], Azenkot teaches grouping cable modems by SNR using multiple logical channels. Ex. 1131, [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. 1131, [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. 1102, ¶131. 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. 1131, [0010], [0068], [0092]-[0093], [0111]; Ex. 1102, ¶131.

Azenkot additionally teaches setting a burst profile that all CMs within a group must use that (i) is tailored to the throughput abilities of the modems in a group, and (ii) is based on the “least capable cable modem” in the group (thereby allowing for communications with the least capable CM). Ex. 1131, [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. 1102, ¶132. 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. 1102, ¶132. 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. 1102, ¶132. In Azenkot, the burst profile includes modulation order (QPSK, 64 QAM, 128 QAM, etc.). Ex. 1131, [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 Prodan's selection of physical layer communication parameters (*e.g.*, a frequency allocation scheme and a modulation scheme) so that optimal physical layer communication parameters can be selected for each group that allow for communications with all CMs in the group. Ex. 1102, ¶133.

Such a combination also would have been obvious because it would have merely been a combination of prior art elements (Prodan's CMTS that applies frequency allocation and modulation parameters to CMs that are grouped based on their SNR characteristics, 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 metric for a CM service group that is based on the individual SNRs of the CMs in that group and that is used to select a frequency allocation scheme and a modulation scheme to communicate with the CM service group). Ex. 1102, ¶134.

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 (Prodan'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 with optimal physical layer communication parameters selected that allow for communications with all CMs in the group). Ex. 1102, ¶135.

Further, a POSITA would have a reasonable expectation of success applying Azenkot's teachings to Prodan's CMTS as it would have involved only straightforward modifications to the programming of Prodan's CMTS, which would have been well within the capabilities of a POSITA. Ex. 1102, ¶135. Accordingly, Prodan-Azenkot teaches the claimed "generating ... a composite SNR-related metric based at least in part on a worst-case SNR profile of said SNR-related metrics." Ex. 1102, ¶¶130-136; Ex. 1101, 4:1-64, 5:4-18; Ex. 1117, 53-55; Ex. 1118, ¶187; Ex. 1119, 8-10.

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

For reasons similar to those described above for Prodan-Cooper⁸⁴⁰, Prodan-Azenkot teaches Elements [1E]-[1F]. In particular, Prodan-Azenkot's CMTS would have similarly selected frequency allocation schemes and modulation schemes based on the worst-case SNR metrics determined for the groups of CMs assigned to service group categories to ensure communication with all modems in the group while also optimizing the network. Ex. 1102, ¶137; *see* Section VI.A.1.e, *supra*.

Prodan-Azenkot's CMTS also would have communicated with the connected CMs using the selected frequency allocation schemes and modulation schemes. Ex. 1111, [0045]-[0047]; Ex. 1102, ¶138; *see* Section VI.A.1.f, *supra*.

Prodan-Azenkot therefore renders claim 1 obvious. Ex. 1102, ¶138.

2. Dependent Claim 2

For reasons similar to those described above for Prodan-Cooper840, Prodan-Azenkot teaches dependent claim 2. Section VI.A.2, *supra*. In particular, Prodan-Azenkot's CMTS selects a modulation scheme, which includes a modulation order, for each CM service group category. Ex. 1111, [0045], Fig. 4; Ex. 1113, [0051]; *see also* Sections VI.A.1.e, VI.A.2, VI.B.1.b-c, *supra*. Therefore, Prodan-Azenkot renders claim 2 invalid. Ex. 1102, ¶139.

3. Dependent Claim 6

a. Element [6A]

As shown above, Prodan assigns CMs into at least three different service group categories based on comparing the CM's SNR versus frequency profile to a threshold. Ex. 1111, [0034], [0044], Fig. 5; Sections VI.A.1.c, VI.B.1.a, *supra*. Thus, Prodan teaches at least "a first service group and a second service group" and a "third cable modem [with] a particular SNR versus frequency profile." Ex. 1102, ¶¶140-142. And as shown above in Section VI.B.1.b, Prodan-Azenkot teaches generating a composite SNR profile for each CM service group based on the worst-case SNR profile of the service group (claimed "first service group [having] a first

composite SNR versus frequency profile, said second service group [having] a second composite SNR versus frequency profile.”). Section VI.B.1.b, *supra*. Accordingly, Prodan-Azenkot teaches Element [6A]. Ex. 1102, ¶¶140-142.

b. Element [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. 1102, ¶143; Ex. 1101, 5:44-55, 8:2-23, 9:9-33.

Prodan-Azenkot teaches element [6B]. As discussed above for Element [6A], Prodan-Azenkot teaches at least a first and second CM 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.B.3.a, *supra*. Prodan-Azenkot also teaches “a third cable modem has a particular SNR versus frequency profile.” *Id*. In addition, Prodan-Azenkot teaches assigning the third CM to a service group having a composite SNR versus frequency profile more similar to the particular SNR versus frequency profile of the third CM—as required by Element [6B]—because when a new CM connects to the network in Prodan, the CMTS measures its SNR versus

frequency profile and assigns the new CM to the service group with the closest composite SNR versus frequency profile in order to achieve Prodan's goal of optimizing network resources. Ex. 1102, ¶143; Ex. 1111, [0028]-[0031], [0034], [0038]-[0039], [0041], [0044]-[0047], Figs. 4-5.

Specifically, Prodan-Azenkot groups modems with similar SNR versus frequency profiles into service groups and selects communication parameters for each service group based on the worst-case SNR-related profile of a CM in a service group so that the CMTS can communicate with each CM, as discussed for elements [1D] and [1E]. Sections VI.A.1.d-e, V.B.1.b-c; Ex. 1102, ¶144.

Thus, a POSITA would understand that because Prodan-Azenkot groups CMs with similar SNR versus frequency profiles, Prodan-Azenkot would also assign a third cable modem to a service group that has the most similar SNR versus frequency profile while still allowing communication with the CMTS. Ex. 1102, ¶144.

Indeed, under any reasonable construction, Prodan-Azenkot teaches element [6B]. *Id.* For example, if the first service group has a worse composite SNR versus frequency profile than that of the second service group, and the third CM has an SNR versus frequency profile between the profiles of the first service group and the second service group, the third CM will be assigned to the first service group. The first service group's composite SNR is more similar to the third CM than that of the second service group. *Id.*

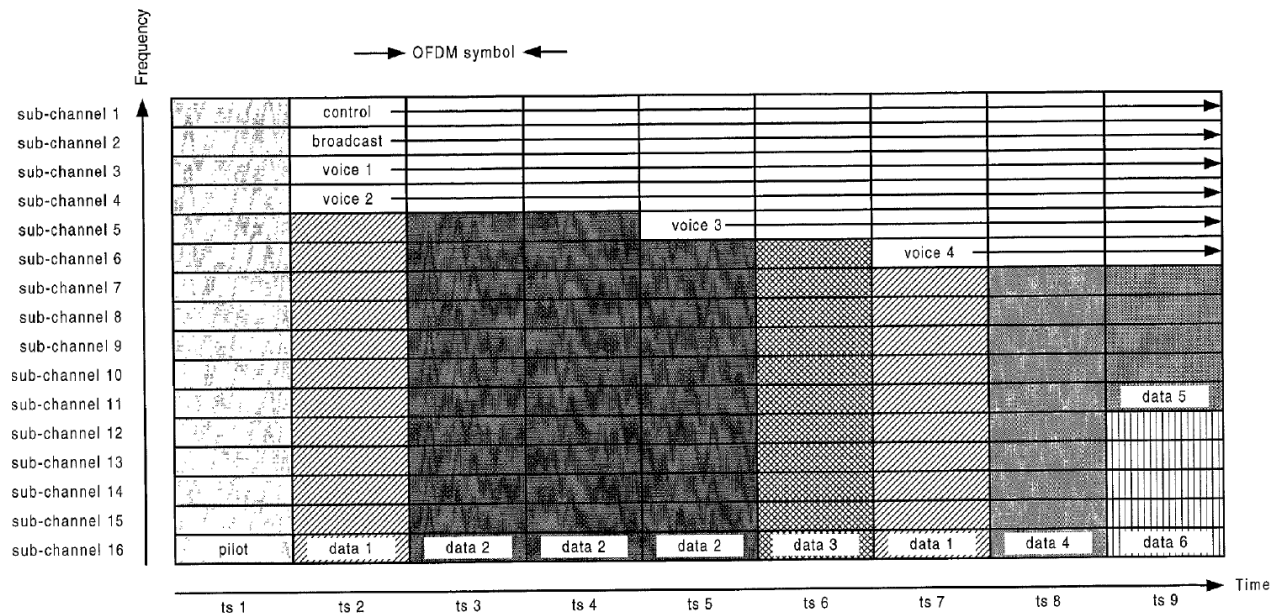
Accordingly, Prodan-Azenkot teaches Element [6B], and claim 6 is therefore invalid as obvious over Prodan-Azenkot. *Id.*, ¶144.

C. Grounds C-D: Claims 3-5 Are Rendered Obvious By Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali

1. Dependent Claim 3

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, Prodan-Cooper840 and Prodan-Azenkot teach a CMTS selecting physical layer communication parameters to communicate with one or more CMs. While Prodan-Cooper840 and Prodan-Azenkot do not teach communicating using OFDM over a plurality of subcarriers, Jalali does. Ex. 1102, ¶145.

Jalali discloses a method of transmitting and receiving multiple types of services along multiple carriers using OFDM. Ex. 1114, Abstract, 3:1-4, 3:29-49, 5:41-6:13, 25:62-26:17, Fig. 1. For example, Jalali's Figure 2 (below) shows a diagram of a transmission channel where the x-axis is time and the y-axis is frequency (divided into 16 sub-channels). *Id.*, 13:49-58; Ex. 1102, ¶146.



Ex. 1114, Fig. 2

Figure 2 also shows data transmission that is partitioned into nine different timeslots, which correspond to the duration of the OFDM modulation symbol. Ex. 1114, 13:58-63. The first timeslot is used for pilot data (*e.g.*, data to help synchronize with receivers and perform channel estimation), while during the other timeslots the subcarriers transmit other various types of data. *Id.*, 13:64-14:49; Ex. 1102, ¶147. As shown, Jalali’s communication system flexibly transmits data through multiple sub-channels, achieving both high performance and high efficiency. Ex. 1114, 14:20-60, 15:26-35; Ex. 1102, ¶147.

Jalali also discloses that “[f]lexibility, performance, and efficiency are further achieved by allowing for independence among the modulation symbols ... [to] be generated from a modulation scheme (*e.g.*, M-PSK, M-QAM, and others) that results in the best use of the resource at that particular time, frequency, and space.” Ex.

1114, 15:36-42, 11:51-12:9, 17:21-34, 22:19-24, 23:54-65, 32:34-44. Also, “each ... sub-channel may be restricted to a particular modulation scheme (*e.g.*, M-PSK, M-QAM) for the duration of the transmission or until such time as a new modulation scheme is assigned.” *Id.*, 15:54-61, 12:45-48. Thus, Jalali teaches communicating data over a plurality of sub-carriers using OFDM, wherein each sub-carrier has a modulation scheme that is independently chosen. Ex. 1102, ¶148.

A POSITA would have been motivated to combine the OFDM communication techniques taught by Jalali with Prodan-Cooper840’s/Prodan-Azenkot’s CMTS to provide increased flexibility, performance, and efficiency in transmitting multiple types of services. *Id.*, ¶149; Ex. 1114, 15:36-42. As discussed in Sections VI.A.1.e and VI.B.1.c, Prodan-Cooper840’s/Prodan-Azenkot’s CMTS assigns service groups of CMs to channels and selects different modulation schemes for those channels based on a composite worst-case SNR. Jalali’s OFDM communication technique allows an increase in capacity by dividing the available bandwidth into subcarriers, while still selecting similar modulation schemes (*e.g.*, QAM) for each subcarrier. Ex. 1102, ¶149. Thus, utilizing OFDM would allow Prodan-Cooper840’s/Prodan-Azenkot’s CMTS to communicate with CMs more efficiently and reliably using selected modulation schemes for each subcarrier. *Id.*

Such combinations also would have been obvious because they would have been nothing more than application of a known technique (Jalali’s OFDM method)

to a known system ready for improvement (Prodan-Cooper840's/Prodan-Azenkot's CMTS and CM system) to yield predictable results (a CMTS that uses OFDM to communicate over a plurality of subcarriers that also use different modulation schemes). *Id.*, ¶150.

Moreover, applying Jalali's teachings to Prodan-Cooper840's/Prodan-Azenkot's CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the CMTS. *Id.*, ¶151. A POSITA would have had a reasonable expectation of success in these programming modifications because OFDM methods, such as the one in Jalali, were widely used and would have been routine to implement in a CMTS, including the CMTS in Prodan-Cooper840/Prodan-Azenkot. *Id.*; Ex. 1111, [0032], [0044], [0048]; Ex. 1114, 33:44-49. Thus, Prodan-Cooper840's/Prodan-Azenkot's CMTS as modified by Jalali teaches the claimed use of "[OFDM] over a plurality of subcarriers for said communicating." Ex. 1102, ¶151.

Therefore, claim 3 is invalid as obvious over Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali. *Id.*, ¶152.

2. Dependent Claim 4

Claim 4 depends from claim 3 and requires the CMTS to select parameters on a per-OFDM-subcarrier basis. As discussed above in Sections VI.A.1.e and VI.B.1.c, Prodan-Cooper840's/Prodan-Azenkot's CMTS selects physical layer

communication parameters for different service groups. As modified by Jalali, this selection process by the CMTS happens on a per-OFDM-subcarrier basis. Ex. 1102, ¶153.

And as discussed above in Section VI.C.1, Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS uses OFDM where each sub-carrier has a particular modulation scheme (*e.g.*, M-PSK, M-QAM). This improves "[f]lexibility, performance, and efficiency." Ex. 1114, 15:36-42. Jalali also discloses encoding that includes error correction coding performed on a per channel or a partial channel basis. *Id.*, 16:35-58; Ex. 1102, ¶¶154-155.

A POSITA would have been motivated to further configure the CMTS in Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali to select physical layer communication parameters on a per-OFDM-subcarrier basis to optimize the best use of the resource at that particular time, frequency, and space as Jalali teaches doing on a per channel basis to make best use of the resource at that particular time, frequency, and space. Ex. 1102, ¶155.

Such combinations also would have been obvious because they would have been nothing more than combining prior art elements (Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS and Jalali's method of assigning communication parameters on a per channel basis) according to known methods (programming a CMTS) to yield predictable results (a CMTS that uses OFDM to

communicate over a plurality of subcarriers and selects physical layer communications parameters on a per-OFDM-subcarrier basis to optimize the best use of the resource at that particular time, frequency, and space). *Id.*, ¶¶156-157.

Moreover, applying Jalali's additional teachings to Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS would have been well within the capabilities of a POSITA as it would have only required minor modifications to the programming of the CMTS. *Id.*, ¶158. A POSITA would have had a reasonable expectation of success in these programming modifications as Jalali's method is implemented with basic electronic circuits, which a POSITA would recognize would be included in Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS. *Id.*; Ex. 1111, [0032], [0044], [0048]; Ex. 1114, 33:44-49.

Thus, Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS teaches claim 4. Ex. 1102, ¶¶158-159. Claim 4 is therefore invalid as obvious over Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali. *Id.*

3. Dependent Claim 5

As discussed in Section VI.C.2, Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS selects "physical layer communication parameters" on a per-OFDM-subcarrier basis based on a composite SNR-related metric. Ex. 1102, ¶160.

In addition, Prodan discloses the use of DOCSIS modems (which transmit and receive in different designated frequency bands) that determine which frequencies

of OFDM subcarriers are used for communication between equipment. Ex. 1111, [0019]; Ex. 1121, 17-19, 23-25; Ex. 1122, 15, 18, 21-24; Ex. 1123, 19, 21, 43, 45-46; Ex. 1102, ¶161. Prodan also acknowledges different requirements in addition to the different frequency bands used in upstream versus downstream communications. Section VI.A.1.f, *supra*; Ex. 1111, [0005], [0017]-[0019], [0023]; Ex. 1102, ¶161.

Because Prodan discloses using different frequency bands for upstream and downstream communication, Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS teaches selecting separate upstream and downstream "physical layer communication parameters" on a per-OFDM-subcarrier basis based on specific frequency bands and a composite upstream or downstream SNR-related metric. Ex. 1102, ¶162. Thus, Prodan-Cooper840-Jalali's/Prodan-Azenkot-Jalali's CMTS teaches claim 5. *Id.*, ¶¶162-163.

Therefore, claim 5 is invalid as obvious over Prodan-Cooper840-Jalali and Prodan-Azenkot-Jalali. *Id.*

D. Grounds E-F: Claims 7-8 are Rendered Obvious by Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper

Claims 7 and 8 depend from claim 1. Claim 7 further requires "assigning said plurality of cable modems ... based on distances between said CMTS and said plurality of cable modems." Claim 8 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 in Sections VI.A.1.c and VI.B.1.a, Prodan's process analyzes the SNR versus frequency profile measured for each of the CMs connected to the CMTS and then uses it to assign each CM to a service group. While Prodan acknowledges that the SNR profile of each CM is impacted by its location in a cable network (*e.g.*, distance from an amplifier), Prodan does not teach assigning each CM to a group based on its location in the network (*e.g.*, its distance from the CMTS or from an upstream amplifier). Ex. 1111, [0027]. Cooper does. Ex. 1102, ¶¶164-165.

Cooper, like Prodan, discloses a CMTS that assigns CMs to service groups based on their SNRs, with each service group being assigned to a logical channel. The communication parameters for each channel are selected so as to increase overall network through-put by optimizing physical layer configuration parameters to each CM grouping. Ex. 1105, [0002]-[0003], [0006]-[0010], [0019], [0026]-[0029], [0030]-[0033], [0039]-[0040], [0043]; Ex. 1102, ¶166-168.

In addition to assigning CMs to logical channels based on SNR, Cooper's 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. Ex. 1105, Abstract, [0008], [0021], [0027]-[0028], [0037]. Cooper further discloses assigning CMs based at least in part on amplifier cascade depth. *Id.* Grouping CMs, at least in part, according to location of network elements in a cable network or according to amplifier cascade depth allows the identification and isolation of geographic areas

in the network that are problematic and/or the identification and isolation of problematic network elements, supporting proactive maintenance activities. *Id.*, [0019]; Ex. 1102, ¶169.

It would therefore have been obvious to modify Prodan-Cooper840's/Prodan-Azenkot's CMTS to also assign CMs to service groups based at least in part on the location of CMs in a cable network or amplifier cascade depth to allow for more proactive maintenance of the network. Ex. 1105, [0019]; Ex. 1102, ¶169. In particular, it would have been obvious to configure Prodan-Cooper840's/Prodan-Azenkot's CMTS: (i) to determine the location of CMs in a cable network, and then also assign the CMs among a plurality of service groups based at least in part on such a location (satisfying claim 7's requirement of "assigning said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems"), or (ii) to also assign a CM to one of a plurality of service groups based at least in part on the amplifier cascade depth (satisfying claim 8's requirement of "assigning any particular one of said plurality of cable modems to one of said plurality of service groups based on which one or more of a plurality of branch amplifiers are upstream of said one of said plurality of cable modems"), in order to quickly identify and isolate problematic geographic regions in the network or network elements for maintenance. Ex. 1102, ¶170.

Such modifications also would have been obvious because they would have merely involved the combination of prior art elements (Prodan-Cooper840's/Prodan-Azenkot's CMTS and CMs and Cooper's methods of assigning CMs to service groups based on each CMs location in a cable network or cascade depth) according to known methods (programming of a CMTS) to yield predictable results (a CMTS that is better able to identify and isolate problematic areas in the network or network elements). *Id.*, ¶171. Applying Cooper's teachings to Prodan-Cooper840's/Prodan-Azenkot's CMTS would have been well within the capabilities of a POSITA because it would have involved straightforward modifications to the programming of Prodan-Cooper840's/Prodan-Azenkot's CMTS. *Id.*

Therefore, claims 7-8 are rendered obvious by Prodan-Cooper840-Cooper and Prodan-Azenkot-Cooper. *Id.*, ¶172.

E. Grounds G-H: Claim 9 Is Rendered Obvious by Prodan-Cooper840-Monk-Cooper437 and Prodan-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 in Sections VI.A.1.b and VI.B.1.a, Prodan-Cooper840 and Prodan-Azenkot teach determining a SNR-related metric for each CM served by the CMTS based on a measurement at the CMTS. However, these combinations do not teach a probe message that initiates the

measurement of the SNR-related metric at the CM or that includes instructions for measuring a metric and reporting said measured metric back to the CMTS (as required by claim 9). Such a probe message is taught by Monk and Cooper⁴³⁷. Ex. 1102, ¶¶173-175.

Monk discloses a method of communication that relies on different modulation schemes based on a communication channel's SNR. Ex. 1115, Abstract, 4:25-38, 6:6-19, 7:14-31, 8:1-11. For example, Monk teaches that higher SNR channels can support higher modulation orders through bit loading (*e.g.*, 16-QAM/64-QAM/256-QAM), while lower SNR channels may use a different modulation scheme such as QPSK. *Id.*, 4:55-59, 8:1-11, 9:9-11, 10:58-62; Ex. 1102, ¶176. 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. 1115, 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. 1102, ¶177.

Monk also teaches that for non-symmetrical channels (such as those in Prodan), a sending node transmits a probe message to a receiving device, which analyzes the probe message and sends the results of the analysis back to the sending device for the sending device to characterize the communication channel and

determine the transmission parameters. Ex. 1115, Abstract, 4:44-59, 9:28-50; Ex. 1102, ¶177. Therefore, a POSITA would have found it obvious to implement Prodan-Cooper840's/Prodan-Azenkot's CMTS (which measures SNR of CMs) so that it sends a probe message to the CMs (claimed "transmitting a probe message to each said plurality of cable modems") in order to implement the measurement and reporting by the CM of the downstream channel's SNR to further the goal of characterizing the communication channel, as taught by Monk and Prodan. Ex. 1115, Abstract; Ex. 1102, ¶177. A POSITA would have further found it obvious to send probe messages to the CMs to distribute processing requirements for measuring among the CMs, thus limiting processing required by the CMTS. *Id.*

Incorporating Monk's probe messages and reporting messages into Prodan-Cooper840 and Prodan-Azenkot also would have been obvious because such an implementation would have been nothing more than combining prior art elements (Prodan-Cooper840's/Prodan-Azenkot's CMTS that measures SNR and Monk's probe and reporting messages used to measure SNR) according to known methods (programming the CMTS to send probe messages and receive reporting messages that provide an analysis of a downstream channel's SNR) to yield predictable results (a system that uses probe messages and reporting messages to determine a downstream channel's SNR). *Id.*, ¶178. Further, a POSITA would have had a reasonable expectation of success applying Monk's teachings to Prodan-

Cooper840's/Prodan-Azenkot's CMTS as it would have only required straightforward modifications to the programming of the CMTS, which would have been well within the capabilities of a POSITA. *Id.*, ¶179.

While Prodan-Cooper840-Monk and Prodan-Azenkot-Monk teach a probe message, they do not teach a probe message that includes instructions for measuring a metric and reporting said measured metric back to the CMTS. *Id.*, ¶180. Cooper437 does. Cooper437 discloses a method for a CMTS to ask for and receive specific noise signal power measurements from CMs in its network. Ex. 1116, Abstract, 1:62-65, 3:47-50, Fig. 1. The CMTS initiates these measurements by transmitting to CMs in the network a message that defines the measurement techniques to be used and how to report the measurements. *Id.*, 8:11-29, 8:60-9:5, 10:56-11:28, 11:30-60.

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. 1102, ¶180. 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. 1116, 8:9-64, 10:56-11:28, 11:30-60; Ex. 1102, ¶181.

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, in order to allow Prodan-Cooper840-Monk's/Prodan-Azenkot-Monk's CMTS to send customized probe messages to specific CMs or service groups to conduct specific testing to determine the SNR of specific service groups or at specific frequencies, resulting in a system that allows more robust communication between the CMTS and CMs on the network. Ex. 1102, ¶181; Ex. 1116, 8:9-64, 10:56-11:28, 11:30-60. Such a modification would allow a CMTS to more quickly identify groups of modems or frequencies that have had a change in their SNR, and would also allow more robust communication between the CMTS and CMs on the network. Ex. 1102, ¶181; Ex. 1116, 8:9-64, 10:56-11:60.

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") would also have been obvious because it would have involved nothing more than combining prior art elements (Prodan-Cooper840-Monk's/Prodan-Azenkot-Monk's probe message with the measurement mode and reporting mode of Cooper437) according to known methods (modifying the contents of a probe messages) to yield predictable results (a CMTS

that uses probe messages that include instructions for measurement and reporting of SNR-related metrics). Ex. 1102, ¶182.

Applying Cooper437's teachings to Prodan-Cooper840-Monk's/Prodan-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 CMTS. *Id.*, ¶183. And a POSITA would have had a reasonable expectation of success in these programming modifications as Prodan-Cooper840-Monk/Prodan-Azenkot-Monk and Cooper437 each teach using the DOCSIS standard for transfer of data over a cable system and rely on generic microprocessors or microcontrollers for execution of their methods. *Id.*, ¶¶183-184; Ex. 1111, [0019]; Ex. 1116, 5:3-14, 7:6-22.

Accordingly, Prodan-Cooper840 or Prodan-Azenkot in view of Monk and Cooper437 render claim 9 obvious. Ex. 1102, ¶184.

F. Grounds I-J: Claims 10-11 and 15 Are Rendered Obvious by Prodan-Cooper840-Pai and Prodan-Azenkot-Pai

1. Independent Claim 10

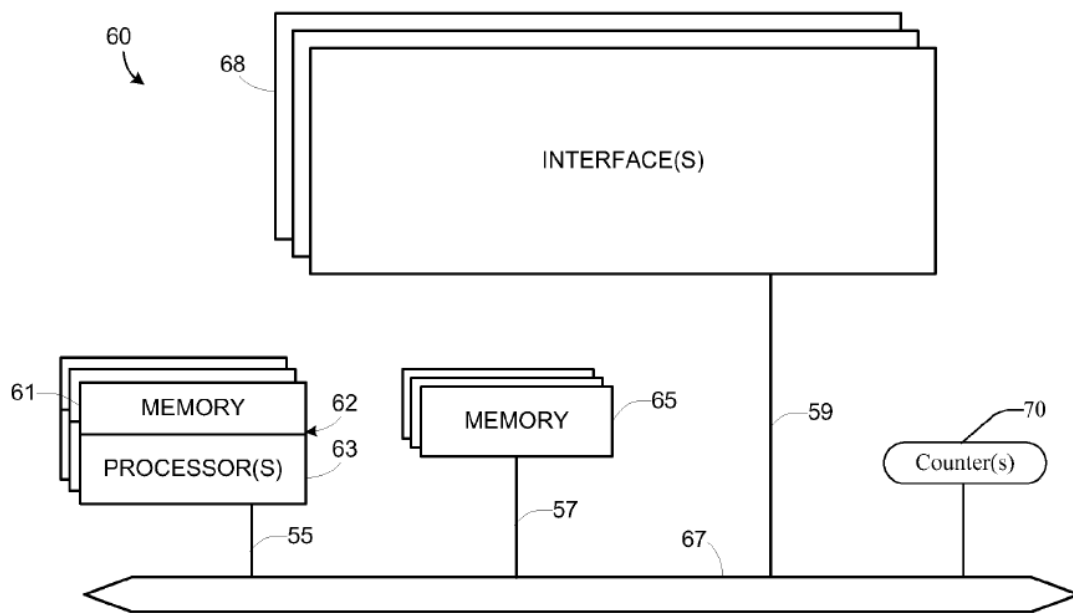
Claim 10 is a system claim with limitations similar to that of method claim 1.

a. Element [10A]

Prodan's "network" described above in Section VI.A.1.b discloses a system as recited in Element [10A]. Section VI.A.1.b, *supra*; Ex. 1111, [0016]-[0017], [0032], Fig. 1; Ex. 1102, ¶185. Although Prodan discloses a CMTS, it does not

expressly disclose that its CMTS includes circuitry comprising a network interface and a processor (although a POSITA would have been well aware that a CMTS possesses a processor and interface). Ex. 1102, ¶185. Pai, for instance, shows that it was known to implement a CMTS with a processor and a network interface in order to control operations of the CMTS and to communicate with other network devices. Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1102, ¶186.

As illustrated below in Figure 6, Pai discloses CMTS 60 that comprises circuitry that includes: (i) processor(s) 63 (claimed “circuitry ... comprising a ... processor”) that implements programming instructions received from memory 61 for controlling operations of the CMTS, and (ii) interface(s) 68 (claimed “circuitry ... comprising a network interface”) that communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1102, ¶186.



Ex. 1120, Fig. 6.

It would have been obvious for a POSITA to implement Prodan-Cooper840's/Prodan-Azenkot's CMTS with the processor and network interface as disclosed by Pai in order to control the operations of Prodan-Cooper840's/Prodan-Azenkot's CMTS and to communicate with other network devices, as taught by Pai and is required by Prodan. Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1102, ¶187.

Such implementations also would have been obvious because they would have been nothing more than combining prior art elements (Prodan-Cooper840's/Prodan-Azenkot's CMTS and Pai's CMTS's circuitry) according to known methods (using Pai's components in Prodan-Cooper840's/Prodan-Azenkot's CMTS) to yield predictable results (a CMTS that utilizes a processor and a network

interface to control operations of the CMTS and to communicate with other network devices). Ex. 1102, ¶187.

Moreover, applying Pai’s teachings would have been well within the capabilities of a POSITA as it would have only required basic knowledge of hardware design and/or programming, leading to an expectation of success. *Id.*, ¶188; Ex. 1111, [0032], [0044], [0048]. Thus, Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach [10A]. Ex. 1102, ¶188.

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

Elements [10B]-[10E] are nearly identical to Elements [1B]-[1E], except Elements [10B]-[10E] recite that the “processor” in the CMTS “is configured to” perform the limitations recited in [1B]-[1E]. *Id.*, ¶¶189-190. Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach that processor(s) 63 in CMTS 60 is configured to perform the limitations described above in Elements [1B]-[1E]. *Id.*; Ex. 1120, [0179]-[0181]. Accordingly, for the reasons set forth above with respect to Elements [1B]-[1E], Prodan-Cooper840-Pai’s/Prodan-Azenkot-Pai’s processor(s) 63 teaches and is configured to perform the limitations recited in Elements [10B]-[10E]. Ex. 1102, ¶¶189-190; Ex. 1120, [0179]-[0181].

Element [10F] is nearly identical to Element [1F], except Element [10F] recites that the claimed “network interface” is configured to perform the limitations recited in Element [1F]. Ex. 1102, ¶191. Prodan-Cooper840-Pai and Prodan-

Azenkot-Pai teach that interface(s) 68 communicates bidirectionally with network devices and controls the sending and receiving of data packets over the network. *Id.*; Ex. 1120, [0181], Fig. 6. Accordingly, for the reasons set forth above with respect to Element [1F], Prodan-Cooper840-Pai's/Prodan-Azenkot-Pai's interface(s) 68 comprise a network interface that teaches and is configured to perform the limitations recited in Element [10F]. Ex. 1102, ¶191; Ex. 1120, [0181], Fig. 6.

2. Dependent Claim 11

Claim 11 depends from claim 10, and claim 11 is nearly identical to claim 2. Ex. 1102, ¶192. Prodan-Cooper840-Pai and Prodan-Azenkot-Pai therefore teach claim 11 for the same reasons described above for claim 2. Sections VI.A.2, VI.B.2, *supra*; Ex. 1102, ¶192.

3. Dependent Claim 15

Claim 15 depends from claim 10, and claim 15 is nearly identical to claim 6. Ex. 1102, ¶193. Prodan-Cooper840-Pai and Prodan-Azenkot-Pai therefore teach claim 15 for the same reasons described above for claim 6. Sections VI.A.3, VI.B.3, *supra*; Ex. 1102, ¶193.

G. Grounds K-L: Claims 12-14 Are Rendered Obvious by Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali

1. Dependent Claim 12

Claim 12 depends from claim 10 and is very similar to claim 3 except claim 12 recites that the claimed “network interface” is configured to perform the limitations recited in claim 3. Ex. 1102, ¶194.

As discussed above in Section VI.F.1.a-b, Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach that interface(s) 68 communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1102, ¶194. And as discussed above in Section VI.C.1, applying Jalali’s teachings of OFDM to Prodan-Cooper840 and Prodan-Azenkot, teach the limitations of claim 3. Jalali is equally applicable to Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Ex. 1102, ¶195. For the same reasons discussed above in Section VI.C.1, a POSITA would have found it obvious and been motivated to apply the OFDM communication techniques taught by Jalali to Prodan-Cooper840-Pai’s/Prodan-Azenkot-Pai’s CMTS. Section VI.C.1; Ex. 1102, ¶195.

Moreover, a POSITA would have a reasonable expectation of success applying Jalali’s teachings to Prodan-Cooper840-Pai’s/Prodan-Azenkot-Pai’s CMTS as it would have only required straightforward modifications to the programming of the CMTS’s processor—well within the capabilities of a

POSITA—that would then communicate through the network interface. Ex. 1102, ¶196; Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1114, 33:44-49.

Accordingly, for the reasons set forth above in Sections VI.C.1 and VI.F.1.a-b, Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali comprise a network interface that teaches and is configured to perform the limitations recited in claim 12. Ex. 1102, ¶196; Sections VI.C.1, VI.F.1.a-b, *supra*.

2. Dependent Claim 13

Claim 13 depends from claim 12 and is very similar to claim 4 except that claim 13 recites that the claimed “network interface” is configured to perform the limitations recited in claim 4. Ex. 1102, ¶¶197-198. As discussed above in Section VI.G.1, Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali teach a network interface that communicates using OFDM over a plurality of subcarriers, each of which is configurable on a per-OFDM subcarrier basis. Accordingly, for the reasons set forth above in Sections VI.C.2 and VI.F.1.a-b, Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali comprise a network interface that teaches and is configured to perform the limitations recited in claim 13. Ex. 1102, ¶198; Sections VI.C.2, VI.F.1.a-b.

3. Dependent Claim 14

Claim 14 depends from claim 12 and is very similar to claim 5. Ex. 1102, ¶199. Prodan-Cooper840-Pai-Jalali and Prodan-Azenkot-Pai-Jalali teach the

additional limitations recited in claim 14 for the same reasons described above for claim 5. *Id.*; Section VI.C.3.

H. Grounds M-N: Claims 16-17 Are Rendered Obvious by Prodan-Cooper840-Pai-Cooper and Prodan-Azenkot-Pai-Cooper

Claims 16-17 depend from claim 10 and are nearly identical to claims 7-8, respectively, except claims 16-17 recite that the claimed “processor” is configured to perform the limitations recited in claims 7-8. Ex. 1102, ¶¶200, 203. As discussed in Sections VI.F.1.a and VI.D, Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach a CMTS that includes a processor(s) 63 configured to implement Prodan-Cooper840’s and Prodan-Azenkot’s methods. Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1102, ¶¶200-202. And as further discussed in Section VI.D, applying Cooper’s teachings to Prodan-Cooper840 and Prodan-Azenkot teaches the limitations of claims 7-8. Cooper is equally applicable to Prodan-Cooper840-Pai and Prodan-Azenkot-Pai.

For the reasons discussed in Section VI.D, a POSITA would have found it obvious and been motivated to configure the processor in Prodan-Cooper840-Pai’s/Prodan-Azenkot-Pai’s CMTS: (i) to determine the location of CMs in a cable network, and then assign the CMs among a plurality of service groups based on such a location (satisfying claim 16’s requirement of “assign[ing] said plurality of cable modems among said plurality of service groups based on distances between said CMTS and said plurality of cable modems”), or (ii) to assign a CM to one of a

plurality of service groups based on the amplifier cascade depth (satisfying claim 17's requirement of "assign[ing] 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"). Ex. 1102, ¶¶201, 205; Section VI.D. As described above in Section VI.D, such combinations would allow more proactive maintenance of the network. Ex. 1102, ¶¶201.

A POSITA would have had a reasonable expectation of success applying Cooper's teachings, which are performed by a microprocessor, to Prodan-Cooper-Pai's/Prodan-Azenkot-Pai's CMTS as it would have only required straightforward modifications to the programing of the CMTS's processor, well within the capabilities of a POSITA. Ex. 1102, ¶¶201, 205; Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1105, [0008], [0023]-[0024]. Accordingly, for the reasons set forth with respect to Sections VI.D and VI.F.1.a, Prodan-Cooper⁸⁴⁰-Pai-Cooper and Prodan-Azenkot-Pai-Cooper comprise a processor that teaches and is configured to perform the limitations recited in claims 16-17. Ex. 1102, ¶¶200-206; Sections VI.D, VI.F.1.a, *supra*.

I. Grounds O-P: Claim 18 Is Rendered Obvious by Prodan-Cooper⁸⁴⁰-Pai-Monk-Cooper⁴³⁷ and Prodan-Azenkot-Pai-Monk-Cooper⁴³⁷

Claim 18 depends from claim 10 and is nearly identical to claim 9, except claim 18 recites that the claimed "network interface" is configured to perform the limitations recited in claim 9. Ex. 1102, ¶207. As discussed above in Section

VI.F.1.a, Prodan-Cooper840-Pai and Prodan-Azenkot-Pai teach an interface(s) 68 that communicates with network devices and controls the sending and receiving of data packets over the network. Ex. 1120, [0179]-[0181], Fig. 6; Ex. 1102, ¶207. And, as discussed in Section VI.E, applying the teachings of Monk and Cooper437 to Prodan-Cooper840 and Prodan-Azenkot teaches the limitations of claim 9.

Monk and Cooper437 are equally applicable to Prodan-Cooper840-Pai and Prodan-Azenkot-Pai. Ex. 1102, ¶¶208-209. Accordingly, for the reasons set forth above with respect to Sections VI.E and VI.F.1.a, Prodan-Cooper840-Pai-Monk-Cooper437 and Prodan-Azenkot-Pai-Monk-Cooper437 each comprise a network interface that teaches and is configured to perform the limitations recited in claim 18. *Id.*

J. Grounds Q-FF: Claims 1-18 are Rendered Obvious by Prodan-Cooper840 (claims 1-2, 6), Prodan-Azenkot (claims 1-2, 6), Prodan-Cooper840-Jalali (claims 3-5), Prodan-Azenkot-Jalali (claims 3-5), Prodan-Cooper840-Cooper (claims 7-8), Prodan-Azenkot-Cooper (claims 7-8), Prodan-Cooper840-Monk-Cooper437 (claim 9), Prodan-Azenkot-Monk-Cooper437 (claim 9), Prodan-Cooper840-Pai (claims 10-11, 15), Prodan-Azenkot-Pai (claims 10-11, 15), Prodan-Cooper840-Pai-Jalali (claims 12-14), Prodan-Azenkot-Pai-Jalali (claims 12-14), Prodan-Cooper840-Pai-Cooper (claims 16-17), Prodan-Azenkot-Pai-Cooper (claims 16-17), Prodan-Cooper840-Pai-Monk-Cooper437 (claim 18), Prodan-Azenkot-Pai-Monk-Cooper437 (claim 18), in further view of Currivan

The combinations described above in Grounds A-P teach Elements [1E] and [10E] by teaching a CMTS selecting network communication parameters (*i.e.*,

frequency allocation scheme and modulation scheme) for a group of modems based on a worst-case SNR metric for a service group of modems. Sections VI.A-I. If it is asserted that those combinations do not teach selecting “physical layer communication parameters” as recited in Elements [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. 1102, ¶¶210-220.

As described above, Prodan (as modified by Cooper⁸⁴⁰ or Azenkot) discloses the CMTS selecting the frequency allocation scheme and modulation scheme based on the composite SNR-related metric. Sections VI.A.1.d-e, VI.B.1.b-c.

Currivan similarly discloses a CM system in which a CMTS segregates CMs into two or more groups. Ex. 1128, [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. Ex. 1128, [0034], [0079], [0157], [0182]; Ex. 1102, ¶211. Currivan describes the relationships between SNR and the physical layer communication parameters of modulation order and transmit power. Ex. 1128, [0067], [0157]-[0158]. In particular, Currivan teaches increasing SNR by increasing transmit power to support a higher modulation order. Ex. 1128, [0020], [0151], [0157]-[0158], [0177], [0200]. Higher modulation orders have higher throughput. Ex. 1128, [0018], [0065], [0158], [0170], [0182]; Ex. 1102, ¶211.

In light of such teachings, a POSITA would have found it obvious to configure Prodan's CMTS (as modified by Cooper840 and 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. 1128, [0018], [0020], [0065], [0151], [0157]-[0158], [0170], [0177], [0182], [0200]; Ex. 1102, ¶212; 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 (Prodan's CMTS—as modified by Cooper840 and 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. 1102, ¶213. Applying Currivan's teachings to Prodan's CMTS (as modified by Cooper840 and 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.*, ¶214; Ex. 1128, [0019]

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. 1128,

[0067]-[0069], [0142], [0151]-[0152], [0157], [0169], [0176]-[0177], [0182]; Ex. 1102, ¶215.

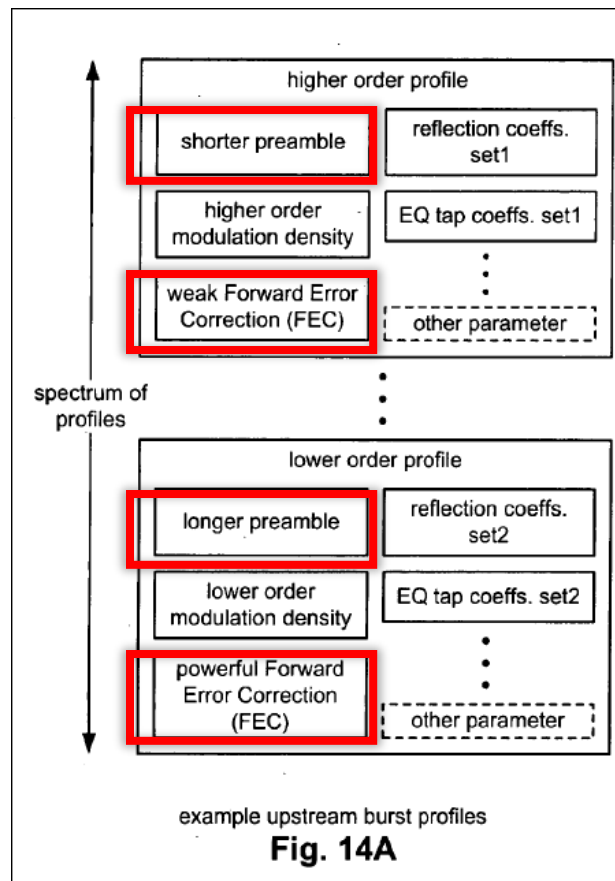
In light of such additional teachings in Currivan, a POSITA also would have found it obvious to configure Prodan's CMTS (as modified by Cooper840 and Azenkot) to increase the transmit power per code word—while reducing the number of codes transmitted for a service group—in order to increase the SNR and allow one of the service groups to communicate at a higher modulation order. Ex. 1102, ¶¶215-216. In addition, such combinations also would have been obvious because they would have merely been a combination of prior art elements (Prodan's CMTS—as modified by Cooper840 and 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. 1102, ¶216.

Applying Currivan's teachings to Prodan's CMTS (as modified by Cooper840 and 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 forward error correction strength and length of preambles. Ex. 1128, [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. 1128, 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. 1128, [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. Ex. 1128, [0163]. As further shown in Figure 14A, the higher order profile utilizes shorter preambles and weaker FEC. Ex. 1128, [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. Ex. 1128, [0153]-[0157], [0162]-[0163], claim 9; Ex. 1102, ¶¶217-218.

In light of such further teachings in Currivan, a POSITA would have found it obvious to configure Prodan'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 requirements and robustness of the communications. Ex. 1128, [0162]; Ex. 1102, ¶219.

Such combinations also would have been obvious because they would have merely been a combination of prior art elements (Prodan's CMTS—as modified by Cooper840 and 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). Ex. 1102, ¶220. Applying Currivan's teachings to Prodan's CMTS (as modified by Cooper840 and 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 13,659, which is less than the 14,000 allowed under 37 CFR § 42.24(a)(1)(i). This total includes 13,659 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

Dated: December 6, 2024

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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:

McAndrews, Held & Malloy, Ltd
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Dated: December 6, 2024

By: /Frederic M. Meeker/

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