

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

CASE: IPR2024-00431
U.S. PATENT NO. 7,295,518

PATENT OWNER'S NOTICE OF APPEAL

Notice is hereby given, pursuant to 37 C.F.R. §§ 90.2(a), 90.3, and 35 U.S.C. §§ 141 and 142, that Patent Owner Entropic Communications, LLC (“Patent Owner”) appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision of the Patent Trial and Appeal Board in IPR2024-00431, entered on September 5, 2025 (Paper 32), and from all underlying orders, decisions, rulings, and opinions. A copy of the Final Written Decision is attached hereto as Exhibit A. This Notice of Appeal is timely under 37 C.F.R. § 90.3, having been filed within 63 days of the Final Written Decision.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Patent Owner states that the issues on appeal include, but are not limited to, the Board’s determination that challenged claims 1,3, and 4 of U.S. Patent No. 7,295,518 are unpatentable, and any related issues, findings, or determinations, leading thereto or underlying that decision.

Patent Owner is filing a copy of this Notice of Appeal with the Director of the United States Patent and Trademark Office, and a copy of this Notice of Appeal is being filed electronically with the Board. In addition, a copy of this Notice of Appeal is being electronically filed with the United States Court of Appeals for the Federal Circuit, along with the required docketing fee.

Dated: September 19, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 90.2(a)(1), on September 19, 2025, the foregoing Notice of Appeal was electronically filed with the Patent Trial and Appeal Board via the P-TACTS System in accordance with 37 C.F.R. § 42.6(b)(1), and submitted electronically to the Director via email at efileSO@uspto.gov, in accordance with 37 C.F.R. § 90.2(a)(1)(i).

Pursuant to 37 C.F.R. § 90.2(a)(2) on September 19, 2025, the foregoing Notice of Appeal was electronically filed with the Court of Appeals for the Federal Circuit via CM/ECF with requisite fees paid via pay.gov.

Pursuant to 37 C.F.R. § 42.6(e) and the parties' agreement to accept electronic service, on September 19, 2025, the foregoing Notice of Appeal was served via email on the following counsel of record for Petitioner:

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EXHIBIT A

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

IPR2024-00431
Patent 7,295,518 B1

Before JON M. JURGOVAN, SCOTT B. HOWARD, and
AARON W. MOORE, *Administrative Patent Judges*.

JURGOVAN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION	4
A. Background and Summary	4
B. Real Parties in Interest.....	4
C. Related Matters.....	5
D. The '518 Patent.....	6
E. Challenged Claims.....	8
F. Evidence of Record	10
G. The Asserted Challenges to Patentability.....	11
II. ANALYSIS AND DISCUSSION	11
A. <i>Legal Standards for Obviousness</i>	11
B. <i>Claim Construction</i>	12
1. “means for determining signal activity”	13
2. “means for producing and transmitting a probe message”	13
3. “means for receiving and analyzing a probe message to determine a bit loading profile used to transmit data”	14
4. Claim Construction Conclusion.....	14
C. <i>Level of Ordinary Skill in the Art</i>	15
D. <i>Ground A: Obviousness over Afshary and Mirfakhraei</i>	16
1. Afshary (Ex. 1006).....	17
2. Mirfakhraei (Ex. 1007)	19
3. Whether Mirfakhraei is Analogous Art	20
a) Field of Endeavor.....	21
b) Reasonable Pertinence	27
4. Motivation to Combine	31
5. Claim 1	54
6. Claim 2.....	61
7. Claim 3.....	62
8. Claim 4.....	64
E. <i>Ground B: Obviousness over Afshary, Mirfakhraei, and Welles</i>	69
1. Welles (Ex. 1022)	70

2. Motivation to Combine	70
3. Claim 2	71
III. CONCLUSION.....	72
IV. ORDER.....	72

I. INTRODUCTION

A. *Background and Summary*

Comcast Cable Communications, LLC (“Petitioner”) filed a Petition requesting inter partes review (“IPR”) of claims 1–4 of U.S. Patent No. 7,295,518 B1 (Ex. 1001, “the ’518 patent”). Paper 2 (“Petition” or “Pet.”). Entropic Communications, LLC (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 6. We instituted *inter partes* review. Paper 8 (“Institution Decision” or “Inst. Dec.”).

Patent Owner filed a Response (Paper 13, “PO Resp.”), Petitioner filed a Reply (Paper 18, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 23, “PO Sur-reply”). An oral hearing was conducted, and the transcript is in the record, along with the demonstratives. Paper 31 (Transcript); Ex. 1039 (Petitioner’s Demonstratives); Ex. 2007 (Patent Owner’s Demonstratives).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). Having reviewed the complete trial record, we determine that Petitioner has shown, by a preponderance of the evidence, that the challenged claims 1, 3, and 4 are unpatentable but not claim 2.

B. *Real Parties in Interest*

Petitioner identifies Comcast Corporation, Comcast Cable Communications, LLC, and Comcast Cable Communications Management, LLC as real parties-in-interest. Pet. v (Petitioner’s Mandatory Notices).

Patent Owner identifies itself as the real party-in-interest. Paper 3, 1 (Patent Owner’s Mandatory Notices).

C. *Related Matters*

Petitioner and Patent Owner (“the parties”) identify the following as matters related to this proceeding:

Entropic Communications, LLC v. DirecTV, LLC,
Case No. 2-23-cv-05253 (C.D. Cal.);

Entropic Communications, LLC v. DISH Network Corporation,
Case No. 2-23-cv-01043 (C.D. Cal.);

Entropic Communications, LLC v. Cox Communications, Inc.,
Case No. 2-23-cv-01047 (C.D. Cal.); and

Entropic Communications, LLC v. Comcast Corporation.,
Case No. 2-23-cv-01048 (C.D. Cal).

Pet. v–vi (Petitioner’s Mandatory Notices); Paper 3, 1 (Patent Owner’s Mandatory Notices).

Patent Owner identifies the following as patents and patent applications related to this proceeding: U.S. Patent No. 7,154,957; U.S. Patent No. 7,499,397; U.S. Patent No. 7,573,822; U.S. Patent No. 7,594,249; U.S. Patent No. 7,889,759; U.S. Patent No. 8,411,565; U.S. Patent No. 8,588,250; U.S. Patent No. 9,112,803; U.S. Patent No. 9,860,144; U.S. Patent Application No. 10/230,687; U.S. Patent Application No. 10/776,796; U.S. Patent Application No. 10/778,505; U.S. Patent Application No. 12/538,339; U.S. Patent Application No. 15/860,400; U.S. Provisional Application No. 60/288,967; U.S. Provisional Application No. 60/316,820; U.S. Provisional Application No. 60/363,420; U.S. Provisional Application No. 60/385,361; and U.S. Patent Application No. 90/019,247. Paper 3, 2–3.

Patent Owner also identifies several *inter partes* reviews against Patent Owner’s patents: U.S. Patent No. 7,889,759 (IPR2024-00452);

IPR2024-00431
Patent 7,295,518 B1

U.S. Patent No. 8,223,775 (IPR2024-00446); U.S. Patent No. 10,135,682 (IPR2024-00445); U.S. Patent No. 10,135,682 (IPR2024-00444); U.S. Patent No. 9,825,826 (IPR2024-00442); U.S. Patent No. 8,284,690 (IPR2024-00430); U.S. Patent No. 8,792,008 (IPR2024-00441); U.S. Patent No. 11,399,206 (IPR2024-00440); U.S. Patent No. 11,399,206 (IPR2024-00439); U.S. Patent No. 11,399,206 (IPR2024-00438); U.S. Patent No. 11,381,866 (IPR2024-00437); U.S. Patent No. 11,381,866 (IPR2024-00436); U.S. Patent No. 11,381,866 (IPR2024-00435); U.S. Patent No. 9,210,362 (IPR2024-00434); U.S. Patent No. 9,210,362 (IPR2024-00433); and U.S. Patent No. 9,210,362 (IPR2024-00432).
Paper 3, 3–4.

D. The '518 Patent

The '518 patent is titled “Broadband Network for Coaxial Cable using Multi-Carrier Modulation.” Ex. 1001, code (54). The patent discloses a broadband local area network that uses coaxial cable wiring for interconnecting terminal devices. *Id.* at code (57). Orthogonal frequency division multiplexing (OFDM) with bit loading is used to overcome channel impairments to provide a path for terminal devices to transmit to and receive from other terminal devices. *Id.* Probe messages are used to characterize the channel between terminal devices to determine the optimum bit loading for the channel. *Id.*

Figure 2 of the '518 patent is shown below.

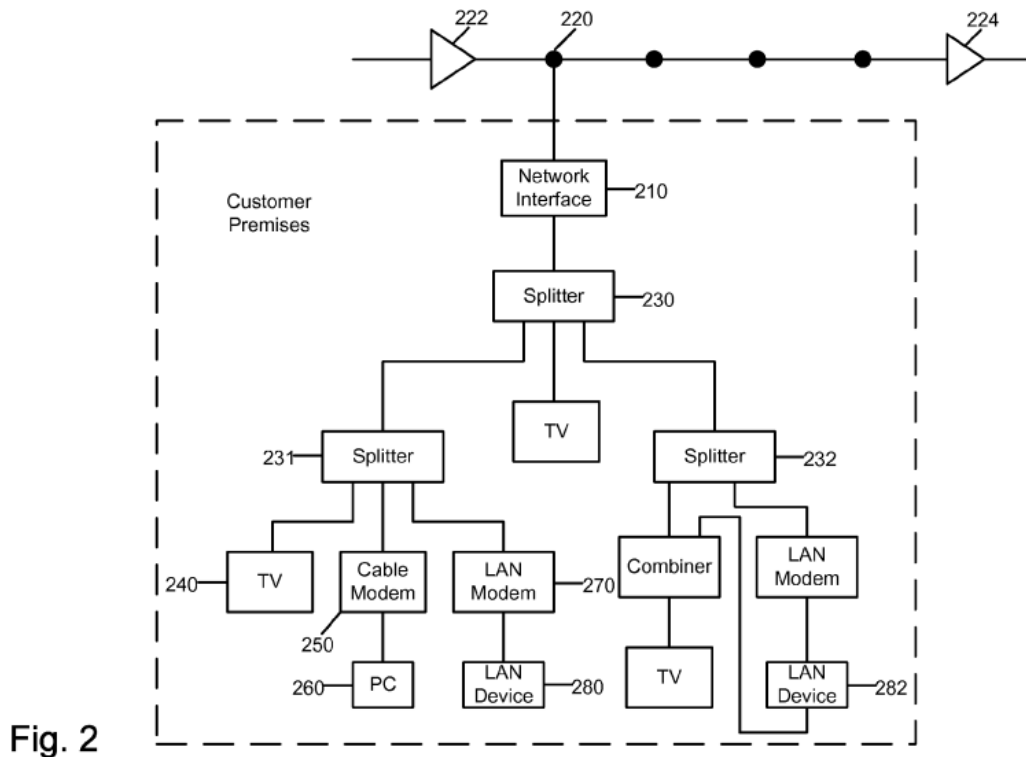


Fig. 2

Figure 2 depicts “a signal distribution plan” of the '518 patent. *Id.* at 5:12–13. LAN modem 270 modulates and demodulates a waveform transmitted over the cable, and has an interface to communicate with LAN device 280, which is the source or destination of data transmitted over the LAN. *Id.* at 5:36–40. LAN device 280 can be a personal computer (PC) and LAN device 282 can be a modulator to produce a signal for driving a TV through a signal combiner. *Id.* at 5:40–43.

LAN devices 280 and 282 can be used for digital video or data services. *Id.* at 5:51–52. LAN device 282 can extract digital video data from a transport stream and produce a signal for a standard TV set. *Id.* at 5:52–56. Existing devices, such as TV 240, cable modem 250, and PC 260, use frequency bands distinct from the frequency band used by the LAN and

operate in the normal manner. *Id.* at 5:57–60. The frequencies used by the LAN can be located above the standard cable frequencies. *Id.* at 5:61–63.

The '518 patent describes multi-tone modulation as including discrete multi-tone (DMT) and OFDM. *Id.* at 7:20–27. The '518 patent states that OFDM uses quadrature phase shift keying (QPSK) and multi-level quadrature amplitude modulation (QAM) in which each OFDM carrier is modulated using an amplitude/phase-varying signal. The modulated carriers are then summed together for transmission over the channel. *Id.* at 7:39–40.

The '518 patent describes bit loading as a method of allocating higher order signal constellations to carriers that have higher signal to noise ratio, and lower order constellations to carriers that have lower signal to noise ratio. *Id.* at 8:9–26.

The '518 patent further describes the use of probe messages transmitted between network devices to estimate channel characteristics. *Id.* at 9:35–41. The probe messages have a known bit sequence that can be used by the receiving device to a bit loading profile to send back to the transmitting device to use if the channel is asymmetric, or the receiving device may calculate a bit loading profile for its own use if the channel is symmetric. *Id.* at 9:42–58.

E. Challenged Claims

Claims 1 and 4 are independent, and claims 2–3 depend from claim 1. Claim 1 is set forth below with Petitioner's limitation identifiers indicated in brackets.

[1pre] A data communication network comprising:

[1A] at least two network devices, each network device comprising a multi-carrier modulator for modulating data, an up converter for translating the modulated data to an RF carrier

frequency, a down converter for translating an RF signal, and a multi-carrier demodulator for demodulating the translated RF signal to produce data; and

[1B] cable wiring comprising a splitter with a common port and a plurality of tap ports, and a plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices;

[1C] whereby network devices communicate with each other through the cable wiring using multi-carrier signaling;

[1D] wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics and bit loading is selected based on the determined channel characteristics.

Ex. 1001, 12:8–26.

Claim 4 is set forth below with Petitioner's identifiers:

[4pre] A network device for communicating data to other network devices over a coaxial wiring system comprising a splitter and a plurality of cable segments connected between the splitter and the network devices, the network device comprising:

[4A] a data modulator to produce a multicarrier modulated signal;

[4B] a demodulator for multicarrier modulated signal to produce data;

[4C] means for producing and transmitting a probe message; and

[4D] means for receiving and analyzing a probe message to determine a bit loading profile used to transmit data.

Id. at 12:36–48.

F. Evidence of Record

Petitioner relies upon the following prior art references¹:

Name	Reference	Date	Exhibit No.
Afshary	US 2006/0218593 A1	Filed Sept. 30, 1998; Published Sep. 28, 2006	1006
Mirfakhraei	EP 1 087 586 A2	Filed Sept. 22, 2000 ; Published Mar. 28, 2001	1007
Welles	US 6,737,984 B1	Filed Mar. 10, 2000; Issued May 18, 2004	1022

Petitioner also supports its challenges with declarations from Mr. James Bertonis. Ex. 1002; Ex. 1036. Patent Owner relies on a declaration from Mr. Albert Garrett. Ex. 2001. Deposition testimony of the declarants is in the record. Ex. 2002; Ex. 2006; Ex. 1032. Other evidence is present in the record as well.

¹ Petitioner states that all of the prior art references were filed, issued, or published before the '518 patent's earliest alleged priority date of August 30, 2001. Pet. 8, 11, 15. Petitioner contends that all of these references are prior art under 35 U.S.C. §§ 102(a) and (e) (pre-Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011)). *Id.* Patent Owner does not refute these assertions.

G. The Asserted Challenges to Patentability

Petitioner asserts the following challenges to patentability:

Ground	Challenged Claim(s)	35 U.S.C. § ²	Reference(s)/Basis
A	1–4	103(a)	Afshary, Mirfakhaei
B	2	103(a)	Afshary, Mirfakhaei, Welles

Pet. 17.

II. ANALYSIS AND DISCUSSION

In this section, we discuss Petitioner’s challenges to claims 1–4 of the ’518 patent and Patent Owner’s arguments against Petitioner’s contentions. For the reasons that follow, we determine that Petitioner has demonstrated that claims 1, 3, and 4 of the ’518 patent are unpatentable as obvious, but not claim 2.

A. Legal Standards for Obviousness

A patent claim is unpatentable as obvious under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the claimed subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the claimed invention pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of

² The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011), amended 35 U.S.C. §§ 102 and 103, effective March 16, 2013. Because the application from which the ’518 patent issued was effectively filed before this date, the pre-AIA versions of §§ 102 and 103 apply.

the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) where present, objective evidence of nonobviousness. *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18 (1966).

B. Claim Construction

We construe the challenged claims under the same standard used by a federal court in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). This standard is articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc) and its progeny, and includes “construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b).

Petitioner contends that three claim terms presumptively invoke means-plus-function under pre-AIA § 112 ¶ 6 through the use of the words “means for.” Pet. 23. Petitioner asserts that all other claim terms should be given their ordinary and customary meaning under § 282(b). *Id.* at 24 (citing 37 C.F.R. § 42.100(b)).

Patent Owner does not dispute Petitioner’s constructions because “the claims containing these terms are not part of any infringement allegation in any district court case.” PO Resp. 70 (citing Ex. 2001 ¶ 57). Patent Owner asserts that “as no argument advanced by Patent Owner or Petitioner hinges on the construction of these terms, no construction is necessary.” *Id.*

Because an assessment of whether the prior art discloses a means-plus-function limitation depends not only on the presence of the recited function but also the structure that performs that function as described in the

patent’s specification, we address Petitioner’s undisputed contentions for the means-plus-function limitations below.

1. *“means for determining signal activity”*

Petitioner contends that the claimed function of “determining signal activity” does not require further construction. Pet. 24 (citing Ex. 1001, claim 2; Ex. 1002 ¶¶ 108–109). As to the corresponding structure, Petitioner asserts that the ’518 patent describes different approaches for determining signal activity. *Id.* Petitioner states that one approach is to perform a Fast Fourier Transform (FFT) on data samples from an analog-to-digital converter (ADC) using the same receiver signal path that is used for data communication. *Id.* at 24–25 (citing Ex. 1001, 8:51–9:27, 11:7–23; Ex. 1002 ¶¶ 109–110).

Petitioner contends that another approach is to measure received signal power with an envelope detector. *Id.* at 25 (citing Ex. 1001, 11:23–29; Ex. 1002 ¶ 110). Petitioner asserts that the envelope detector is another corresponding structure for “determining signal activity.” *Id.* (citing Ex. 1002 ¶ 110).

2. *“means for producing and transmitting a probe message”*

Petitioner contends that the claimed function of “producing and transmitting a probe message” does not require further construction. Pet. 25 (citing Ex. 1001, claim 4; Ex. 1002 ¶¶ 111–112). As to the corresponding structure, Petitioner contends that a probe message is a signal “known by the receiving device” that is used “to estimate the channel characteristics” such as SNR.³ *Id.* (citing Ex. 1001, 4:48–62, 7:22–42, 8:9–35, 9:36–10:20;

³ Signal-to-noise ratio. Ex. 1001, 6:30.

Ex. 1002 ¶¶ 111–112). Petitioner contends that the corresponding structure for “producing and transmitting a probe message” is a processor. *Id.* at 26 (citing Ex. 1002 ¶¶ 111–112). Petitioner contends that “[t]o the extent the identified structure of a processor requires an algorithm for performing the recited function, the algorithm is: (a) generating a signal known to a receiving device; and (b) transmitting the known signal.” *Id.* (citing Ex. 1001, code (57), 4:48–62, 9:35–10:38, Fig. 7; Ex. 1002 ¶¶ 111–112).

3. *“means for receiving and analyzing a probe message to determine a bit loading profile used to transmit data”*

Petitioner asserts that the claimed function for this term, which is “receiving and analyzing a probe message to determine a bit loading profile used to transmit data,” requires no further construction for purposes of this IPR. Pet. 27 (citing Ex. 1001, claim 4; Ex. 1002 ¶¶ 113–114).

Petitioner further asserts that the corresponding structure for this function is a processor. *Id.* (citing Ex. 1001, 10:29–38; Ex. 1002 ¶¶ 113–114).

Petitioner contends that, “[t]o the extent the identified structure of a processor requires an algorithm for performing the recited function, the algorithm is: (a) receiving a known signal; (b) determining a SNR for each subchannel based on the received known signal; and (c) determining a bit loading for each subchannel based on the determined SNR for the subchannel. *Id.* (citing Ex. 1001, code (57), 4:48–62, 8:9–26, 9:17–19, 9:35–10:38, 10:61–11:6, Fig. 7; Ex. 1002 ¶¶ 113–114).

4. *Claim Construction Conclusion*

Petitioner’s constructions for the means-plus-function limitations are reasonable and Patent Owner does not dispute them. Accordingly, we agree with and will use those constructions in this Decision. For the remaining

claim terms, we apply the ordinary and customary meaning. 37 C.F.R. § 42.100(b).

C. Level of Ordinary Skill in the Art

Petitioner contends as follows:

In relation to the '518 patent, a person of ordinary skill in the art (“POSITA”) would have had a bachelor’s degree in electrical engineering, computer engineering, or a similar discipline, and three to four years of experience working in signal processing and/or communication systems/networks. Additional education may substitute for experience, and significant work experience may substitute for formal education.

Pet. 23 (citing Ex. 1002 ¶¶ 103–105).

Patent Owner states the following:

A POSITA would have at least a bachelor’s degree in electrical engineering, computer engineering, or an equivalent field with at least two years of experience with coaxial cables. . . . Experience with coaxial networking is central to the patent’s field of work. *Id.* The title, claims, abstract, background, and detailed description all refer to coaxial cable. . . . As referenced in the summary of the invention, the use of terms such as “coaxial cable wiring” in connection with “splitters” confirms that the summary of the invention section refers to a coaxial network. . . . Claim 1’s use of a “splitter with a common port and a plurality of tap ports” also confirms the coaxial network.

PO Resp. 10–11 (citing Ex. 1001, codes (54, 57), 1:27–29, 4:36–40, 5:14–16, Fig. 3, claim 1; Ex. 2001 ¶¶ 37–43).

Patent Owner’s proposal to limit a POSITA’s education and experience to “broadband networks over coaxial cables” is too narrow. Although Patent Owner points to various parts of the '518 patent as supporting its restrictive proposal, other parts of the patent are not so limited. For example, the patent’s technical field and summary are not limited to coaxial cable, and the patent discusses twisted pair wiring and

satellite communications as media that can be used. *See, e.g.*, Ex. 1001, 1:27–29, 3:33–35, 3:49–50, 3:67–4:3, 5:61–6:3, 8:20–23, 9:28–33.

Accordingly, we adopt the following level of ordinary skill in the art for use in this Decision:

A POSITA would have a bachelor’s degree in electrical engineering, computer engineering, or a related field, and two to four years of experience with broadband communication networks. Additional professional experience could substitute for education, and additional education could substitute for professional experience.

We find that this skill level is consistent with the problems and solutions identified in the ’518 patent and the prior art references asserted by Petitioner. In addition, we find the adopted skill level consistent with the education and experience that a POSITA would have had. *See In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)) (citing factors to consider when determining level of ordinary skill in the art).

D. Ground A: Obviousness over Afshary and Mirfakhraei

Petitioner contends that claims 1–4 would have been obvious over the combination of Afshary and Mirfakhraei. Pet. 28–68. Patent Owner disputes Petitioner’s contentions. PO Resp. 11–70. We address below the disclosures of Afshary and Mirfakhraei, the parties’ contentions on whether Mirfakhraei is analogous art, the motivation to combine, and the parties’ contentions regarding obviousness of these claims. We determine that claims 1, 3, and 4 would have been obvious over the combination, but not claim 2.

1. *Afshary (Ex. 1006)*

Afshary is titled “Digital Coaxial Cable LAN.” Ex. 1006, code (54). Afshary relates to networking and data distribution through a coaxial cable that takes advantage of the operating frequency spectrum of the coaxial cable so as not to interfere with client data. *Id.* ¶ 2.

Afshary’s Figure 1 is shown below.

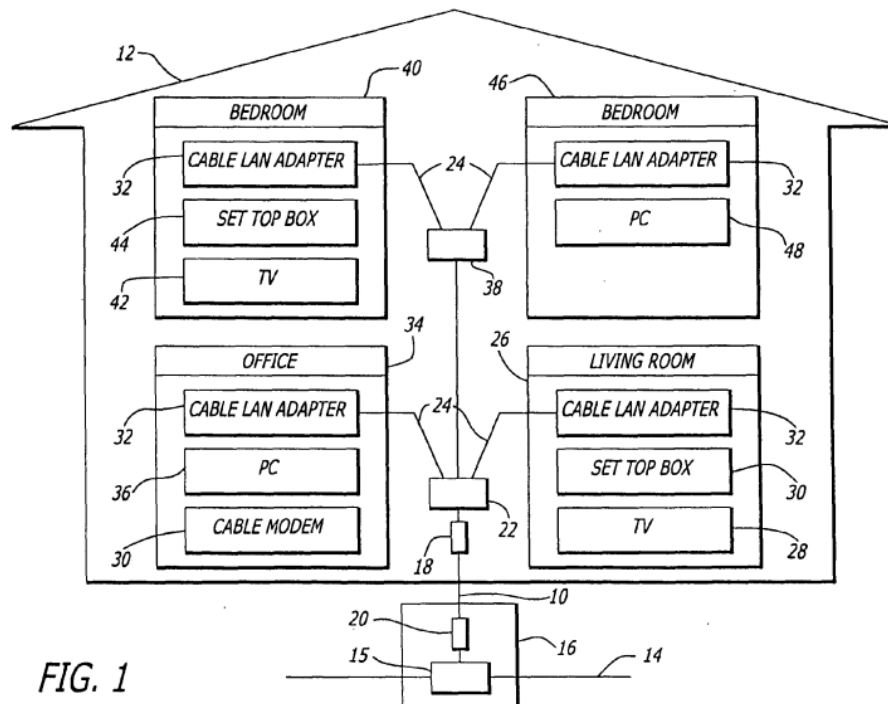


Figure 1 shows an in-home coaxial cable LAN. *Id.* ¶ 8. Drop cable 10 enters home 12 after tapping main trunk 14 through splitter 15 within distribution box 16. *Id.* ¶ 14. Low pass filter (LPF) 18 is installed upstream of the in-home cable LAN network and downstream of low pass filter 20 supplied by a cable service company. *Id.* LPF 18 maintains security for the cable LAN by preventing signals generated within the cable LAN from getting back to the public cable network where they may also interfere operations of the cable service company. *Id.* ¶¶ 15–16.

Splitter 22 divides the signal on cable 10 into different cable wires 24 which are routed to different rooms in home 12 where they connect with devices such as television (TV) 28, set top box (STB) (or cable modem) 30, and personal computer (PC) 36. *Id.* ¶ 18. These client devices are connected to cable wires 24 with cable LAN adapters 32. *Id.* ¶ 19.

Afshary's Figure 3 is shown below.

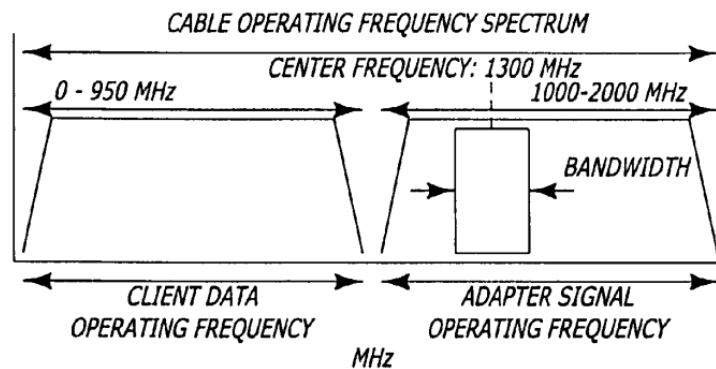


FIG. 3

Figure 3 shows an operating frequency of the client data and adapter signal. *Id.* ¶ 10. The lower region from 0–950 MHz is where conventional cable TV, digital cable TV, and cable modem services are offered. *Id.* ¶ 25. The cable LAN signal is located within the higher range of 1000–2000 MHz at a center frequency of 1300 MHz, and thus does not interfere with conventional services. *Id.* ¶¶ 25, 28.

Afshary's Figure 4 is shown below.

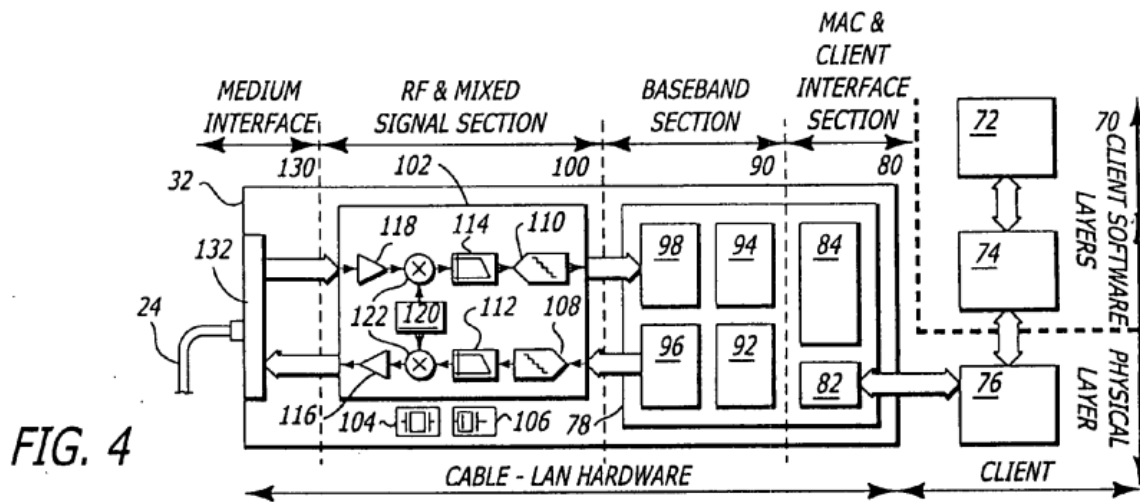


Figure 4 shows an architecture of a cable LAN adapter. *Id.* ¶ 11. Modulator 96 modulates data from a client device using a modulation scheme such as Quadrature Phase Shift Keying (QPSK) digital modulation. *Id.* ¶¶ 26, 35–41. Radio Frequency (RF) and Mixed Signal section 100 up-converts the modulated data to an RF frequency. *Id.* ¶¶ 38–39. RF data signals received by the cable LAN adapter are down-converted by RF and Mixed Signal section 100 and demodulated by demodulator 98 for transmission to a client device. *Id.* ¶¶ 38–42.

2. *Mirfakhraei* (Ex. 1007)

Mirfakhraei is titled “Bit loading Process for Multicarrier Communications.” Ex. 1007, code (54). *Mirfakhraei* relates to modems and transceivers that use multiple carrier frequencies for information transmissions. *Id.* ¶ 1. *Mirfakhraei*’s modems use discrete multi-tone (DMT) modulation and bit-loading to increase transmission rates. *Id.* ¶¶ 3, 5.

Mirfakhraei discloses that “[f]or data transmission, a sending modem breaks transmitted data into packets for simultaneous transmission on separate sub-channels and independently modulates communication signals

for the sub-channels according to the data carried on each sub-channel.” *Id.*
¶ 3. For data reception, the “receiving modem separates sub-channel signals according to carrier frequency, demodulates the separate sub-channel signals, and reassembles the data.” *Id.*

Mirfakhraei discloses a bit-loading process that determines noise for each sub-channel of the DMT signal. *Id.* ¶ 5. The process determines target loadings to provide a desired error rate at the measured noise. *Id.* The process rounds target loadings to integers; and determines whether the proposed loadings provide a desired error rate. *Id.* If not, the process selects one or more sub-channels with a negative difference between target and proposed loadings, and for each selected sub-channel decreases the proposed loading by 1. *Id.* Gains of channels with decreased loadings are decreased for improved power efficiency. *Id.*

Mirfakhraei discloses a handshake process in which one transceiver transmits a handshake signal to a remote receiver when establishing a connection or retraining. *Id.* ¶ 20. The handshake signal includes a pattern that the remote transceiver requests or indicates a pattern for the remote transceiver to transmit to the one transceiver. *Id.* SNRs for the sub-channels can be determined from these handshake signals. *Id.* ¶ 22.

3. *Whether Mirfakhraei is Analogous Art*

Prior art references apply to the obviousness inquiry only when they are analogous to the claims challenged. *In re Clay*, 966 F.2d 656, 658 (Fed. Cir. 1992); *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). A prior art reference is analogous when (1) the reference is from the same field of endeavor as the claims; or (2) the reference is reasonably pertinent to the particular problem with which the inventor was involved. *Corephotonics*,

Ltd. v. Apple, Inc., 84 F.4th 990, 1004 (Fed. Cir. 2023); *Airbus S.A.S. v. Firepass Corp.*, 941 F.3d 1374, 1379 (Fed. Cir. 2019); *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1378 (Fed. Cir. 2007). “The Supreme Court’s decision in *KSR* . . . directs us to construe the scope of analogous art broadly.” *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1238 (Fed. Cir. 2010).

a) *Field of Endeavor*

Patent Owner initially asserts that the ’518 patent’s field of endeavor is an “on-premises broadband network implemented over existing cables.” PO Resp. 12, 16–17 (citing Ex. 1001, codes (54, 57), 1:25–29, 1:33–4:33; Ex. 2001 ¶¶ 58–59). In its Sur-reply, however, Patent Owner revises the ’518 patent’s field of endeavor as “on-premises local area broadband **coaxial cable networks** and even more specific to communication between network devices over the tap-ports of a coaxial splitter.” PO Sur-reply 20. According to Patent Owner, “[e]very aspect” including the title, abstract, technical field, background, and claims supports this definition of the ’518 patent’s field of endeavor. *Id.*

Patent Owner argues that Mirfakhraei’s field of endeavor is “an out-of-home, point-to-point system that communicates over conventional telephone lines” using “DSL connections over twisted pair.” PO Resp. 15–16, 20–21 (citing Ex. 1007 ¶¶ 2–6, 14–15, 19; Ex. 2001 ¶¶ 61, 71–72), 18. Patent Owner asserts that Mirfakhraei does not discuss broadband networks, or existing on-premises coaxial cables, coaxial splitters, or multi-path reflections which are “all key to the ’518 patent.” *Id.* at 16, 21. In addition, Patent Owner alleges that Mirfakhraei’s bit-loading processes would not work with the signal splitters present in a coaxial environment. *Id.* at 16.

Patent Owner contends that that twisted pair wiring used in telephone lines only transmits low frequencies and thus is used in simple, point-to-point networks, whereas coaxial cables, being shielded, can support larger, high-frequency bandwidths. *Id.* at 19 (citing Ex. 2001 ¶¶ 63–69; Ex. 2003, 82; Ex. 2004). Patent Owner states that the frequency response of coaxial cables is chaotic due to transmission-line effects such as reflections, with sharp increases in attenuation at specific frequencies. *Id.* at 19–20 (citing Ex. 2001 ¶ 70; Ex. 2003, 67⁴). Patent Owner states that these effects occur even in the much shorter cable lengths used in homes as compared to longer telephone lines. *Id.* at 20.

Patent Owner criticizes the Petition for not undertaking any analysis of Mirfakhraei’s field of endeavor or comparing it to that of the ’518 patent. *Id.* at 21. Patent Owner asserts, however, that the Petition “appears to agree” that the ’518 patent is directed to communications using coaxial building wiring. *Id.* at 17–18 (citing Pet. 2; Ex. 1001, 1:28–29, 1:33–35; Ex. 1002 ¶¶ 59–61).

Patent Owner also alleges that the Institution Decision made its own findings apart from those in the Petition, oversimplified Mirfakhraei’s field of endeavor, relied on Mirfakhraei’s boilerplate language, and did not appreciate that Mirfakhraei’s “communication signal” in claim 1 implies transmission over conventional telephone wires, as described in its specification. *Id.* at 16, 22–23 (citing Ex. 1007 ¶¶ 21, claim 1; Ex. 2001 ¶ 62; Inst. Dec. 20–21).

⁴ Citation not found.

In addition, Patent Owner draws comparisons between *Wang Labs.* and the present case, arguing that this precedent binds us to decide the field of endeavor issue in its favor. *Id.* at 23–24 (citing *Wang Labs., Inc. v. Toshiba Corp.*, 993 F.2d 858, 864–865 (Fed. Cir. 1993) (prior art references not in same field of endeavor merely because they relate to computer memories)).

Patent Owner criticizes Petitioner’s expert, Mr. Bertonis, for his alleged “results-oriented approach” and inconsistency in how he considered the title, field, and claims of the ’518 patent to conclude it was not limited to co-axial cable, and the same parts of Mirfakhraei to conclude it was not limited to telephone lines (twisted pair). PO Sur-reply 20–22. Patent Owner also asserts that Petitioner failed to apply *Airbus*’s holistic approach by ignoring certain parts of the ’518 patent, and that Petitioner mischaracterized Patent Owner’s proposed field of endeavor for the ’518 patent, which Patent Owner did not limit to use of probe messages in adaptive bit-loading. *Id.* at 21–22. In addition, Patent Owner alleges that Petitioner attempted to broaden the ’518 patent’s field of endeavor and improperly conflated the two prongs of the analogous art test, revealing that Petitioner is using improper hindsight reconstruction in its analysis. *Id.* at 22–23.

Patent Owner further asserts that Petitioner’s uses of the ’518 patent’s references to non-coaxial references amounts to improper hindsight and ignores the ’518 patent’s claims and the district court’s confirmation that claim 1 relates to a coaxial network. *Id.* at 23 (citing Pet. Reply 5). Patent Owner alleges that Petitioner does not dispute Patent Owner’s evidence showing that Mirfakhraei is directed to conventional telephone line (twisted pair) communications, and instead uses broad boilerplate language that does

not outweigh the entirety of Mirfakhraei’s disclosure, which does not mention coaxial cables. *Id.* at 24. Patent Owner asserts that Petitioner thus broadly characterizes the field of endeavor as “network communications” to capture the non-analogous Mirfakhraei reference. *Id.*

Petitioner asserts that the field of endeavor is “network communications.” Pet. Reply 3 (citing Ex. 1002 ¶ 88; Ex. 1036 ¶ 2). Petitioner argues that this is supported by the ’518 patent and Mirfakhraei consistent with the holistic approach of *Airbus*. *Id.* at 2–8. Petitioner asserts that Petitioner improperly narrowed the field of endeavor, and contends that Mirfakhraei’s disclosure is not limited to twisted pair telephone lines. *Id.*

As previously stated, we determine that the ’518 patent’s field of endeavor is “broadband communication networks.” See § II.C, *supra*. This is made clear from the ’518 patent’s technical field which states “[t]his invention relates to *broadband communication networks* and specifically to communications using coaxial cable building wiring.” Ex. 1001, 1:27–29 (emphasis added). We choose the ’518 patent’s broader statement of the field (“broadband communication networks”) because the field of endeavor is “not limited to the specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field.” *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1001 (Fed. Cir. 2016); Pet. Reply 3. Mirfakhraei shares this field of endeavor with the ’518 patent.

Although Patent Owner argues that Petitioner failed to conduct an analysis for the field of endeavor, the Federal Circuit has cautioned that a petition may show analogousness even if it does not explicitly identify it as such. *Netflix, Inc. v. DIVX, LLC*, 80 F.4th 1352, 1359–1360 (Fed. Cir. 2023)

(Board abused its discretion in determining Netflix failed to articulate a field of endeavor).

The Petition indicated, for example, that Mirfakhraei's receiver (specifically, its time domain equalizer) samples and filters a signal described as *broadband*. See, e.g., Pet. 38–40 (citing Ex. 1007 ¶ 24). The Petition further mentions Mirfakhraei's handshake procedure to implement bit-loading between *network* devices. See, e.g., *id.* at 48 (citing Ex. 1007, code (57) ¶¶ 2–3, 5–8, 14–25, Figs. 1–3). In substance, the Petition identifies Mirfakhraei's field of endeavor as “broadband communication networks.”

Patent Owner argues that Mirfakhraei's field of endeavor is limited to twisted pair or DSL. PO Resp. 15–16, 20–21. Mirfakhraei discloses various forms of DSL including ADSL and HDSL (collectively referred to as “xDSL”), and states that its bit loading processes can be implemented with an “xDSL transceiver.” Ex. 1007 ¶¶ 3, 9–10, 14–15, 18, 26–28. However, Mirfakhraei does not preclude the use of its disclosed processes in other types of networks. *Id.* ¶¶ 6–9, claim 14; Pet. Reply 6–7.

For example, Mirfakhraei's “Summary” describes its DMT bit-loading processes, and then concludes by stating that “[o]ther embodiments of the invention include xDSL transceiver implementing any of the process disclosed herein.” Ex. 1007 ¶ 9. This implies that the processes described in the “Summary” encompass other types of transceivers and networks that are not xDSL. *Id.* ¶¶ 6–8. Similarly, Mirfakhraei's claim 14 recites “[a]n ADSL transceiver that performs the process of any one of the preceding claims” such that the processes recited in the preceding claims are not so limited.

Furthermore, the '518 patent's background mentions several patents relating to "broadband networks" including one that concerns DSL. Ex. 1001, 3:33–35. In our view, the '518 patent's mentioning this patent is evidence that broadband DSL technologies are in the same field of endeavor as the '518 patent.

Regarding Patent Owner's contention that the '518 patent's field of endeavor is limited to "on-premises" or "local" networks, as Petitioner observes, there is no such limitation in the claims (although it is mentioned elsewhere in the patent). Pet. Reply 4. Even if we agreed with this assertion (we do not), Mirfakhraei discloses that its bit-loading processes use local networks. Ex. 1007 ¶¶ 6, 16.

We do not belabor Patent Owner's criticisms of the Institution Decision (we are beyond the preliminary stage of this proceeding) other than to state we disagree with them. We address, however, Patent Owner's assertion that "communication signal" in the Mirfakhraei's claims limits them to communications over telephone lines because Mirfakhraei's description mentions this. PO Resp. 16, 22–23; Ex. 1007 ¶ 21. Other parts of Mirfakhraei, such as its title, abstract, technical field, summary, and claims (except for paragraph 9 and claim 14), are set forth broadly and indicate an intention not to limit Mirfakhraei's bit-loading processes to telephone lines, twisted pair, or DSL. Pet. Reply 6–7; Ex. 1007, codes (54, 57), ¶¶ 1, 5–8, claims 1–13 and 15–18.

Patent Owner's reliance on *Wang Labs* is misplaced, as Petitioner argues. See Pet. Reply 8. In that case, the Federal Circuit determined that an asserted patent related to a compact memory module for personal computers was not in the same field of endeavor as prior art relating to a

memory module for a larger, more costly industrial controller in which space was not an issue. *Wang Labs.*, 993 F.2d at 864–865. Expert testimony established that the industrial memory module could not be used in a personal computer. *Id.* at 864. In contrast, the ’518 patent and Mirfakhraei are directed to the same field of endeavor—broadband communication networks—and their network devices are agnostic, at least above the physical layer, to the mediums used to convey signals between them.

As to Patent Owner’s assertion that Mirfakhraei’s bit loading would not work with the splitters used for coaxial cables, Petitioner relies on Afshary to explain how this would be done. *See, e.g.*, Pet. 8–9, 45–47. In any case, this argument does not relate to the field of endeavor, but to the reasonable expectation of success in combining prior art references.

Petitioner’s statement of the field of endeavor as “communication networks” is too broad in light of the ’518 patent for the reasons explained.

We conclude that Petitioner has shown by preponderant evidence that Mirfakhraei is in the same field of endeavor as the ’518 patent, i.e., “broadband communication networks.” Mirfakhraei is thus analogous art because it is in the same field of endeavor as the ’518 patent.

b) Reasonable Pertinence

Patent Owner argues that Mirfakhraei is not reasonably pertinent to the problems addressed by the ’518 patent. PO Resp. 24–29. Patent Owner asserts that the ’518 patent solves impairments specific to on-premises communication between network devices over existing coaxial cable wiring and splitters, whereas Mirfakhraei addresses synchronization for “point-to-point” communication within a twisted pair system without these splitters or

the micro-reflections that they cause. *Id.* at 24 (citing Ex. 1001, 4:36–47; Ex. 2001 ¶¶ 73, 79; Ex. 2002, 78:6–16).

Patent Owner asserts that the ’518 patent addresses signal impairments specific to on-premises coaxial cabling including (1) inter-port isolation from communicating across splitters; (2) variable signal attenuation caused by different channel paths, and (3) imperfect connection points at splitters, which cause micro-reflections. *Id.* at 25 (citing Ex. 1001, 2:27–48, 3:5–16, 4:23–25, 4:36–47; Ex. 2001 ¶¶ 75–76).

Patent Owner states that “[s]uch impairments are the result of using a preexisting coaxial network and are not present in every type of wired network.” *Id.* Patent Owner asserts that splitters in coaxial networks have isolated ports forming imperfect connections which cause inter-port isolation and reflections not found in other network types. *Id.* According to Patent Owner, the varying signal paths between devices causes variable signal attenuation. *Id.* Patent Owner asserts that the ’518 patent overcomes these issues that previously restricted network devices from communicating with each other. *Id.* at 26 (citing Ex. 1001, 4:36–47; Ex. 2001 ¶ 76).

Patent Owner states that Petitioner’s expert, Mr. Bertonis, testified that attenuation characteristics apply to any medium while acknowledging that intersymbol interference (“ISI”) is specific to reflections caused by insertion points in coaxial networks created by amplifiers and splitters, confirming that problem and solution of the ’518 patent is specific to the use of splitters in a coaxial LAN environment. *Id.* (citing Ex. 2002, 118:21–119:10, 120:18–21).

Petitioner contends that Mirfakhraei is reasonably pertinent to the problems that the ’518 patent addresses. Pet. Reply 8–11. Petitioner states

that the Institution Decision recognized that variable attenuation and signal noise are problems shared by the '518 patent and Mirfakhraei and that the solution of multi-carrier modulation with bit-loading is agnostic to whether impairments are caused by coax splitters or other features. *Id.* at 9 (citing Ex. 1001, 4:37–40, 4:42–46, 7:49–50, 8:9–12; Ex. 1036 ¶¶ 23–24).

Petitioner further contends that, like the '518 patent, Mirfakhraei seeks to improve network communication efficiency using the same solution—multi-carrier modulation with bit-loading—in the face of similar channel impairments (including frequency-dependent attenuation). *Id.* at 9–10. Specifically, Petitioner states that Mirfakhraei seeks to increase data transmission rate, select optimal symbol sets, and optimize bandwidth and power to address similar problems using the same solution. *Id.* (citing Ex. 1007 ¶¶ 3–4, 14, 34–35; Ex. 1036 ¶¶ 23–24). Petitioner asserts that “[t]he focus of the problem, commonly addressed by the '518 patent and Mirfakhraei, is finding ways to most effectively deal with encountered transmission impairments, whatever their cause.” *Id.* at 10. Petitioner asserts that “Mirfakhraei would have commended itself to an inventor’s attention in considering the problem addressed by the '518 patent.” *Id.* (citing *Clay*, 966 F.2d at 659).

Petitioner argues that Patent Owner “seeks to exclude Mirfakhraei as analogous art under both the field of endeavor and reasonable pertinence prongs for essentially the same reason: that Mirfakhraei is allegedly focused on a twisted-pair telephone line rather than coaxial cable network.” *Id.* at 10 (citing PO Resp. 18–21, 24–29). Petitioner asserts that Patent Owner’s approach conflates the field of endeavor and reasonable pertinence inquiries and is improper under Federal Circuit precedent. *Id.* at 8–9 (citing *Donner*

Tech. v. Pro Stage Gear, LLC, 979 F.3d 1353, 1361 (Fed. Cir. 2020); *In re ICON Health*, 496 F.3d at 1380).

Patent Owner responds that the '518 patent “solves impairments specific to on-premises communications between network devices **over existing coaxial cable wiring**.” PO Sur-reply 15. Patent Owner argues that the “Reply continues to ignore the coaxial context, including the claim language, which is directed toward communication between network devices through tap ports of a splitter.” *Id.* (citing Ex. 1001, 1:27–29, 4:28–33, claim 1; Ex. 2001 ¶ 47). Patent Owner further argues that Petitioner applies the wrong framework for the reasonable-pertinence inquiry by focusing on the solution rather than the problem addressed by the '518 patent. *Id.* (citing Ex. 2001 ¶¶ 71–72, 79; Ex. 2002, 78:6–16; Ex. 1036 ¶¶ 23–24; *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)).

Having considered the parties' contentions, we determine that Mirfakhraei is analogous art to the '518 patent at least because the two address the common problems of variable attenuation and noise on signals transmitted in broadband communication networks. Ex. 1001, 2:41–44, 3:11–16, 4:37–62, 6:45–46, 8:9–35; Ex. 1007, code (57), ¶¶ 2, 6. The '518 patent and Mirfakhraei address these problems, at least in part, through the use of the same solution—multicarrier modulation (OFDM or DMT) with bit loading. Ex. 1001, code (57), 4:37–62, 8:9–26; Ex. 1007, code (57), ¶¶ 5–8, 14, 22, 25–28, 31, 35, claims 1, 13, 15, 18.

Although Patent Owner focuses on the differences in transmission media discussed in the '518 patent (coaxial cable with splitters) compared to Mirfakhraei (twisted pair telephone lines), the two types of media suffer the

same problems of variable attenuation and noise no matter that the sources of those problems might be somewhat different. Mirfakhraei discloses that conventional telephone lines suffer frequency-dependent attenuation that distorts communication signals having large bandwidths. Ex. 1007 ¶ 2. In the '518 patent, similar problems stem from differing coaxial cable lengths in homes or buildings causing variable attenuation, and the fact that the splitters used in such networks were originally designed to prevent communication across the tap ports with high impedances that cause micro-reflections leading to frequency-variable noise (e.g., ISI). *See, e.g.*, Ex. 1001, 2:28–48, 4:37–47; Ex. 1007 ¶ 2.

Nonetheless, these problems are fundamentally the same, and the fact that Mirfakhraei and the '518 patent address them using the same solution—multicarrier modulation with bit loading—is further evidence they are reasonably pertinent to one another.

Accordingly, Petitioner has shown by preponderant evidence that Mirfakhraei is reasonably pertinent to the problems addressed by the '518 patent. Mirfakhraei is thus analogous art as reasonably pertinent to the problems that the '518 patent addresses.

4. *Motivation to Combine*

Petitioner contends that a POSITA would have been motivated to combine Afshary and Mirfakhraei for several reasons. Pet. 40–45. Petitioner asserts that a POSITA would understand that Afshary's network operates over a coaxial cable has variable frequency response caused by signal reflections and interference. *Id.* at 40–41 (citing Ex. 1006, code (57), ¶¶ 7, 12–20, Fig. 1; Ex. 1002 ¶¶ 29–55, 128–138; Ex. 1007 ¶¶ 2–5, 14; Ex. 1018, 305–307). According to Petitioner, implementing Mirfakhraei's

DMT bit-loading protocol would increase the data transmission rate in Afshary's coaxial cable network, and would also improve reliability and robustness of communications therein. *Id.* at 41–42 (citing Ex. 1007 ¶ 3; Ex. 1002 ¶¶ 29–55, 139). Although Mirfakhraei describes DMT bit loading for a conventional telephone line, Petitioner contends that a POSITA would have understood that its bit-loading scheme could be implemented over coaxial cable. *Id.* at 42 (citing Ex. 1010, 374; Ex. 1013, code (54), 2:30–5:39, Figs. 1–2; Ex. 1016, code (54), 1:9–16, 3:34–59, 6:66–7:46, Fig. 1; Ex. 1017, 74; Ex. 1018, 305–307, 312; Ex. 1002 ¶ 140).

Petitioner further asserts that integrating Mirfakhraei's DMT bit-loading protocol into Afshary's cable LAN adapter would entail incorporating Mirfakhraei's multi-carrier modulator and demodulator into an application specific integrated circuit ("ASIC"). *Id.* at 42–43 (citing Ex. 1007 ¶ 15, Fig. 1; Ex. 1002 ¶¶ 141–144). Petitioner contends that this implementation would enable Afshary's cable LAN adapter to communicate at higher data rates, and that it would be more robust and reliable and less affected by the harsh environment of a coaxial cable infrastructure, including interference and signal reflections. *Id.* at 43 (citing Ex. 1007 ¶ 2; Ex. 1018, 305–307, 312; Ex. 1002 ¶¶ 141–144). Petitioner asserts that the combination would improve power efficiency by using more available bandwidth for communicating, and using higher order modulation schemes to transmit more bits onto frequency channels that experience less noise and interference. *Id.* Petitioner asserts that this implementation is the combination of known elements according to known methods, or applying a known technique to a known device ready for the improvement, to yield predictable results. *Id.* at 43–44 (citing Ex. 1002 ¶¶ 145–146).

a) *Frustration of Goals*

Patent Owner argues that replacing Afshary's single carrier modulation with Mirfakhraei's multi-carrier modulation would frustrate Afshary's goal of providing a simple, low-cost home networking solution because it would add unwanted complexity, hardware cost, and operational costs to Afshary's network. PO Resp. 31–32 (citing Ex. 1006 ¶¶ 5–6, 37; Ex. 2001 ¶¶ 82–91). Patent Owner argues that Afshary's LAN adapters provide robust communication with cost-effective components without the need to update or change existing hardware. *Id.* at 32–33 (citing Ex. 1006 ¶¶ 28–42, Fig. 4; Ex. 2001 ¶¶ 84–87). According to Patent Owner, even if Afshary's process reflects a “trade-off” between cost and performance, Afshary decided to favor cost management. *Id.* at 33. Patent Owner asserts that a POSITA would not have been motivated to insert Mirfakhraei's components into Afshary's adapters due to added cost and complexity. *Id.* (citing Ex. 1002 ¶ 83). Patent Owner then points to particulars of Mirfakhraei's system to support its assertion of added cost and complexity. *Id.* at 33–35 (citing Ex. 1007 ¶¶ 5, 14, 17–19; Ex. 2001 ¶¶ 88–91).

Petitioner criticizes Patent Owner's argument that because Afshary describes its coaxial cable LAN as “cost effective” a POSITA would not be motivated to add expensive components. Pet. Reply 16. Petitioner asserts that “courts reject this type of economic argument as irrelevant” and states that “many obvious modifications have some cost that is outweighed by the known benefit.” *Id.* (citing *Orthopedic Equipment Co., Inc. v. U.S.*, 702 F.2d 1005, 1013 (Fed. Cir. 1983); *In re Farrenkopf*, 713 F.2d 714, 718 (Fed. Cir. 1983)). Petitioner asserts that the Board was correct in its initial determination that “Patent Owner's arguments at most establish that a

POSITA would have considered tradeoffs between cost and complexity and performance in making the combination.” *Id.* (citing Inst. Dec. 26; *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000)).

Petitioner further argues that Patent Owner’s “assumption that Mirfakhraei’s bit-loaded multi-carrier approach would necessarily add cost and complexity is unfounded” because the computational complexity of a multicarrier system can be significantly less than that of a single-carrier system, especially in networks that suffer from interference and/or reflections. *Id.* at 16–17 (citing Ex. 1018, 305–306; Ex. 1036 ¶ 39).

Patent Owner responds that Petitioner fails to establish any alleged benefits that would outweigh the negative impact to Afshary’s expressed simplicity and cost concerns for multicarrier modulation. PO Sur-reply 4. Patent Owner argues that the technical evidence of its expert, Mr. Garrett, strongly favors Patent Owner in establishing that the combination would add complexity and costs contrary to Afshary’s stated goal. *Id.* at 4–5 (citing Ex. 2001 ¶¶ 82–91).

Petitioner asserts that Patent Owner’s arguments are premised on two false assumptions: “(1) that an Afshary-Mirfakhraei adapter is only capable of transmitting the same data to all other adapters at the same time . . . ; and (2) that transmissions on the Afshary-Mirfakhraei LAN would not include a mechanism to identify both the sender and recipient.” Pet. Reply 18 (citing Ex. 2001 ¶ 104; Ex. 1032, 59:24–68:17; Ex. 1036 ¶¶ 47–51).

Petitioner asserts that Patent Owner’s expert, Mr. Garrett, admitted that Afshary is not limited to broadcast transmissions, and contradicted himself regarding whether the alleged problem would exist in a non-broadcast scenario. *Id.* at 18–19 (citing Ex. 1032, 62:14–16, 67:17–69:14;

Ex. 1036 ¶ 47). Petitioner further asserts that it was well known that LANs like Afshary's employed addressing techniques to identify a message sender and recipient, as Mr. Garrett admitted. *Id.* at 19–20 (citing Ex. 1006 ¶ 41; Ex. 1034, 12–14, 150–151, 168–170, 184–186; Ex. 1033, 7–10, 275–282; Ex. 1031, 253–263; Ex. 1032, 45:19–46:12; Ex. 1036 ¶¶ 47–51; Ex. 2001 ¶ 123).

Petitioner further notes that the '518 patent does not describe how to configure its probing messages to avoid this alleged problem. *Id.* at 20 (citing Ex. 1032, 45:21–49:16; Ex. 1036 ¶ 44; *Muniauction, Inc. v. Thomson Corp.*, 532 F.3d 1318, 1327 n.3 (Fed. Cir. 2008) (patentee's argument that POSITA could not implement the combination was undermined by lack of description in patent itself)).

Petitioner further contends that Afshary's TDMA⁵ regulates access to the shared coaxial cable medium in the same manner as the '518 patent's scheduler. *Id.* at 20–21 (citing Ex. 1006 ¶ 34; Ex. 1001, 6:11–24, 9:42–49; Ex. 1032, 46:13–47:17, 48:4–49; Ex. 1036 ¶¶ 45, 52–53). Petitioner argues that Mirfakhraei does not require a dedicated connection, and that the reference describes, but is not limited to, a communication medium that is twisted pair. *Id.* at 21 (citing Ex. 1036 ¶ 53; Ex. 1007 ¶ 15). Petitioner asserts that “a POSITA would have understood that Mirfakhraei's handshake process is indeed not a substitute for TDMA but instead would operate within the TDMA scheme used by Afshary, enabling any two adapters to exchange probe messages and responses, just like any other type of message that could be exchanged by the adapters.” *Id.* (citing Ex. 1036 ¶¶ 53–54).

⁵ Time Division Multiple Access. Ex. 1006 ¶ 34.

Having considered the parties’ contentions and evidence, in our view, Patent Owner’s arguments focus on Afshary’s cost and complexity concerns, but overlook that Afshary also requires its system to be “robust.” Ex. 1006 ¶ 37. Afshary recognizes there is a trade-off between these considerations, stating

It is important for cable LAN adapter 32 to be screened from noise and hardy enough to work in any environment while remaining inexpensive. Thus, in order to keep costs low and the system robust, the architecture design of adapter 32 uses a digital modulation scheme such as Frequency Shift Keying (FSK) modulation or Binary Phase Shift Keying (BPSK) modulation.

Id. Although Patent Owner’s expert, Mr. Garrett, points to the components of Mirfakhraei as supporting his contention that Petitioner’s combination would add cost and complexity, he does not address Petitioner’s evidence that multi-carrier modulation with bit loading can actually be less costly and complex by reducing the FFT size and the number of computations needed as compared to single carrier modulation. Ex. 1018, 305–306; Ex. 1036 ¶ 39.

Accordingly, Petitioner has shown preponderant evidence that the combination of Afshary and Mirfakhraei would not frustrate any of Afshary’s stated goals.

b) Incompatibility

The parties present several contentions regarding whether the technologies of Mirfakhraei and Afshary are compatible, which we address below.

(1) ASIC Redesign

Patent Owner argues that a POSITA would not implement Mirfakhraei’s multi-carrier modulator and demodulator in Afshary because

it would fundamentally change its ASIC's architecture. PO Resp. 36 (citing Ex. 2001 ¶ 92). Patent Owner asserts that Mirfakhraei operates in an "always on" fashion and operates at different frequencies than Afshary, and that adding Mirfakhraei's modulator and demodulator would require additional improvements in Afshary's baseband layer. *Id.* at 37.

Patent Owner further argues that Petitioner's combination omits Mirfakhraei's controller 130, which is needed to implement its handshake process to achieve bit loading. *Id.* at 37–39 (citing Ex. 1007 ¶¶ 20–23, Fig. 1; Ex. 1002 ¶¶ 142–144; Ex. 2001 ¶¶ 95–97; Ex. 2002, 63:6–8, 63:20–64:5, 65:21–66:12). In addition, Patent Owner argues that Afshary "does not provide a synchronization mechanism that would overcome the shortcomings of Petitioner's combination." *Id.* at 39 (citing Ex. 1006 ¶ 31; Ex. 2001 ¶¶ 98–99; Ex. 2002, 87:20–88:6).

Patent Owner further asserts that Petitioner's combination would require additional buffers, controls, and overhaul of the circuit board, and would need to reconcile broadband to analog conversion within the ASIC when transmitting data from the MAC layer. *Id.* at 40 (citing Ex. 2001 ¶¶ 99–100). According to Patent Owner, the work needed to create the ASIC would not motivate a POSITA to make the combination when Afshary was already complete and needed no improvements. *Id.*

Petitioner contends that the technical difficulties that Patent Owner mentions, including circuitry level modification of an ASIC and details in data package encapsulations, are routine engineering tasks within the skillset of a POSITA that the '518 patent itself omits. Pet. Reply 2, 21–23 (citing Ex. 1036 ¶¶ 43–46, 52, 55–56). Petitioner further argues that Patent Owner provided no evidence that such changes are required, and that its expert,

Mr. Garrett, admitted there was “[n]o reason why” additional functionality could not be incorporated into Afshary’s ASIC based on Mirfakhraei’s teachings. *Id.* at 22 (citing Ex. 1032, 59:6–16) (alteration in original).

Patent Owner responds that Petitioner’s reliance on the capabilities of a POSITA comes too late to address the “long list of modifications identified by Mr. Garrett.” PO Sur-reply 10. Patent Owner argues that the ’518 patent’s claims have no effect on whether a POSITA would be motivated to combine Afshary and Mirfakhraei. *Id.* Patent Owner further argues that Petitioner consistently cites to the ’518 patent “to fill gaps—a clear tactic of hindsight reconstruction.” *Id.* at 10, 12–13 (citing Ex. 1001, 9:59–10:20, Fig. 7; Ex. 2006, 50:14–17, 50:25–51:2).

Patent Owner further argues that Petitioner failed to establish that Mirfakhraei’s DMT bit loading scheme for a point-to-point network would properly characterize its bit loading scheme on Afshary’s multi-point network that communicates across a coaxial splitter or how the signal-to-noise (SNR) ratio would be calculated. *Id.* at 11–12.

We do not agree with Patent Owner’s arguments. Petitioner stated at the outset that “a POSITA would have understood that modifying Afshary’s cable LAN adapter 32 to implement the DMT bit-loading protocol of Mirfakhraei would, for example, entail incorporating the functionality of Mirfakhraei’s multi-carrier modulator and multi-carrier demodulator into an ASIC.” Pet. 42; Ex. 1002 ¶¶ 52, 55–56, 141–144. Petitioner’s Reply contentions were grounded in the Petition and responsive to Patent Owner’s arguments in its Response, and hence are not new argument. *See Rembrandt Diagnostics, LP v. Alere, Inc.*, 76 F.4th 1376, 1385 (Fed. Cir. 2023).

When questioned during his deposition, Patent Owner's expert, Mr. Garrett, stated that there was "no reason why" additional functionality could not be incorporated into the controller of Afshary's ASIC but that "a lot of modifications [would be] required" to achieve Petitioner's combination. Ex. 1032, 58:18–59:16. Numerous modifications, however, does not necessarily mean it would be beyond the capability of a POSITA. In addition, as Petitioner notes, the '518 patent omits the details that Patent Owner would require of Petitioner's combination.

Accordingly, Petitioner has demonstrated preponderant evidence that a POSITA would have been able to implement Mirfakhraei's functionality in Afshary's ASIC. Patent Owner's arguments are unavailing.

(2) *Point-to-Point Versus Multi-Point*

Patent Owner argues that Mirfakhraei's point-to-point bit loading scheme is incompatible with Afshary's multi-point communication network. PO Resp. 40–44. Patent Owner asserts Mirfakhraei is designed for a point-to-point communication network without variance of endpoints whereas Afshary uses splitters within a home network to reach multiple client endpoints which receive identical data. *Id.* at 41 (citing Ex. 1007 ¶¶ 6–7, 18, Fig. 1; Ex. 2001 ¶ 101; Ex. 2002, 78:6–16; Ex. 1002 ¶¶ 80–81).

Patent Owner argues that Mirfakhraei's bit loading on its point-to-point connection would not operate effectively when providing the same bit loading profile to multiple endpoints. *Id.* at 41–42 (citing Ex. 1007 ¶¶ 22–23, 31–32, 34; Ex. 2001 ¶¶ 103–105; Ex. 2002, 78:6–16). Patent Owner asserts that Petitioner could not explain how Mirfakhraei's handshake process would work in the combination. *Id.* at 42–43 (citing Ex. 1007 ¶¶ 20–23; Ex. 2001 ¶¶ 106–107; Ex. 2002, 57:18–60:11, 61:19–62:2).

Patent Owner further argues that, in Petitioner’s combination, the transmitting node would not be able to differentiate reported characteristics for signal paths from the receiving nodes, and thus would have to calculate SNR for the entire house, which would result in sub-optimal bit loading on the signal paths between nodes and lead to less efficient data transfer than what Afshary already provides. *Id.* at 43–44 (citing Ex. 2001 ¶¶ 108–110).

Petitioner replies that each of the features Patent Owner alleges to be required in Petitioner’s combination are not found in the ’518 patent’s claims and that the ’518 patent is silent on implementation details. Pet. Reply 22 (citing Ex. 1036 ¶¶ 43–46, 56; *Muniauction*, 532 F.3d at 1327 n.3). Petitioner further contends that Patent Owner provides no evidence that such changes or additions would be required, nor does Patent Owner argue or provide any evidence that such changes were not within the capabilities of a POSITA or that a POSITA would not have a reasonable expectation of success in incorporating Mirfakhraei’s techniques into Afshary’s ASICs. *Id.* at 22–23 (citing Ex. 2001 ¶¶ 88–100; Ex. 1036 ¶¶ 45, 55–56).

We agree with Petitioner that the ’518 patent does not describe how its LAN devices distinguish signal paths when reporting SNR and deciding bit loading for a particular path on a network. We find this lack of description to be evidence that the ’518 patent’s drafter thought that a POSITA would have understood how message addressing is performed on a multi-point network to provide appropriate bit loading on signal paths based on SNR. We find it inappropriate to hold Petitioner’s combination to a higher standard of specificity than the ’518 patent provides.

Furthermore, Petitioner’s expert, Mr. Bertonis, correctly states that such addressing is a fundamental principle of how devices communicate

over a LAN of which a POSITA would be aware. Ex. 1036 ¶ 48. He further states that Afshary mentions “designated” adapters, implying Afshary employs addressing techniques. *Id.* ¶¶ 49–51 (citing Ex. 1006 ¶ 42). Patent Owner has not explained sufficiently what would have been difficult about using Mirfakhraei’s multi-carrier bit loading in Afshary’s LAN adapters, particularly when Afshary’s LAN adapters and devices already use addressing and TDMA which would support communication of SNR and bit loading profiles between devices.

Accordingly, Petitioner presents preponderant evidence that Mirfakhraei’s multi-carrier bit loading would be compatible with Afshary’s multi-point network. Patent Owner’s arguments are unavailing.

(3) *Different Frequencies*

Patent Owner further argues that Afshary operates on frequencies that are not used by Mirfakhraei. PO Resp. 44–48; PO Sur-reply 5. Specifically, Patent Owner contends that the operational range of Afshary is between 1000 to 2000 MHz to avoid interference with cable TV services below 950 MHz. PO Resp. 44–45 (citing Ex. 1006 ¶¶ 7, 12, 24–28, Fig. 3; Ex. 2001 ¶¶ 111–113, 115). Patent Owner states that Mirfakhraei’s ADSL transceiver (i.e., modem) communicates over conventional telephone lines on the very frequencies that Afshary’s adapters specifically avoid. *Id.* at 45–46 (citing Ex. 1006 ¶¶ 24–25; Ex. 1007 ¶¶ 2–3, 5, 15; Ex. 2001 ¶¶ 113–114). Patent Owner asserts that Mirfakhraei’s ADSL system is adapted for long range transmission and functions over low frequency bands to avoid loss in signal characteristics over long distances. *Id.* at 46 (citing Ex. 2001 ¶¶ 113–114; Ex. 2002, 54:17–55:1). Patent Owner further argues that Afshary’s in-home network includes an ADSL cable modem 30 operating below 950

MHz whereas the LAN adapters operate at 1000–2000 MHz. *Id.* at 46–48 (citing Ex. 1006 ¶¶ 18, 25, Fig. 1; Ex. 2001 ¶¶ 116–117).

Petitioner responds that Patent Owner’s “distinct frequency bands” argument is meritless. Pet. Reply 23–25. Specifically, Petitioner contends that a POSITA would have understood that Mirfakhraei’s multi-carrier signals would be transmitted over Afshary’s operating frequency range using Afshary’s up-conversion and down-conversion techniques. *Id.* at 23–24 (citing Pet. 31–32, 54–56; Ex. 1006, code (57), ¶¶ 2, 7, 12, 24–25, 35–39, 41, Figs. 1, 3–4; Ex. 1007 ¶¶ 4, 18–19; Ex. 1036 ¶¶ 57–61).

We agree with Petitioner that any difference in the operating frequency ranges of Mirfakhraei and Afshary are not a barrier to their combination. Pet. 31–32, 54–56. Mirfakhraei’s multi-carrier bit loading is not fundamentally different whether implemented in the lower frequency band that ADSL or cable TV services occupy (to the extent Mirfakhraei is limited to these ranges), or a higher frequency band used for home networks. Hence, we view Patent Owner’s argument as one of bodily incorporation of Mirfakhraei’s teachings into Afshary, which is an improper approach to obviousness. Pet. Reply 24; *Allied Erecting and Dismantling Co., Inc. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016).

In addition, we agree with Petitioner that Mirfakhraei’s multi-carrier signals would be transmitted over Afshary’s operating frequency range using its up-conversion and down-conversion techniques to translate signals to different frequencies. Pet. 31–32, 54–56; Pet. Reply 23–25.

Thus, Petitioner shows preponderant evidence that any differences in operating frequencies between Mirfakhraei and Afshary would not render them incompatible. Patent Owner’s argument is unavailing.

(4) *Expert Experience*

Patent Owner argues that Petitioner’s expert, Mr. Bertonis, has experience in **wireless** broadband technology relating to DOCSIS for communication over wireless paths. PO Resp. 48 (citing Ex. 2002, 11:17–13:4, 15:11–17, 17:16–18, 22:6–8, 22:18–23:3; Ex. 1002, Appx. A at 5). Patent Owner states that Mr. Bertonis admits that in these types of wireless schemes, modulation is not controlled by the device but by cable operators. *Id.* (citing Ex. 2002, 36:21–37:5). Patent Owner contends that, because of his alleged lack of knowledge in the coaxial field, Mr. Bertonis misses fundamental issues for his proposed combinations and analysis of the prior art. *Id.* at 49. Patent Owner argues that during Mr. Bertonis’s deposition, it allegedly became clear that his interpretation of the prior art was based on a “cursory review at best,” that he had no professional knowledge of multi-carrier modulation schemes, and that he spent years on a “hobby-type mission triggered by his friend’s startup” learning about the technology that a POSITA would not have had. *Id.* at 50 (citing Ex. 2002, 42:11–18, 44:7–10; Ex. 2001 ¶ 54). Patent Owner further alleges that Mr. Bertonis has made significant sums of money by working with Petitioner, calling into question the helpfulness of his testimony. *Id.* at 50–51.

Patent Owner argues that, conversely, Patent Owner’s expert, Mr. Garrett, has years of experience with coaxial cable and is “the sole expert with the requisite experience to opine about what an actual POSITA would and would not have found obvious, and is better positioned to provide helpful testimony.” *Id.* at 49 (citing Ex. 2001 ¶¶ 8–13). Patent Owner asserts that Mr. Garrett is the “more relevant declarant” who states that “a

POSITA would not have made the proposed combination.” *Id.* at 50 (citing Ex. 2001 ¶ 54).

Petitioner contends that Mr. Bertonis is well qualified to testify from the perspective of a POSITA. Pet. Reply 25–26. Petitioner states that “Mr. Bertonis’s industry experience with coaxial cable and with multicarrier modulation is extensive.” *Id.* at 25 (citing Ex. 1036 ¶¶ 62–63). Petitioner contends he began working with coaxial cable in 1976 and his work includes cable modulators, cable boxes, and headend equipment. *Id.* (citing Ex. 1002, Appx. A at 3; Ex. 2002, 81:9–85:8; Ex. 1036 ¶ 62). Petitioner further asserts that Mr. Bertonis began to study the DOCSIS cable standard in 1999 and followed it “fairly heavily” because it was important for his product he developed, similar to a cable system, to be compliant with the standard. *Id.* at 25–26.

Petitioner further disputes that Mr. Bertonis’s opinions are biased due to past dealings with Petitioner. *Id.* at 26. Petitioner acknowledges that Mr. Bertonis’s company sold product to Petitioner, but it was also sold to other major cable operators and occurred twenty-one years ago such that “it defies belief” that it would influence his testimony. *Id.* (citing Ex. 2002, 26:17–30; Ex. 1036 ¶ 64).

Petitioner asserts that Patent Owner’s expert, Mr. Garrett, did not have “any industry experience with coaxial cable until almost 2008, almost 6 years *after* the relevant time period.” *Id.* (citing Ex. 2001 ¶¶ 8–11, Appx. A, p. 81). Petitioner asserts that Mr. Garrett admitted he did not qualify as a POSITA in the relevant 2002 timeframe under his own standard, contrary to his declaration. *Id.* (citing Ex. 1032, 12:6–13:9; Ex. 2001 ¶ 40). Petitioner further states that Mr. Garrett left the communications industry for the

financial services industry over five years ago in 2019, contrary to the CV appended to his declaration. *Id.* (citing Ex. 1032, 13:10–14:15). Petitioner argues that “if either expert suffers from a lack of pertinent experience, it is Mr. Garrett.” *Id.*

We determine that Mr. Bertonis and Mr. Garrett had at least the skill level of a POSITA at the time they submitted their declarations and testimony in this case. Ex. 1002 ¶¶ 4–15, Appx. A; Ex. 2001 ¶¶ 8–12, Appx. A; *cf Osseo Imaging, LLC v. Planmeca USA Inc.*, 116 F.4th 1335 1341 (Fed. Cir. 2024) (“An expert need not have acquired that skill level prior to the time of the invention to be able to testify from the vantage point of a person of ordinary skill in the art.”). Accordingly, we see no reason to disregard the testimony of either on the basis that they do not have a POSITA’s skill level.

c) *Impermissible Hindsight*

Patent Owner argues that the ’518 patent is the only reference in this proceeding that discloses bit loading on a coaxial network, and that there is no evidence this would have been obvious. PO Resp. 51 (citing Ex. 2001 ¶¶ 118–119; *McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1351 (Fed. Cir. 2001)). Patent Owner asserts that the Petition is “fraught with hindsight bias” and while the ’518 patent “does not propose any new processing of signals, it is the only reference that recognized the issues of ISI in coaxial networks and addressed specific impairments that previously restricted high bandwidth communication between devices over ***on-premises coaxial cabling*** over coaxial splitters.” *Id.* at 52 (citing *Power Integrations, Inc. v. Fairchild Semiconductor Int’l, Inc.*, 711 F.3d 1348, 1368 (Fed. Cir. 2013)). Patent Owner asserts that “in cases like this, it is incredibly

important to focus on what a POSITA would have been **motivated** to do, not simply what a POSITA would have been **able** to do.” *Id.* (citing *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1068–69 (Fed. Cir. 2018)). Patent Owner asserts that Petitioner over-relies on “unsupported and conclusory expert opinions [which] is a clear sign of hindsight bias.” *Id.* (citing *In Touch Techs., Inc. v. VGO Commc’ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)).

Patent Owner argues that Petitioner relies on two alleged shortcomings of Afshary’s coaxial cables: (1) variable frequency response of the cable medium; and (2) the addition of Mirfakhraei’s DMT adds reliability and robustness to communications with Afshary’s system. *Id.* at 53 (citing Pet. 41–42). Patent Owner asserts that Afshary already solves each alleged shortcoming, and these are not impairments and do not support a motivation to improve Afshary and Mirfakhraei. *Id.*

(1) Variable Frequency Response

Patent Owner argues that Afshary addresses the alleged impairment of “variable frequency response” by implementing filters to address reflection issues and thus would not need Mirfakhraei’s multi-carrier bit loading to solve that problem. PO Resp. 54–56 (citing Pet. 41; Ex. 1006 ¶ 42; Ex. 1007 ¶ 3; Ex. 1002 ¶¶ 49–55, 128–138; Ex. 2001 ¶¶ 121–122). Patent Owner further contends that these filters are low-cost and thus consistent with Afshary’s goal of a low-cost solution. *Id.* at 55–56 (citing Ex. 2001 ¶¶ 121–122).

Petitioner asserts that Patent Owner contradicts itself by arguing that Afshary does not suffer channel impairments but on the other hand uses various mechanisms (such as filters and error correct codes) to address

channel impairments. Pet. Reply 14 (citing PO Resp. 55, 58, 61–62). Petitioner states that Afshary’s network suffers from the same channel impairments as does the ’518 patent’s network. *Id.* (citing Ex. 1036 ¶ 46).

Petitioner further argues that the use of certain techniques in Afshary to improve reliability does not remove the motivation to also use Mirfakhraei’s bit-loaded multi-carrier modulation to further improve the transmission robustness and efficiency. *Id.* (citing *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380–81 (Fed. Cir. 2023) (“That [the two references] address the same problem and that [the second reference discloses] a known way to address that problem is precisely the reason that there’s a motivation to combine under *KSR* and our precedent”))).

Petitioner observes that communication systems typically employ multiple mechanisms to achieve an optimal result. *Id.* at 14–15 (citing Ex. 1036 ¶¶ 32–33). Petitioner further asserts that a POSITA would recognize that replacing Afshary’s single-carrier modulation with Mirfakhraei’s bit-loaded multi-carrier modulation is simply applying a known techniques to a known problem yielding an expected benefit, i.e., increased system efficiency and robustness. *Id.* at 15 (citing Ex. 1007 ¶¶ 2, 4, 14; Ex. 1036 ¶¶ 34–35). Petitioner further asserts that Afshary’s filters at best only address reflections from LPF 18, not reflections from other sources. *Id.* (citing Ex. 1006 ¶ 42; Ex. 1036 ¶ 34).

Patent Owner replies that Petitioner’s conclusory assertion that a multi-carrier system **can** be more efficient than a single-carrier system does not refute its expert’s testimony that it **would** add complexity and costs to Afshary’s network. PO Sur-reply 2–3. Patent Owner further argues that Petitioner conflates impairments between Afshary’s network and its medium

while avoiding Afshary's disclosure that coaxial cables are "a very clear, clean medium" and a POSITA would not turn to Mirfakhraei's network that uses telephone lines to improve Afshary. *Id.* at 3. Patent Owner argues that Afshary's network uses filters to address channel impairments. *Id.* Patent Owner reiterates that a POSITA would not have been motivated to insert Mirfakhraei's bit-loaded multi-carrier modulation because Afshary already provides a reliable and robust system. *Id.*

We disagree with Patent Owner's arguments. In our view, a POSITA would understand that adding Mirfakhraei's multi-carrier modulation with bit loading to Afshary's network would enhance its robustness by providing noise immunity and greater bandwidth through added channels, and efficient use of those channels through bit loading.

That Mirfakhraei discloses using multi-carrier modulation with bit loading on telephone lines does not detract from a POSITA's understanding that the technique would improve Afshary's coaxial cable network by addressing impairments such as variable frequency response and signal attenuation using Mirfakhraei's technique. Ex. 1036 ¶¶ 26, 33. That these benefits come at some cost and complexity does not diminish that, at least in some cases, a POSITA would have deemed them desirable such as for robustness and reliability. *Id.* ¶¶ 36–39.

Petitioner demonstrates by preponderant evidence that a POSITA would have seen the value of using Mirfakhraei's multi-carrier modulation with bit loading in Afshary's coaxial network.

(2) Robust and Reliable System

In addition, Patent Owner argues that Afshary already achieved a robust and reliable communication system and did not need Mirfakhraei's

multi-carrier modulation scheme to improve Afshary's network. PO Resp. 59–60 (citing Pet. 25, 41, 43, Ex. 1004 ¶ 72; Ex. 1006 ¶ 37; Ex. 1007 ¶ 3; Ex. 1013, 26:4–20⁶; Ex. 1002 ¶¶ 49–55, 141–144; Ex. 2001 ¶¶ 125–133); PO Sur-reply 3, 6–8. Specifically, Patent Owner contends that Afshary already has an efficient bit-loading scheme to improve available bandwidth and thus would not need Mirfakhraei's multi-carrier bit loading. PO Resp. 59–60.

Petitioner contends that the use of certain techniques in Afshary to improve reliability does not remove the motivation to use Mirfakhraei's bit-loaded multi-carrier modulation to further improve transmission robustness and efficiency. Pet. Reply 14 (citing *Intel*, 61 F.4th at 1380–81).

We agree with Petitioner that a POSITA would understand that adding Mirfakhraei's bit-loaded multi-carrier modulation to Afshary's network would enhance its robustness and reliability through noise immunity and increased bandwidth used efficiently through bit-loading. *See, e.g.*, Pet. 42; Ex. 1036 ¶¶ 29–35. A POSITA would have seen this improvement as desirable at least in scenarios where the cost and complexity concerns that Patent Owner mentions were outweighed by the desire for robustness and reliability of network communications.

Accordingly, Petitioner presents preponderant evidence that a POSITA would have been motivated not by hindsight but by a desire for robustness and reliability of communications to make the combination of Afshary and Mirfakhraei.

⁶ Citation not found.

(3) *Harsh Environment*

Patent Owner asserts that Petitioner contends Afshary operates in a “harsh” environment as a reason to improve Afshary with Mirfakhraei but Afshary describes its coaxial medium as very clean. PO Resp. 54 (citing Ex. 1006 ¶ 24; Ex. 2001 ¶¶ 121–124). Patent Owner further asserts that “harshness” is “an umbrella term for issues that could affect *all* communication mediums and is far too generic to support the Petition’s combination.” *Id.* (citing Ex. 2002, 113:9–120:21).

Patent Owner further asserts that Afshary’s coaxial network is a clean medium and not a “harsh” one as Petitioner alleges. *Id.* at 60–64 (citing Pet. 42; Ex. 1006 ¶¶ 5–6; Ex. 2001 ¶¶ 126–127). Patent Owner contends that Afshary differentiates between coaxial cabling and telephone lines, and favors the former as a cleaner medium such that Petitioner relied on hindsight to arrive at the proposed combination. *Id.* at 60–61 (citing Ex. 1006 ¶¶ 5–24, 27; Ex. 2001 ¶¶ 126–127). Patent Owner argues that Petitioner disregards Afshary’s disclosure in asserting coaxial cable is a “harsh” environment. *Id.* at 61–62 (citing Pet. 41–42; Ex. 1006 ¶¶ 6, 24; Ex. 1002 ¶¶ 54, 127; Ex. 2001 ¶ 128; Ex. 1018). Patent Owner further asserts that a POSITA would not look to improve transmission quality using an ADSL transceiver that operates over telephone lines like Mirfakhraei. *Id.* at 62 (citing Ex. 2001 ¶ 128).

Petitioner alleges that Afshary’s description of the coaxial cables as “a very clear, clean medium” refers to the cables, but not Afshary’s network. Pet. Reply 11 (citing Ex. 1006 ¶ 24). Petitioner argues that a POSITA would have understood that Afshary’s network includes components with imperfect connections and cabling that would introduce channel

impairments such as frequency-dependent attenuation and noise. *Id.* (citing Ex. 1010, 374–375, Fig. 1; Ex. 1018, 305; Ex. 1036 ¶ 25). Petitioner asserts that Mirfakhraei addresses frequency-dependent attenuation and other impairments. *Id.* at 11–12 (citing Ex. 1007 ¶¶ 2, 6; Ex. 1010, 375; Ex. 1018, 306; Ex. 1036 ¶¶ 26–27). Petitioner further contends that the motivation to combine Afshary and Mirfakhraei need not necessarily be what motivated the ’518 patent’s inventors. *Id.* at 12–13 (citing *Honeywell Int’l Inc. v. 3G Licensing, S.A.*, 124 F.4th 1345, 1353–54 (Fed. Cir. 2025)).

Patent Owner asserts that Petitioner did not address its arguments regarding why a POSITA would turn to a reference that uses telephone lines when Afshary “highlights issues with this medium,” or why a POSITA would turn to Mirfakhraei when Afshary already addresses channel impairments. PO Sur-reply 5–6. Patent Owner further contends that Petitioner conflates Afshary’s coaxial medium, which is clean, and the network, which suffers channel impairments addressed by its filters. *Id.* at 6 (citing Ex. 1006 ¶¶ 24, 42; Ex. 2001 ¶ 122).

We agree with Patent Owner that Afshary teaches that coaxial cables are a “very clear, clean medium” and that its comment concerning “harsh environment” pertains to AC power lines, not coaxial cable. Ex. 1006 ¶¶ 5 (Table 1), 24. Hence, Petitioner’s assertion of motivation to combine by reason of coaxial cable presenting a “harsh environment” is not persuasive.

(4) *Power-Efficient Modulation*

Patent Owner asserts that Petitioner attempts to argue that Mirfakhraei’s “DMT bit loading scheme” would improve Afshary by allowing more use of the bandwidths to transmit more bits onto frequency channels that experience less noise and/or interference. PO Resp. 64 (citing

Pet. 43; Ex. 1002 ¶¶ 141–144). Patent Owner argues that Afshary’s modulation scheme “already transmits data on channels with less noise and interference, and does so using optimal power for its architecture.” *Id.* at 64–65 (citing Ex. 2001 ¶¶ 124, 130; Ex. 1002 ¶¶ 141–146).

Specifically, Patent Owner alleges that Afshary uses signal carrier signaling as a robust, cost-effective method to provide high bandwidth in a “clean” medium, like coaxial cables, using FSK, BPSK, and QPSK to ensure efficient communication through the system. *Id.* at 65 (citing Ex. 1006 ¶¶ 36–37; Ex. 2001 ¶ 131). According to Patent Owner, Petitioner ignores Afshary’s modulation schemes and their efficiencies in power consumption and data transmission. *Id.* Patent Owner argues that the combination of Afshary and Mirfakhraei would not provide improved power efficiency by using more available bandwidth for communicating because the bit loading schemes are not tied to the specific SNRs profile of the channel to each specific endpoint in the proposed combination, either resulting in too many or too few bits for the given SNR profile leading to inefficiencies or data loss. *Id.* at 65–67 (citing Ex. 2001 ¶¶ 132–133).

Petitioner contends that Mirfakhraei discusses bandwidth and power optimization, and that Mirfakhraei would have commended itself to an inventor’s attention in considering the problem addressed by the ’518 patent. Pet. Reply 9–10 (citing Ex. 1036 ¶¶ 23–24). Petitioner argues that Afshary employs addressing techniques that would enable channel characterization on the specific communication paths between network devices, such that power optimization could be carried out on a channel-by-channel basis. *Id.* at 10–20 (citing Ex. 1006 ¶ 41; Ex. 1036 ¶¶ 47–51; Ex. 2001 ¶ 123).

We agree with Petitioner’s contentions that a POSITA would have understood that Mirfakhraei’s multi-carrier bit loading techniques would be applied to Afshary such that power would be optimized on each of multiple channel frequencies rather than a single bit loading profile that is assigned to all network devices for communication, as Patent Owner argues. Ex. 1036 ¶¶ 47–51; Ex. 2001 ¶¶ 123–124, 130, 132–133. Petitioner correctly contends that this would be accomplished through the capability of Afshary’s LAN adapters to address each other on the local cable network, as the term “designated . . . adapter” in Afshary implies. Ex. 1006 ¶ 41; Ex. 1036 ¶¶ 47–51. Alternatively, or in addition, Afshary’s LAN adapters would communicate with scheduled time slots via TDMA. Ex. 1006 ¶ 34. Hence, we do not agree that Petitioner’s combination would be inefficient in terms of its bit loading or power usage.

*d) Conclusion for Motivation to Combine with
Reasonable Expectation of Success*

On this record, Petitioner has shown that a POSITA would have been motivated to combine Afshary and Mirfakhraei with a reasonable expectation of success. We determine that this motivation would not frustrate the ’518 patent’s goals; that the two references are not incompatible by reason of required ASIC redesign, or that Mirfakhraei discloses a point-to-point network while Afshary is multi-point, or that the two use different frequency bands. We determine that both Mr. Bertonis and Mr. Garrett qualify as POSITAs. We determine that Petitioner did not use impermissible hindsight with respect to the motivations to combine regarding variable frequency response, robustness and reliability, and

power-efficient modulation, but did use impermissible hindsight with respect to the “harsh environment” motivation as contrary to Afshary’s teaching.

Accordingly, overall, we determine that Petitioner has presented preponderant evidence of motivations to combine Afshary and Mirfakhraei with a reasonable expectation of success for the reasons explained.

5. *Claim 1*

We now address Petitioner’s contentions that claim 1 is disclosed by the combination of Afshary and Mirfakhraei. Pet. 28–51. Patent Owner does not dispute Petitioner’s contentions. We conclude for claim 1 that Petitioner has shown preponderant evidence that claim 1 would have been obvious over Afshary and Mirfakhraei for the reasons that follow.

a) *Preamble 1pre: Data Communication Network*

Petitioner contends that Afshary discloses a coaxial cable local area network (LAN) (“data communication network”). Pet. 28–29 (citing Ex. 1006 ¶¶ 2, 7, 12, 14, 19–23, 41, Figs. 1–2; Ex. 1002 ¶¶ 118–120).

We determine that Petitioner has shown preponderant evidence that Afshary discloses the preamble 1pre so we do not decide whether the preamble is limiting.

b) *Limitation 1A: At Least Two Network Devices*

Limitations 1A recites “at least two network devices, each network device comprising a multi-carrier modulator for modulating data, an up converter for translating the modulated data to an RF carrier frequency, a down converter for translating an RF signal, and a multi-carrier demodulator for demodulating the translated RF signal to produce data.”

Petitioner contends that Afshary discloses each feature of limitation 1A other than a modulator and demodulator that are multi-carrier, but asserts that such devices are disclosed by Mirfakhraei. Pet. 29.

Petitioner contends that Afshary discloses cable LAN adapters 32 (“at least two network devices”) within its coaxial LAN. *Id.* at 30 (citing *id.* at § VI.A.1.a; Ex. 1006 ¶¶ 18–19, 21–23, 41, Figs. 1–2; Ex. 1002 ¶ 121).

Petitioner contends that Afshary discloses a modulator 96 and RF & Mixed Signal section 100, digital to analog converter (DAC) 108, up converter 112, local oscillator (LO) frequency synthesizer timing circuit 120, mixer 122, and power amplifier (PA) 116 (collectively, “up converter for translating the modulated data to an RF carrier frequency”). *Id.* at 31–32 (citing Ex. 1006 ¶¶ 38–39; Ex. 1002 ¶¶ 123–124).

Petitioner contends that Afshary discloses that these components operate to translate the modulated data from the Baseband section 90 to a 1300 MHz center frequency (“RF carrier frequency”) and that the modulated data occupies a bandwidth of 5 MHz. *Id.* at 31–32 (citing Ex. 1006 ¶¶ 25, 38–39; Ex. 1002 ¶¶ 123–124). Petitioner asserts that the up-converted modulated data is transmitted as an RF signal to another cable LAN adapter 32 to facilitate communication between client devices. *Id.* (citing Ex. 1006 ¶¶ 23, 26, 39, 41, Fig. 3; Ex. 1002 ¶¶ 123–124).

Petitioner further contends that, for receiving RF modulated data, the RF & Mixed Signal section 100 includes low noise amplifier (LNA) 118, LO 120, mixer 122, down converter 114, and analog to digital converter (ADC) 110 (collectively, “down converter for translating an RF signal”). *Id.* at 33 (citing Ex. 1006 ¶¶ 38–39, 41; Ex. 1002 ¶¶ 125–126). Petitioner asserts that “Afshary teaches that these components operate to translate a

received RF signal to a lower frequency signal.” *Id.* (citing Ex. 1006 ¶¶ 38–39, 41; Ex. 1002 ¶¶ 125–126). According to Petitioner, “Afshary teaches that the down-converted signal from the RF & Mixed Signal section 100 is demodulated by demodulator 98.” *Id.* (citing Ex. 1006 ¶¶ 41–42; Ex. 1002 ¶¶ 125–126). Petitioner states that the “demodulated data from demodulator 98 is decoded and corrected by FEC decoder 94 to recover digital data that is provided to MAC & Client Interface section 80.” *Id.* (citing Ex. 1006 ¶¶ 41–42; Ex. 1002 ¶¶ 125–126).

Petitioner asserts that “Figure 1 of Mirfakhraei . . . shows a transmitter 110 and a receiver 190 of a transceiver 100 that communicates using Mirfakhraei’s DMT and a bit-loading scheme.” *Id.* at 35 (citing Ex. 1007 ¶¶ 5–8, 14–15; Ex. 1002 ¶ 130). According to Petitioner, Mirfakhraei teaches that the transmitter 110 includes framer 113, tone ordering block 114, constellation mapper 115, Inverse Discrete Fourier Transform (IDFT) block 116, buffer 117, and TX handshake block 120 (collectively, “multi-carrier modulator for modulating data”). *Id.* at 35–36 (citing Ex. 1007 ¶¶ 15–19; Ex. 1002 ¶ 130).

Petitioner contends that “Mirfakhraei teaches that the receiver 190 includes time domain equalizer (TEQ) 180, buffer 197, Discrete Fourier Transform (DFT) block 196, frequency domain equalizer 195, slicer 194, deframer 193, and RX handshake block 170 (collectively, “multi-carrier demodulator for demodulating the translated RF signal to produce data”).” *Id.* at 38–39 (citing Ex. 1007 ¶¶ 21–24; Ex. 1002 ¶ 135).

We determine that Petitioner has shown preponderant evidence that limitation 1A is disclosed by the combination of Afshary and Mirfakhraei.

c) *Limitation 1B: Cable Wiring*

Limitation 1B recites “cable wiring comprising a splitter with a common port and a plurality of tap ports, and a plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices.”

Petitioner contends that Afshary discloses cable LAN adapters 32 (“network devices”) within the coaxial cable LAN. Pet. 45 (citing Ex. 1006 ¶¶ 18–19, 21–23, Figs. 1–2; Ex. 1002 ¶¶ 148–149). According to Petitioner, “Afshary explains that drop cable 10 is provided to splitter 22 within home 12.” *Id.* (citing Ex. 1006 ¶¶ 16, 18–19; Ex. 1002 ¶¶ 148–149). Petitioner asserts that “Afshary teaches that ‘drop cable 10 is split by splitter 22 into different cable wires 24, [with] each cable wire 24 being routed to different rooms in home 12.’” *Id.* at 45–46 (citing Ex. 1006 ¶ 18; Ex. 1002 ¶¶ 148–149) (alteration in original).

Referring to Afshary’s Figure 1, Petitioner contends that the splitter 22 (“splitter”) includes an input port (“common port”) and multiple output ports (“plurality of tap ports”). *Id.* at 46 (citing Ex. 1006 ¶¶ 16, 18–19; Ex. 1001, 1:53–57, Fig. 1; Ex. 1002 ¶¶ 148–149). According to Petitioner, from the output ports, multiple cable wires 24 (“cable wiring” and “plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices”) are connected to the cable LAN adapters 32. *Id.* at 46–47 (citing Ex. 1006 ¶¶ 16, 18–19; Ex. 1001, 1:53–57, Fig. 1; Ex. 1002 ¶¶ 148–150).

We determine that Petitioner has shown by preponderant evidence that limitation 1B is disclosed by Afshary.

d) Limitation 1C: Multi-Carrier Signaling

Limitation 1C recites “whereby network devices communicate with each other through the cable wiring using multi-carrier signaling.”

Petitioner contends that Afshary discloses cable LAN adapters 32 (“network devices”) that communicate with each other via cable wire 24 (“cable wiring”). Pet. 47 (citing Ex. 1006 ¶¶ 16, 18–19, 21–23, Figs. 1–2; Ex. 1002 ¶ 151). Petitioner asserts that the cable LAN adapters 32 in the Afshary-Mirfakhraei system communicate with each other using the DMT bit-loading protocol taught by Mirfakhraei. *Id.* at 47–48 (citing Ex. 1007, code (54), ¶¶ 2–3, 5–8, 14–15, Fig. 1; Ex. 1002 ¶ 151). Petitioner alleges that “Mirfakhraei explains that DMT is a multi-carrier communication technique (claimed ‘communicat[ing] ... using multi-carrier signaling’).” *Id.* at 48 (citing Ex. 1007, code (54), ¶¶ 2–3, 5–6, Fig. 1; Ex. 1002 ¶¶ 151–152) (alterations in original).

We determine that Petitioner has shown by preponderant evidence that limitation 1C is disclosed by the combination of Afshary and Mirfakhraei.

e) Limitation 1D: Probe Messages

Limitation 1D recites “wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics and bit loading is selected based on the determined channel characteristics.”

Petitioner asserts that “the Afshary-Mirfakhraei system implements the DMT bit loading scheme taught by Mirfakhraei.” Pet. 48 (citing Ex. 1007, code (54), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶ 153). Petitioner states that, “[t]o facilitate the DMT bit loading scheme, the cable

LAN adapters (claimed “network devices”) of the Afshary-Mirfakhraei system include the TX handshake block 120 . . . and the RX handshake block 170 . . . to implement the ‘bit-loading’ process that characterizes the capabilities of sub-channels and determines the number of bits-per-symbol transmitted over the channel’ as taught by Mirfakhraei.” *Id.* (citing Ex. 1007, code (57), 14, ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶ 153).

According to Petitioner, Mirfakhraei discloses that TX handshake block 120 of a first transceiver generates and transmits handshake signals to a second transceiver (“transmit probe messages through the cable wiring”), with each handshake signal comprising a known signal (*e.g.*, a known signal pattern or a known pseudo-random signal). Pet. 49–50 (citing Ex. 1007 ¶¶ 20–23; Ex. 1002 ¶ 154). Petitioner asserts that “Mirfakhraei further teaches that RX handshake block 170 of the second transceiver estimates the SNR (claimed “channel characteristics”) for each sub-channel based on received handshake signals (claimed “analyze received probe message signals”). *Id.* at 50 (citing Ex. 1007 ¶¶ 21–23; Ex. 1002 ¶ 154).

Regarding Mirfakhraei’s bit-loading, Petitioner contends that Mirfakhraei discloses that “the size of a constellation map for a subchannel, and hence the number of bits represented by each transmitted signal, is based on the SNR of the subchannel.” *Id.* (citing Ex. 1007 ¶¶ 4–8, 14, 17–18, Figs. 1–2; Ex. 1002 ¶¶ 29–55, 155).

According to Petitioner, Mirfakhraei discloses that “the RX handshake block 170 facilitates implementation of the bit loading process by comparing the received handshake signal to the known signal values that were transmitted.” *Id.* (citing Ex. 1007 ¶¶ 5–8, 14, 20, 22–23, 25–32, Figs. 1–2; Ex. 1002 ¶ 155). Petitioner asserts that, “[b]ased on the

comparison, SNR values for each sub-channel are determined.” *Id.* (citing Ex. 1007 ¶¶ 5–8, 14, 20, 22–23, 25–32, Figs. 1–2; Ex. 1002 ¶ 155).

Petitioner argues that the “appropriate bit-loadings for each sub-channel are then determined based on the SNR values determined for each sub-channel (claimed “bit loading is selected based on the determined channel characteristics”).” *Id.* at 50–51 (citing Ex. 1007 ¶¶ 5–8, 14, 17, 20, 22–23, 25–32, Figs. 1–2; Ex. 1002 ¶ 155).

Petitioner further contends that “[s]ub-channels having higher SNRs are assigned higher order modulation constellations.” *Id.* at 51 (citing Ex. 1007 ¶¶ 5–8, 14, 17, 20, 22–23, 25–32, Figs. 1–2; Ex. 1002 ¶ 155). According to Petitioner, “[s]ub-channels having lower SNRs are assigned lower order modulation constellations.” *Id.* Petitioner states that “[f]or example, a sub-channel with a higher SNR modulates data using a larger QAM constellation such as 256-QAM, which enables each transmitted QAM symbol to represent 8 bits, while a sub-channel with a lower SNR modulates data using a smaller QAM constellation such as 16-QAM, which enables each transmitted QAM symbol to represent 4 bits.” *Id.* (citing Ex. 1007 ¶¶ 4, 17–18, 23–24; Ex. 1002 ¶¶ 29–55, 155). Petitioner contends that the “RX handshake block 170 of the second transceiver sends the determined bit-loadings for each sub-channel to the first transceiver, which then employs the bit-loadings in subsequent communications with the second transceiver.” *Id.* (citing Ex. 1007 ¶¶ 5–8, 14, 20, 22–23, 25–32, Figs. 1–2; Ex. 1002 ¶¶ 29–55, 153–156).

We determine that Petitioner has presented preponderant evidence that limitation 1D is disclosed by the combination of Afshary and Mirfakhraei.

f) Conclusion for Claim 1

We determine that Petitioner has shown preponderant evidence that a POSITA would have combined Afshary and Mirfakhraei with a reasonable expectation of success notwithstanding Patent Owner's arguments to the contrary. Petitioner has further demonstrated that each limitation is disclosed by the combination of Afshary and Mirfakhraei. Accordingly, Petitioner has shown that claim 1 of the '518 patent would have been obvious over the combination of Afshary and Mirfakhraei.

6. Claim 2

Claim 2 depends from claim 1 and recites "wherein a network device comprises a means for determining signal activity and selects a frequency band for operation that is not used by other services."

Petitioner contends that Mirfakhraei's receiver includes DFT block 196 that receives data samples from ADC 160. Pet. 52 (citing Ex. 1007, code (57), ¶¶ 15, 19, 24, Fig. 1; Ex. 1002 ¶¶ 157–158). According to Petitioner, Mirfakhraei explains that "discrete Fourier transform (DFT) block 196 performs a discrete Fourier transform on the filtered time-domain samples ... to determine frequency components associated with the sub-channels" (corresponding to the function of "determining signal activity" for the term "means for determining signal activity"). *Id.* (citing Ex. 1007 ¶ 24; Ex. 1002 ¶¶ 157–158; Ex. 1001, 8:4–8, 8:27–39, 11:14–18, Fig. 6) (alteration in original).

In the combination, Petitioner contends that Afshary's cable LAN adapter 32 would incorporate the portion of Mirfakhraei's receiving including DFT block 196 which performs a DFT, equivalent to an FFT, on samples from the ADC converter (corresponding to the structure of the

“means for determining signal activity”). *Id.* at 53–54 (citing Ex. 1006 ¶¶ 38–42, Fig. 4; Ex. 1007 ¶¶ 15, 21, 24, Fig. 1; Ex. 1001, 8:4–8, 8:27–39, 8:65–9:4; Ex. 1002 ¶¶ 157–160; Ex. 1019, 100–109; Ex. 1020, 554–561; Ex. 1021, 581–585).

Petitioner further contends that “in the Afshary-Mirfakhraei system, each cable LAN adapter selects a frequency band for operation so as to not interference with conventional cable TV service (claimed ‘selects a frequency band for operation that is not used by other services’).” *Id.* at 54–55 (citing Ex. 1006, code (57) ¶¶ 2, 7, 12, 24–25, 39, Figs. 1, 3; Ex. 1002 ¶ 161).

Although Patent Owner does not dispute Petitioner’s contentions for claim 2, we nonetheless determine that Petitioner has not shown preponderant evidence that claim 2 would have been obvious. From the ’518 patent’s description, we determine frequency band selection to refer to a band in which the channels or sub-channels supporting communication would exist, not the selection of channels or sub-channels for bit loading within a frequency band. *See, e.g.*, Ex. 1001, 11:8–12:6. The Afshary-Mirfakhraei combination does not disclose a network device with the capability to select between frequency bands (as opposed to channels or sub-channels within a frequency band).

Accordingly, we determine that Petitioner has not shown preponderant evidence that claim 2 would have been obvious.

7. Claim 3

Claim 3 depends from claim 1 and recites “wherein the network shares the cable wiring with a cable television service and the network

device up converter translates the modulated data to an RF carrier frequency above the frequency used by the cable television service.”

Petitioner contends that Afshary discloses a coaxial cable LAN that shares the coaxial cable wire 24 with existing cable services, including a conventional cable TV service. Pet. 56 (citing *id.* § VI.A; Ex. 1006, code (57), ¶¶ 2, 7, 12, 24–25, 39, Figs. 1, 3; Ex. 1002 ¶ 163). Petitioner asserts that Afshary’s RF & Mixed Signal section 100 translates modulated data of the coaxial cable LAN to an RF carrier frequency that ensures that the operating frequency range of the coaxial cable LAN is above and does not overlap the operating frequency range of the conventional cable TV service. *Id.* at 56–57 (citing Ex. 1006 ¶¶ 2, 17, 24–25, 37–39; Ex. 1002 ¶ 163).

Patent Owner argues that Mirfakhraei operates over the exact frequencies Afshary seeks to avoid. PO Resp. 67–68 (citing Ex. 1006 ¶¶ 24–25; Ex. 1007 ¶¶ 5, 15; Ex. 2001 ¶¶ 134–137). Patent Owner asserts that there is no basis to support that Mirfakhraei’s modulation scheme would work at higher frequencies, and that Petitioner’s expert testimony is unsupported by preponderant evidence. *Id.* at 68–69 (citing Ex. 1006 ¶¶ 26; Ex. 1007 ¶¶ 2–3; Ex. 2001 ¶¶ 56, 138–140, 163–164; *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985) (expert testimony based on a lack of factual support offers little probative value)).

Petitioner responds that Patent Owner “ignores that a POSITA would have the skill to modify Afshary’s RF & Mixed Signal section 100 to up-convert a signal to virtually any carrier frequency and therefore frequency range.” Pet. Reply 24–25 (citing Ex. 1036 ¶¶ 60–61).

We agree with Petitioner that, in the Afshary-Mirfakhraei combination, Afshary's LAN adapters up convert modulated data via their up converters to an RF carrier frequency that is above the frequency used by the cable television service. Pet. 56–57; Ex. 1006, code (57) ¶¶ 2, 7, 12, 17, 24–25, 37–39, Figs. 1, 3; Ex. 1002 ¶ 163. Mr. Bertonis's testimony is well supported by the evidence. Ex. 1036 ¶¶ 60–61.

We determine that Petitioner has shown preponderant evidence that claim 3 would have been obvious over the Afshary-Mirfakhraei combination.

8. *Claim 4*

Claim 4 is similar to claim 1 and incorporates means-plus-function limitations discussed in § II.B. Reviewing Petitioner's contentions for claim 4 (Pet. 57–68), for which Patent Owner does not present any arguments specific to its limitations, we determine that Petitioner has shown preponderant evidence that claim 4 would have been obvious over the combination of Afshary and Mirfakhraei.

a) *Preamble 4pre: Network Device*

Preamble 4pre recites “A network device for communicating data to other network devices over a coaxial wiring system comprising a splitter and a plurality of cable segments connected between the splitter and the network devices, the network device comprising.”

Petitioner contends that Afshary discloses a LAN over coaxial cable (“coaxial wiring system”) that includes cable LAN adapters (“network device for communicating data to other network devices”). Pet. 57–58 (citing Ex. 1006, code (57), ¶¶ 2, 7, 12, 14, 18–23, Figs. 1–2; Ex. 1002 ¶¶ 165–166). Petitioner further asserts that Afshary's cable LAN includes

splitters and multiple cable wires connected between the splitters and LAN adapters (“plurality of cable segments connected between the splitter and the network devices”). *Id.*

We determine that Petitioner has shown preponderant evidence that Afshary discloses preamble 4pre and thus do not decide whether it is limiting.

b) Limitation 4A: Data Modulator

Limitation 4A recites “a data modulator to produce a multicarrier modulated signal.”

Petitioner contends that “the cable LAN adapters of the Afshary-Mirfakhraei system would include the functionality of Mirfakhraei’s multi-carrier modulator to implement the DMT bit loading scheme taught by Mirfakhraei.” Pet. 59 (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶ 167). Petitioner asserts that “Mirfakhraei teaches a transmitter 110 that includes framer 113, tone ordering block 114, constellation mapper 115, IDFT block 116, buffer 117, and TX handshake block 120 (collectively, claimed ‘data modulator to produce a multicarrier modulated signal’) that generate a multi-carrier modulated signal based on Mirfakhraei’s DMT bit-loading scheme.” *Id.* (citing Ex. 1007 ¶¶ 14–19, Fig. 1; Ex. 1002 ¶ 167). Petitioner further argues that “Mirfakhraei teaches that these components of transmitter 110 operate to generate ‘a discrete multi-tone (DMT) communication signal’ (claimed ‘multicarrier modulated signal’).” *Id.* at 59–60 (citing Ex. 1007, code (57), ¶¶ 1–3, 5–8, 14–25, Figs. 1–2; Ex. 1002 ¶¶ 167–168).

We determine that Petitioner has demonstrated by preponderant evidence that limitation 4A is disclosed by the Afshary-Mirfakhraei combination. *Id.* at 60 (citing Ex. 1002 ¶¶ 167–168).

c) Limitation 4B: Demodulator

Limitation 4B recites “a demodulator for multicarrier modulated signal to produce data.”

Petitioner asserts that “the cable LAN adapters of the Afshary-Mirfakhraei system would include the functionality of Mirfakhraei’s multi-carrier demodulator to implement the DMT bit loading scheme taught by Mirfakhraei.” Pet. 60–61 (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶ 169). According to Petitioner, “Mirfakhraei teaches that the receiver 190 includes RX handshake block 170, TEQ 180, buffer 197, DFT block 196, frequency domain equalizer 195, slicer 194, and deframer 193 (collectively, claimed ‘demodulator for multicarrier modulated signal to produce data’).” *Id.* at 61 (citing Ex. 1007 ¶¶ 21–24; Ex. 1002 ¶ 169). Petitioner further asserts that “Mirfakhraei explains that these components operate to recover a data bit stream (claimed ‘produce[d] data[.]’) from different QAM symbols transmitted on each subcarrier of a multicarrier modulated signal.” *Id.* at 61–62 (citing Ex. 1007 ¶ 24, Fig. 1; Ex. 1002 ¶¶ 169–170).

We determine that Petitioner has shown preponderant evidence that limitation 4B is disclosed by the Afshary-Mirfakhraei combination.

d) Limitation 4C: Means for Producing and Transmitting

Limitation 4c recites “means for producing and transmitting a probe message.”

Petitioner asserts that “each cable LAN adapter 32 in the Afshary-Mirfakhraei system would use Mirfakhraei’s handshake signals to facilitate implementation of the DMT bit loading scheme described by Mirfakhraei.” Pet. 63 (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶ 171). Petitioner asserts that Mirfakhraei’s TX handshake block 120 generates a handshake signal that is a “known pseudo-random signal” or known signal pattern (corresponding to the function of “producing and transmitting a probe message” of the term “means for producing and transmitting a probe message”). *Id.* (citing Ex. 1007 ¶¶ 20–22; Ex. 1002 ¶ 171).

Petitioner contends that “Mirfakhraei teaches that TX handshake block 120 may be implemented in software by a host computer” and that “a POSITA would understand that a host computer implementing the TX handshake block 120 in software would entail executing software on a processor (corresponding to the structure of a ‘processor’ for the term ‘means for producing and transmitting a probe message’).” *Id.* at 64–65. Petitioner further contends that “the TX handshake block 120, when implemented by executing software on a processor, performs an algorithm that includes generating a signal known to a remote transceiver and transmitting the known signal to the remote transceiver (corresponding to the algorithm of ‘(a) generating a signal known to a receiving device; and (b) transmitting the known signal,’ identified as the algorithm performed by the corresponding structure of a ‘processor’).” *Id.* at 64–65 (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶¶ 171–173).

We determine that Petitioner has presented preponderant evidence that the Afshary-Mirfakhraei combination discloses limitation 4C.

e) Limitation 4D: Means for Receiving and Analyzing

Limitation 4D recites “means for receiving and analyzing a probe message to determine a bit loading profile used to transmit data.”

Petitioner contends that “each cable LAN adapter 32 in the Afshary-Mirfakhraei system would implement the DMT bit loading scheme described by Mirfakhraei.” Pet. 65 (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶ 174). Petitioner asserts that “each cable LAN adapter 32 includes the RX handshake block 170 . . . [that] receives a handshake signal from a TX handshake block 120 from another cable LAN adapter 32.” *Id.* (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶¶ 22, 174). According to Petitioner, “Mirfakhraei teaches that the RX handshake block 170 compares the received handshake signal to the known values that were transmitted to estimate the SNR for each sub-channel, which are then used to determine the appropriate bit loadings for each sub-channel (corresponding to the function of ‘receiving and analyzing a probe message to determine a bit loading profile used to transmit data’ of the term ‘means for receiving and analyzing a probe message to determine a bit loading profile used to transmit data’).” *Id.* at 66 (citing Ex. 1007 ¶¶ 25–32, Figs. 1–2; Ex. 1002 ¶ 174).

Petitioner asserts that “Mirfakhraei teaches that RX handshake block 170 may be implemented in software by a host computer” and a “POSITA would understand that a host computer implementing the RX handshake block 170 in software would entail executing software on a processor (corresponding to the structure of a ‘processor’ for the term ‘means for receiving and analyzing a probe message to determine a bit loading profile used to transmit data’).” *Id.* at 67–68 (citing Ex. 1007 ¶ 15, Fig. 1; Ex. 1002

¶ 175). Petitioner further contends that “the RX handshake block 170, when implemented by executing software on a processor, performs an algorithm that includes receiving a known signal from a remote transceiver, determining SNR levels for each subchannel based on the received known signal, and determining the bit-loading for each subchannel based on the determined SNR level for each subchannel (corresponding to the algorithm of ‘(a) receiving a known signal; (b) determining a SNR for each subchannel based on the received known signal; and (c) determining a bit loading for each subchannel based on the determined SNR for the subchannel,’ identified as the algorithm performed by the corresponding structure of a ‘processor’).” *Id.* at 68 (citing Ex. 1007, code (57), ¶¶ 2–3, 5–8, 14–25, Figs. 1–3; Ex. 1002 ¶¶ 174–175).

We determine that Petitioner has shown preponderant evidence that the Afshary-Mirfakhraei combination discloses limitation 4D.

f) Conclusion for Claim 4

Petitioner has shown preponderant evidence that a POSITA would have been motivated to combine Afshary and Mirfakhraei with a reasonable expectation of success. Petitioner has further demonstrated that each limitation of claim 4 is disclosed by the combination.

Accordingly, Petitioner has shown by a preponderance of the evidence that claim 4 would have been obvious over the Afshary-Mirfakhraei combination.

E. Ground B: Obviousness over Afshary, Mirfakhraei, and Welles

Petitioner asserts that claim 2 is obvious over the combination of Afshary, Mirfakhraei, and Welles in ground B. Pet. 68–73. Patent Owner relies on its arguments for claim 1, from which claim 2 depends.

1. *Welles (Ex. 1022)*

Welles relates to a communication system for communication between utility meters in a local area network and a central database. Ex. 1022, code (57). Transmitters in utility meters transmit meter data over power lines to a receiver in another meter, and the receiver communicates those data measurements to a central database. *Id.* Meter 110 includes envelope detectors 192, 194 which are used to determine signal quality and whether the power line transceiver 150 should lock onto the signal. *Id.* at 6:18–50.

Welles discloses that noise and signals in the range from 10 to 100 KHz present difficulties for communication. *Id.* at 5:51–64. The patent uses frequency pairs in this range to communicate, and receiver 300 and CPU 900 may detect spurious data or noise in portions of the frequency range and select alternative operational frequencies within that range for transmission. *Id.*

2. *Motivation to Combine*

We have already addressed the motivation to combine Afshary and Mirfakhraei (§ II.D.4). Petitioner contends that a POSITA would have combined Welles' envelope detector to determine signal activity over a frequency range to determine whether it adversely affected by interference or noise. Pet. 70. Petitioner asserts that Welles's envelope detector is a simple diode and its inclusion in the Afshary-Mirfakhraei combination would provide a simple and straightforward way to determine whether a range of frequencies would be suitable for communication. *Id.* at 70–71 (citing Ex. 1022, 5:5–6:17, 7:2–11; Ex. 1002 ¶¶ 56, 179–180). Petitioner asserts that Welles's envelope detector would be useful in achieving

Afhsary’s goal of ensuring that existing services provided over the same communication medium are not disturbed by local network communications. *Id.* at 70–73 (citing Ex. 1006, code (57), ¶¶ 2, 7, 21–28, Fig. 3; Ex. 1002 ¶¶ 56, 84, 95–102, 178–183; Ex. 1022, 1:15–17, 2:4–9, 5:5–16, 5:23–35, 7:1–11; Ex. 1002 ¶¶ 56, 95–102, 181–183).

3. Claim 2

Claims 2 depends from claim 1 and recites “wherein a network device comprises a means for determining signal activity and selects a frequency band for operation that is not used by other services.”

Petitioner contends that “Welles teaches that its transceiver uses its envelope detector to determine if a range of frequencies is already in use so as to select a frequency range of operation not occupied by communication from other transceivers or systems.” Pet. 72–73 (citing Ex. 1022, 5:5–7:11, Figs. 1–2, 4; Ex. 1002 ¶ 183).

While we agree with Petitioner that Welles’s envelope detector detects signal activity, we do not agree that it, at least not alone, “selects a frequency band for operation that is not used by other services.” Rather it appears that the receiver 300 (which includes envelope detectors 192, 194) and CPU 900 together perform that function.

Hence, we determine that Petitioner has not demonstrated preponderant evidence that Welles’s envelope detector, standing alone, teaches or suggests claim 2.⁷

⁷ Although Petitioner cites evidence in Welles that the receiver and CPU select a frequency band free of interference and noise for communication, we limit our Decision to the Petition contentions. *SAS Institute, Inc. v. Iancu*, 584 U.S. 357, 365 (2018).

III. CONCLUSION

In light of the foregoing, we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 3, and 4, but not claim 2, are unpatentable as obvious over Afshary and Mirfakhraei (ground A). We determine that claim 2 is not unpatentable as obvious over Afshary, Mirfakhraei, and Welles (ground B).

IV. ORDER

For the foregoing reasons, it is

ORDERED that pursuant to 35 U.S.C. § 318(a), claims 1, 3, and 4, but not claim 2, of the '518 patent have been shown to be unpatentable; and

FURTHER ORDERED that any party seeking judicial review must comply with the notice and service requirements of 37 C.F.R. § 90.2.⁸

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–4	102	Afshary, Mirfakhraei	1, 3–4	2

⁸ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Decision, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

IPR2024-00431
Patent 7,295,518 B1

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
2	103(a)	Afshary, Mirfakhraei, Welles		2
Overall Outcome			1, 3–4	2

IPR2024-00431
Patent 7,295,518 B1

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