

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LG ELECTRONICS, INC.,
Petitioner,

v.

CONSTELLATION DESIGNS, LLC,
Patent Owner.

IPR2023-00228
Patent 10,693,700 B1

Before MIRIAM L. QUINN, BRENT M. DOUGAL, and
MICHAEL T. CYGAN, *Administrative Patent Judges*.

DOUGAL, *Administrative Patent Judge*.

DECISION

Denying Institution of *Inter Partes* Review
35 U.S.C. § 314, 37 C.F.R. § 42.4

I. INTRODUCTION

A. *Background and Summary*

Petitioner, LG Electronics Inc., requests that we institute an *inter partes* review challenging the patentability of claims 1, 4, 6–11, 14, 16–21, 24, and 26–30 (the “challenged claims”) of U.S. Patent 10,693,700 B1 (Ex. 1001, “the ’700 patent”). Paper 2 (“Petition” or “Pet.”). Patent Owner, Constellation Designs, LLC, argues that Petitioner’s request is deficient and should not be granted. Paper 7 (“Preliminary Response” or “Prelim. Resp.”).

Applying the standard set forth in 35 U.S.C. § 314(a), which requires demonstration of a reasonable likelihood that Petitioner would prevail with respect to at least one challenged claim, we deny the Petition and decline to institute an *inter partes* review.

B. *Related Matters*

The parties identify the following related district court litigation: *Constellation Designs, LLC v. LG Electronics Inc. et al.*, No. 2:21-cv-00448 (E.D. Tex.). Pet. 94–95; Paper 5, 1. Patent Owner also identifies the following related *inter partes* reviews: IPR2022-01482, IPR2022-01549, IPR2023-00229, IPR2023-00319, and IPR2023-00320. Paper 5, 1–2.

C. *The ’700 Patent*

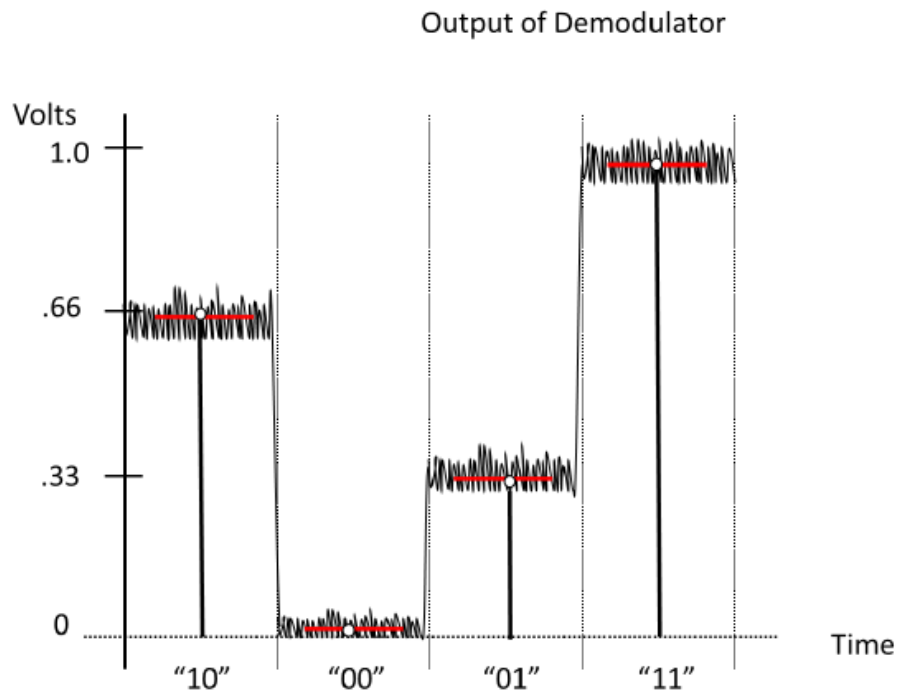
The ’700 patent is directed to digital communication or transmission systems with “unequally spaced constellations.” Ex. 1001, 1:38–44. As background to the technology, “[a] digital communication system is used to transmit digital bits (sequences of 0s and 1s) from one device (a transmitter) to another (a receiver).” Ex. 2001 ¶ 11. “Each digital communication system has a measurable ‘capacity,’ which is the maximum amount of information that the system can reliably send over the channel.” *Id.* ¶ 14. The transmitter

maps each new bit sequence to constellation points. *Id.* ¶¶ 15, 18. “[A] ‘constellation’ point is a carrier signal value (such as amplitude and/or phase) that can be used to represent a longer sequence of bits.” *Id.* The receiver in turn attempts to detect symbols that were received, from the transmitter, by mapping a received signal to a constellation. Ex. 1001, 1:44–46. The minimum distance ($d_{\min}$) between constellation points at high signal-to-noise ratios (SNRs) correlates to the capacity of the constellation, and accordingly, many communication systems aim to maximize this value in order to maximize capacity of the system. Ex. 2001 ¶¶ 46–54. This is to decrease the risk that the noise in the signal makes the signal unreadable, i.e. decreases the risk that the system is unable to determine which signal value was intended between two adjacent signal values.

As a simple illustration, Patent Owner’s declarant, Dr. Giuseppe Caire, provides the following example of a one-dimensional constellation, with bit values (constellation label) and signal amplitude values (constellation location):

Constellation Label	Constellation Location
“00”	0
“01”	.33
“10”	.66
“11”	1.0

Ex. 2001 ¶ 29. An output based on this constellation, and including an illustration of signal noise, is reproduced below.



Id. ¶ 32. The above figure, provided by Dr. Caire, is a graph of the signal amplitude, in volts, over time. As can be seen above, “a time-dependent continuous waveform is shown in black including noise, the average of the time-dependent continuous waveform is shown in red, the output of the demodulator is shown as discrete time values in black, and the figure is again annotated with the corresponding bit sequence.” *Id.* Thus, it can be seen how each bit value (constellation label) corresponds to the signal amplitude value (constellation location) in wave form. The receiver, with information about the constellation, is thus able to determine the bit values communicated from the transmitter.

As mentioned, the ’700 patent is directed to digital communication systems with “unequally spaced constellations.” Ex. 1001, 1:38–44. Rather than focusing on maintaining a minimum distance ($d_{\min}$) between the signal values of the constellation, the ’700 patent attempts to provide “direct optimization of the constellation points of a communication system utilizing

a capacity approaching channel code, [that] can yield different constellations depending on the SNR for which they are optimized” *Id.* at 5:11–16. The ’700 patent explains that “capacity optimized constellation at low SNRs are geometrically shaped constellations that can achieve significantly higher performance gains (measured as reduction in minimum required SNR) than constellations that maximize $d_{\min}$.” *Id.* at 8:24–29. The ’700 patent provides that “a constellation at one code rate can achieve gains that cannot be achieved at another code rate.” *Id.* at 5:20–21. Dr. Caire provides one example of “a constellation optimized for a code rate of $1/2$ may not have the same performance at a code rate of $2/3$,” and “[i]nstead, a different constellation optimized for a code rate of $2/3$ may perform better when the system is operating at a code rate of $2/3$ than if the system used the constellation optimized for a code rate of $1/2$.” Ex. 2001 ¶ 55.

“Capacity measures that can be used in the selection of the location of constellation points include . . . parallel decode (PD) capacity and joint capacity.” Ex. 1001, 5:6–8. The “PD capacity of a channel can be viewed in terms of the mutual information between the output bits of the encoder (such as an LDPC encoder) at the transmitter and the likelihoods computed by the demapper at the receiver,” and it is “influenced by both the placement of points within the constellation and by the labelling assignment.” *Id.* at 6:64–7:3. Joint capacity describes “the achievable capacity between the input of the mapper on the transmit side of the link and the output of the channel (including for example AWGN and Fading channels).” *Id.* at 7:18–21.

D. Illustrative Claim(s)

Of the challenged claims, claims 1, 11, and 21 are independent, and claim 1, reproduced below with emphasis added, is illustrative:

1. A communication system, comprising:

a receiver capable of receiving signals via a communication channel having a channel signal-to-noise ratio (SNR), wherein the receiver comprises:

a demodulator capable of demodulating a received signal into a demodulated signal;

a demapper, coupled to the demodulator, capable of determining likelihoods using the demodulated signal and a multidimensional symbol constellation selected from a plurality of multidimensional symbol constellations; and

a decoder, coupled to the demapper, capable of using the likelihoods determined by the demapper to provide a sequence of received bits based upon a low density parity check (LDPC) code;

wherein the plurality of multidimensional symbol constellations comprises a plurality of different non-uniform multidimensional symbol constellations having the same number of constellation points, where the constellation points are non-uniformly spaced in each degree of freedom available to the multidimensional symbol constellations;

wherein the receiver is capable of selecting an LDPC code rate and multidimensional symbol constellation pair from a plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs, *where each of the plurality of different non-uniform multidimensional symbol constellations is only included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs.*

Ex. 1001, 13:43–14:5.

E. Evidence

Petitioner's grounds of unpatentability rely on the following evidence:

Name	Non-Patent Literature	Author(s)	Exhibit
DVB-T	<i>Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television, July 1999</i>	ETSI EN 300 744 V1.2.1	1005
Sommer	<i>Signal Shaping by Non-Uniform QAM for AWGN Channels and Applications Using Turbo Coding, Jan. 2000</i>	D. Sommer, G.P. Fettweis	1006
DVB-S2	<i>Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications, June 2006</i>	ETSI EN 302 307 V1.1.2	1009
DVB-TS	<i>Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems, October 2002</i>	ETSI TS 102 006 V1.2.1	1013
DeGaudenzi	<i>Turbo-coded APSK modulations design for satellite broadband communications, May 2006</i>	R. De Gaudenzi, A.G. Fabregas, A. Martinez	1014

Name	Patent Document	Exhibit
Eroz	US Patent Pub. 2004/0054960 (Mar. 18, 2004)	1004

F. Asserted Grounds

Petitioner asserts the following grounds of unpatentability (Pet. 2), supported by the declaration of Dr. Bertrand Hochwald (Ex. 1003):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 8, 10, 11, 18, 20, 21, 28, 30	103(a) ¹	Eroz, DVB-T
1, 6, 8, 10, 11, 16, 18, 20, 21, 26, 28, 30	103(a)	Eroz, DVB-T, DeGaudenzi
4, 14, 24	103(a)	Eroz, DVB-T, Sommer
4, 14, 24	103(a)	Eroz, DVB-T, Sommer, DeGaudenzi,
7, 17, 27	103(a)	Eroz, DVB-T, DVB-S2
7, 17, 27	103(a)	Eroz, DVB-T, DVB-S2, DeGaudenzi
9, 19, 29	103(a)	Eroz, DVB-T, DVB-TS
9, 19, 29	103(a)	Eroz, DVB-T, DVB-TS, DeGaudenzi

II. ANALYSIS

A. Legal Standards

Petitioner bears the burden to demonstrate unpatentability. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). At this preliminary stage, we determine whether the information presented in the Petition shows a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious over the proposed combinations of prior art. *See* 35 U.S.C. § 314(a).

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 285–88 (2011), revised 35 U.S.C. § 103 effective March 16, 2013. We refer to the pre-AIA version of § 103.

A claim is unpatentable as obvious if “the differences between the subject matter sought to be patented and the prior art are such that the 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 said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (quoting 35 U.S.C. § 103(a)). We resolve the question of obviousness based on underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the prior art and the claims; (3) the level of skill in the art; and (4) when in evidence, objective indicia of nonobviousness. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We apply these principles to the Petition’s challenges.

B. Level of Ordinary Skill in the Art

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art at the time of the invention. *Id.* at 13, 17. Petitioner asserts that a person of ordinary skill in the art

would have had at least a Master’s degree in an academic area emphasizing electrical engineering or a similar discipline, and at least two years of experience in the field working with, teaching, or researching communication systems including the use of constellations in transmitting signals between devices. EX1003, ¶¶21-23. Superior education could compensate for a deficiency in work experience, and *vice-versa*. *Id.*

Pet. 9.

Though Patent Owner makes arguments with reference to “a person of ordinary skill,” Patent Owner does not directly address or contest Petitioner’s level of skill. *See e.g.*, Prelim. Resp. 31. We are persuaded, on the present record, that Petitioner’s proposal is consistent with the problems

and solutions in the '700 patent and prior art of record. We adopt Petitioner's definition of the level of skill for the purposes of this Decision.

C. Claim Construction

In *inter partes* review, we construe claims using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including 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) (2022).

Petitioner asserts that no terms require express construction. Pet. 9. Likewise, Patent Owner does not argue that any terms require express construction. *See generally*, Prelim. Resp.

We determine that no terms need to be construed. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. 35 U.S.C. § 103(a)

The Petition sets forth two grounds asserting that independent claims 1, 11, and 21 would have been obvious to one of ordinary skill in the art. Pet. 2, 10–66. The Petition relies on Eroz and DVB-T for the first ground. *Id.* at 10–66. For the second ground, the Petition relies on Eroz and DVB-T in the same manner as the first, but adds DeGaudenzi to their argument over the last limitation of claim 1.² *Id.* at 38, 49–66.

² The Petition only refers to claim 1, however, this is likely a typographical error as independent claims 11 and 21 both include a similar limitation.

Among other arguments, Patent Owner argues that the Petition fails to show a reasonable likelihood of obviousness with respect to the last limitation of the independent claims. Prelim. Resp. 31–32, 49–57.

In our below analysis, we first review the prior art and then discuss the parties’ arguments with respect to the last limitation of the independent claims. In our analysis, we determine that Petitioner has not established a reasonable likelihood of succeeding in showing that the combination of Erozi and DVB-T, with or without DeGaudenzi, teaches or renders obvious the last limitation of independent claims 1, 11, and 21. Thus, Petitioner has not established a reasonable likelihood of succeeding in showing that any of the claims are unpatentable.³

1. Erozi

Erozi is a U.S. Patent Publication titled “Method and System for Providing Low Density Parity Check (LDPC) Encoding” Ex. 1004, code (54). Erozi describes a non-hierarchical digital communications system in which a transmitter utilizes a traditional equally spaced constellation coupled with LDPC codes. Ex. 1004 ¶¶ 33, 69. Erozi teaches a point-to-point (i.e.,

³ Petitioner originally presented a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB. *See* Pet. 93–94. However, Petitioner has effectively withdrawn this stipulation by asserting that they are basing their invalidity arguments in the related District Court proceeding on DeGaudenzi. Ex. 2020. Because we decline to institute, it is unnecessary for us to perform an analysis under *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 6 (PTAB Mar. 20, 2020). However, any further review of this case would likely require further analysis under *Fintiv* based on the withdrawal of the stipulation.

one-to-one) digital communication system, in which a single transmitter communicates to a single receiver. *Id.* ¶¶ 30, 33.

2. *DVB-T*

DVB-T is a standard document titled “Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television.” Ex. 1005, 1. DVB-T describes hierarchical modulation, in which two data streams having different transmission performance can be made available on a single TV frequency channel. *Id.* at 9. The hierarchical modulation can provide a lower-quality fallback signal in the case of weak signals, which allows for a graceful degradation instead of a complete signal loss. *Id.* Further, hierarchical modulation also allows for varying levels of quality of service. *Id.*

3. *DeGaudenzi*

DeGaudenzi is an article titled “Turbo-coded APSK modulations design for satellite broadband communications.” Ex. 1014, 261. DeGaudenzi describes Amplitude Phase Shift Keying (APSK) constellations, in which the constellation point locations are indicated by two signal characteristics, amplitude and phase. *Id.* at 263–264. “Because both amplitude and phase are used to indicate a constellation point’s location, in APSK, different constellation points can have the same amplitude but still be at different locations because they have different phases.” Ex. 2001 ¶ 84; Ex. 2002 ¶ 15. As part of its optimization process, DeGaudenzi places constraints on the available locations including constraints on the number of constellation points located at each ring/amplitude and the phase aspect for each of those locations. Ex. 1014, 262–263. DeGaudenzi requires that for each ring/amplitude, the constellation points be uniformly spaced in phase. *Id.* at 264

4. *Analysis of the Claims*

Independent claim 1 includes the following limitation:

wherein the receiver is capable of selecting an LDPC code rate and multidimensional symbol constellation pair from a plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs, *where each of the plurality of different non-uniform multidimensional symbol constellations is only included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs.*

Ex. 1001, 13:65–14:5. Independent claims 11 and 21 include a similar limitation. *Id.* at 15:65–16:5, 17:60–67. Because all of the challenged dependent claims depend from either of claim 1, 11, or 21, this limitation is relevant to all challenged claims.

a) *Eroz and DVB-T*

The Petition argues, and Patent Owner does not contest, that the combination of Eroz and DVB-T teaches a “receiver . . . capable of selecting an LDPC code rate and multidimensional symbol constellation pair from a plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs,” as required by claim 1. Pet. 37–38.

Concerning the second half of the limitation (above in *italics*), Petitioner argues that “[w]hile a plurality of constellation and code rate pairs can be used in a communication system, in some cases, an optimized set of constellation-code rate pairs would have been obvious and desirable to use.” *Id.* at 38 (citing Hochwald Decl. ¶ 123). The Petition asserts that “while it was known in the art that a constellation can be utilized with different code rates and, more generally, can be configured in various suitable ways, configuring constellation and code rate pairs that have been optimized for SNR or spectral efficiency would have been desirable so that inferior SNR

or inefficient constellation and code rate pairs are not utilized in EDC's system." *Id.* The Petition further asserts that as a result of this optimization, "each of the plurality of different nonuniform multidimensional symbol constellations is only included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs." *Id.* (emphasis omitted).

Patent Owner argues that "the Petition fails to even attempt to identify this limitation in either *Eroz* or *DVB-T*," but instead "provides a number of conclusory statements that it would be obvious to optimize each constellation." Prelim. Resp. 3. We agree. We first note that the Petition does not argue that *Eroz* or *DVB-T*, alone or in combination, teaches or renders obvious the noted limitation. Rather, the Petition argues that the combination of *Eroz* and *DVB-T* needs to be further modified, or "optimized for SNR or spectral efficiency," in order to achieve the limitation. Pet. 38.

Petitioner's argument is largely conclusory, and does not sufficiently explain why it would have been obvious to modify or optimize the combination of *Eroz* and *DVB-T* to arrive at the claimed invention. The Petition asserts that limiting each constellation to only one constellation-code rate pair would be "desirable so that inferior SNR or inefficient constellation and code rate pairs are not utilized in [the combined *Eroz* and *DVB-T*] system" without any cited factual evidence to support this explanation. Pet. 38. Further, the Petition does not discuss or describe how the optimization would work in view of the teachings of *Eroz* or *DVB-T*, other than to merely assert that optimization would result in the claimed invention. This is insufficient.

Petitioner does cite to its declarant for support, but the declarant makes identical statements as the Petition without further explanation. *Compare* Pet. 38–39, with Ex. 1003 ¶¶ 122–123. Because the declarant testimony, like the Petition, is conclusory in nature with respect to the alleged obviousness of the limitation (i.e., “where each of the plurality of different non-uniform multidimensional symbol constellations is only included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs”), it is entitled to little weight. *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9, 15 (August 24, 2022) (precedential) (holding declaration is entitled to little weight when it contains an exact restatement of the petition’s conclusory arguments without any additional supporting evidence or reasoning). We further note that page 38 of the Petition provides no citations, other than to their declarant, in support of their assertions as to why it would have been obvious to optimize the combination of Eroz and DVB-T to achieve the claimed limitation. In any event, even if we were to credit Dr. Hochwald that such a conclusion is evident to a person of ordinary skill in the art, the Petition lacks sufficient reasoning that would inform how the desire to optimize the constellation-rate pairs would have resulted in the claimed limitation. *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017) (holding obviousness determination to be improper where the record lacked a “clear, evidence-supported account” of “how the combination” would work).

The Petition later cites to the ’700 patent for the general proposition “that individual constellations are designed and optimized” for capacity. Pet.

39 (citing Ex. 1001, 1:52–54).⁴ However, this does not explain why or how it would have been obvious to limit each constellation to only one constellation-code rate pair as required by the claim. *See id.*

Moreover, even if we accept Petitioner’s explanation, it does not limit a given constellation from being assigned to more than one constellation-code rate pair. Rather, Petitioner’s explanation simply excludes “inefficient constellation and code rate pairs” from being utilized, not excluding an efficient constellation from being paired with multiple code rates. As the claims require that a given constellation cannot be in more than one constellation-code rate pairing, this explanation is insufficient.

Relatedly, Patent Owner explains that Eroz utilizes a “single [...] uniform constellation for all code rates,” while DVB-T teaches selecting between “two [...] non-uniform constellations,” each requiring a “high priority code rate” and a “low priority code rate,” wherein each code rate can be “any of five different code rate values.” *Id.* at 52 (citing Ex. 1005, 9, 31–33). Even when optimized, it is unclear why Eroz and DVB-T’s modified system would result in each constellation being only included in one of the plurality of code rate and constellation pairs. DVB-T on its face suggests each constellation is paired with two different code rates and Eroz pairs a single constellation with multiple code rates. Thus, it is unclear how or why the optimized combination results in a plurality of code rate and constellation pairs, where each constellation is only included in one of the plurality.

⁴ The Petition also points generally to DeGaudenzi and their discussion of the second ground for support. Pet. 39 (“The obviousness of such a system is corroborated in DeGaudenzi, as described in more detail below.”) We address Petitioner’s arguments surrounding DeGaudenzi in the next section.

Thus, we agree with Patent Owner that Petitioner's argument is conclusory and does not sufficiently explain why it would have been obvious to a person of ordinary skill in the art to modify the combination of Eroze and DVB-T to arrive at the claimed invention. For these reasons, Petitioner has not established a reasonable likelihood of succeeding in showing that the combination of Eroze and DVB-T, teaches or renders obvious the last limitation of independent claims 1, 11, and 21.

Patent Owner also argues that "modifying a constellation to improve the efficiency of one data stream [i.e., the high code rate of DVB-T], the efficiency of the other data stream [i.e., the low code rate of DVB-T] will be reduced." *Id.* at 55; *see also* Ex. 2001 ¶ 97. Thus, Petitioner's asserted obviousness rationale (i.e., "configuring constellation and code rate pairs that have been optimized for SNR or spectral efficiency would have been desirable so that inferior SNR or inefficient constellation and code rate pairs are not utilized in EDC's system") does not account for a hierarchical constellation, as in DVB-T, where "there are *two* code rates that must be defined, the high priority code rate, and the low priority code rate." *Id.* at 55–56. Thus, as mentioned previously, Petitioner's argument fails to address the actual teachings of the references, or even fully explain their rationale in view of the teachings of DVB-T.

Based on this additional reason, Petitioner has also not established a reasonable likelihood of succeeding in showing that the combination of Eroze and DVB-T, teaches or renders obvious the last limitation of independent claims 1, 11, and 21

b) Eroz, DVB-T, and DeGaudenzi

Petitioner also argues that the last limitation of the independent claims would have been obvious in view of Eroz, DVB-T, and DeGaudenzi. Pet. 60–62. Under this alternative ground, Petitioner asserts that “DeGaudenzi discloses optimizing the spectral efficiency or SNR of non-uniform symbol constellations by optimizing their parameters such as the location of the constellation points and the code rates” and that “as shown in DeGaudenzi’s Table I, the spectral efficiency/SNR of a number of 32-ary APSKs [(constellations)] has been optimized” such that “each of the listed constellations is a unique non-uniform constellation.” *Id.* (citing e.g., Ex. 1014, 268, 271, 279). Petitioner concludes that “[i]t would have been obvious to a POSITA that when the teachings of DeGaudenzi (such as Table I) are incorporated into [the combined Eroz and DVB-T] system, each of the plurality of different non-uniform multidimensional symbol constellations would only be included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs.” *Id.* at 61.

Petitioner states that “DeGaudenzi’s teachings are broad, are not limited to APSKs, and can be applied to LDPC encoded signals and QAM constellations.” *Id.* (citing Ex. E1014, 262–264). Thus, Petitioner asserts that “in the combination of [Eroz, DVB-T,] and DeGaudenzi, a table similar to DeGaudenzi’s Table I but with optimized 16-QAM or 64-QAM constellations and corresponding parameters (e.g., code rate, α , spectral efficiency) would have been provided” and that “in such a table, an LDPC code rate-constellation pair of non-uniform-16-QAM with $\alpha=2$ and code rate that is optimized for a particular spectral efficiency/SNR would similarly

have only been included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs.” *Id.* at 62.

In response, Patent Owner correctly argues that the Petition fails to discuss how DeGaudenzi’s teachings from a non-hierarchical system would apply to DVB-T’s hierarchical system relied on in the combination by Petitioner. Prelim. Resp. 58–59. Patent Owner notes that “*De Gaudenzi* provides no suggestion or teaching whatsoever of how to optimize a hierarchical modulation system to improve capacity, where points represent multiple data streams and where multiple code rates can be used with a single constellation.” *Id.* at 59 (citing Ex. 2001 ¶ 47).

Patent Owner’s argument is supported by the testimony of Dr. Guillén i Fàbregas, one of the authors of DeGaudenzi, who states “our optimization process only considered non-hierarchical APSK constellations in which a single data stream is represented and which only has one code rate associated with it at any one time,” and “it is not clear or straightforward how [anyone could] apply the techniques I disclosed in *De Gaudenzi* to a hierarchical system.” Ex. 2002 ¶ 27. Patent Owner’s declarant further explains: “my techniques were directed towards improving joint capacity for a constellation representing a single data stream that could only be used with a single code rate at any one time and could not be used with a hierarchical constellation having two code rates,” such as relied on in DVB-T. *Id.*

Patent Owner also correctly argues that DeGaudenzi’s optimization teachings are not readily applicable to a QAM constellation. Prelim. Resp. 62–65. Patent Owner’s argument, supported by declarant testimony, explains that DeGaudenzi optimizes a uniform phase and varying ring ratio while in

the QAM constellations of DVB-T it is taught to “modulate (varies) the amplitude of two components of a sinusoid (the in-phase and quadrature components) that are offset in phase by 90 degrees.” *Id.* at 62. Patent Owner’s declarant states that “it is not clear how to apply the teachings of uniform phase and varying ring ratio [in DeGaudenzi] to a rectangular QAM” in *DVB-T*. Ex. 2002 ¶ 31. Patent Owner’s declarant further explains that in contrast to DeGaudenzi, there is no ring ratio to optimize or phase to maintain as uniform in a QAM constellation. *Id.*

As with the initial ground, we agree with Patent Owner that Petitioner’s argument here is largely conclusory and does not sufficiently explain how or why it would have been obvious to combine Erož, DVB-T, and DeGaudenzi to arrive at the claimed invention, including how to apply Table I, which lists a single code rate per APSK constellation, to a constellation that requires two different code rates (i.e., a high priority code rate and a low priority code rate). Moreover, as Patent Owner persuasively states, “[e]ven if a person of ordinary skill in the art were to try to combine De Gaudenzi with the Erož and DVB-T combination, the Petition has failed to explain how they could possibly derive each constellation from two respective code rates using the teachings of De Gaudenzi [...], or] recognize that each of the DVB-T constellations requires two code rates, rather than DeGaudenzi’s one code rate[...], and thus] a person of ordinary skill in the art would not find it obvious to make the proposed combination nor have a reasonable expectation of success in doing so.” Prelim. Resp. 59–60.

As the Petition does not sufficiently identify how the combination of Erož, DVB-T, and DeGaudenzi teaches or renders obvious the limitation of “where each of the plurality of different non-uniform multidimensional

symbol constellations is only included in one of the plurality of predetermined LDPC code rate and multidimensional symbol constellation pairs” in the independent claims, it fails to establish a reasonable likelihood of prevailing in showing that any of the claims are unpatentable.

III. CONCLUSION

For the foregoing reasons, we do not institute trial.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), no *inter partes* review as to any claim of U.S. Patent 10,693,700 B1 is instituted.

IPR2023-00228
Patent 10,693,700 B1

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