UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner,

v.

RAMOT AT TEL AVIV UNIVERSITY, LTD.,
Patent Owner.

IPR2022-00575
U.S. Patent No. 11,133,872 B2

PETITIONER'S NOTICE OF APPEAL TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

via P-TACTS
Patent Trial and Appeal Board

via Email
Director of the United States Patent and Trademark Office
efileSO@uspto.gov

via CM/ECF
United States Court of Appeals for the Federal Circuit

Pursuant to 28 U.S.C. § 1295(a)(4)(A), 35 U.S.C. §§ 141(c), 142, and 319, and 37 C.F.R. §§ 90.2(a), 90.3, 5 U.S.C. §§ 701–706, and Federal Circuit Rule 15(a)(1), Petitioner Cisco Systems, Inc. ("Petitioner") provides notice that it appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision of the Patent Trial and Appeal Board ("Board") entered September 29, 2023 (Paper 33), the Board's Decision Denying Petitioner's Request on Rehearing of the Final Written Decision entered March 5, 2024 (Paper 38), and from all underlying and related orders, decisions, rulings, and opinions regarding U.S. Patent No. 11,133,872 B2 ("the '872 patent") in *Inter Partes* Review IPR2022-00575.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), the expected issues on appeal include, but are not limited to: the Board's error(s) in determining that Petitioner has failed to demonstrate that challenged claims 1–12, 15-22, and 30 of the '872 patent are unpatentable, that Petitioner's Request for Rehearing should be denied, and any finding or determination supporting or related to those determinations, as well as all other issues decided adversely to Petitioner in any orders, decisions, rulings, or opinions in *Inter Partes* Review IPR2022-00575.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a), this Notice is being filed with the Director of the United States Patent and Trademark Office and with the Patent Trial and Appeal Board. In addition, a copy of this Notice and the required docketing fees are being filed with the Clerk's Office for the United States Court of

Appeals for the Federal Circuit via CM/ECF.

Respectfully submitted,

Dated: April 22, 2024

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CERTIFICATE OF FILING

The undersigned hereby certifies that, in addition to being electronically filed through PTAB P-TACTS, a true and correct copy of the above-captioned PETITIONER'S NOTICE OF APPEAL TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT is being filed by email with the Director on April 22, 2024, at efileSO@uspto.gov.

The undersigned also hereby certifies that a true and correct copy of the above-captioned PETITIONER'S NOTICE OF APPEAL TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT and the filing fee is being filed via CM/ECF with the Clerk's Office of the United States Court of Appeals for the Federal Circuit on April 22, 2024.

Respectfully submitted,

Dated: April 22, 2024

/Theodore M. Foster/
Theodore M. Foster
Counsel for Petitioner
Registration No. 57,456

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6, this is to certify that a true and correct copy of the foregoing "Petitioner's Notice of Appeal to the United States Court of Appeals for the Federal Circuit" was served on counsel for Patent Owner Ramot At Tel Aviv University Ltd. as detailed below:

Date of service	April 22, 2024
Manner of service	Email: bentzminger@bdiplaw.com cjohanningmeier@bdiplaw.com BDIP_RamotIPRService@bdiplaw.com
Documents served	**Petitioner's Notice of Appeal to the United States Court of Appeals for the Federal Circuit**
Persons served	Brenda Entzminger Corey Johanningmeier (Pro Hac Vice) Bunsow De Mory LLP 701 El Camino Real Redwood City, CA 94063

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Paper 33
Date: September 29, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner,

v.

RAMOT AT TEL AVIV UNIVERSITY, LTD.,
Patent Owner.

IPR2022-00575
Patent 11,133,872 B2

Before CHRISTOPHER L. CRUMBLEY, MONICA S. ULLAGADDI, and JASON M. REPKO, *Administrative Patent Judges.*

Opinion for the Board filed by *Administrative Patent Judge* ULLAGADDI.

Opinion Concurring filed by *Administrative Patent Judge* REPKO.

ULLAGADDI, *Administrative Patent Judge*.

JUDGEMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Cisco Systems, Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1–12, 15–22, and 30 ("the challenged claims") of U.S. Patent No. 11,133,872 B2 (Ex. 1001, "the '872 patent"), accompanied by the supporting Declaration of Dr. Daniel J. Blumenthal (Ex. 1003). Ramot at Tel Aviv University Ltd. ("Patent Owner") filed a Preliminary Response. Paper 8 ("Prelim. Resp.").

Upon review of the preliminary record, we instituted *inter partes* review, pursuant to 35 U.S.C. § 314, as to the challenged claims based on the challenges set forth in the Petition. Paper 10 ("Institution Decision" or "Inst. Dec.").

After institution of trial, Patent Owner filed a combined Request for Rehearing and Request for Precedential Opinion Panel (POP) Review. Paper 12 ("Req. Reh'g"). On February 22, 2023, the Request for POP Review was denied. Paper 20. On May 22, 2023, we denied Patent Owner's Request for Rehearing. Paper 25.

Patent Owner filed a Response (Paper 18, "Patent Owner's Response" or "PO Resp.") accompanied by the supporting Declaration of Dr. John Dallesasse (Ex. 2018), Petitioner filed a Reply to Patent Owner's Response (Paper 24, "Petitioner's Reply" or "Pet. Reply"), and Patent Owner filed a Sur-Reply (Paper 28, "Patent Owner's Sur-Reply" or "PO Sur-Reply").

On July 5, 2023, we held an oral hearing. A transcript of the hearing is of record. Paper 32 ("Tr.").

For the reasons that follow, we conclude that Petitioner has not established, by a preponderance of the evidence, that the challenged claims of the '872 patent are unpatentable.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies Cisco Systems, Inc. and its subsidiary, Acacia Communications, Inc. as the real parties-in-interest. Pet. 78.

Patent Owner identifies Ramot at Tel Aviv University Ltd. as the real party-in-interest. Paper 4, 2.

B. Related Matters

The parties indicate that the ’872 patent is involved in the following district court case: *Cisco Systems, Inc. et al. v. Ramot at Tel Aviv University Ltd.*, Case No. 1-21-cv-01365 (D. Del.) (pending). Pet. 78; Paper 4, 2.

The parties further indicate that the ’872 patent is also related to three patents that were/are the subject of the following administrative proceedings:

Cisco Systems, Inc. v. Ramot at Tel-Aviv University Ltd., IPR2020-00122 (PTAB) (institution denied);

Cisco Systems, Inc. v. Ramot at Tel-Aviv University Ltd., IPR2020-00123 (PTAB) (institution denied);

Cisco Systems, Inc. v. Ramot at Tel-Aviv University Ltd., IPR2020-00484 (PTAB) (institution denied);

Ex Parte Reexamination, Control No. 90/014,526, merged with 90/014,608 (reexamination certificate issued);

Ex Parte Reexamination, Control No. 90/014,527, merged with 90/014,606 (decision on appeal reverses examiner’s rejections); and

Ex Parte Reexamination, Control No. 90/014,528, merged with 90/014,607 and 90/014,728 (notice of intent to issue reexamination certificate issued). Pet. 78–79; Paper 4, 2–3.

The parties additionally indicate that the ’872 patent is the subject of a concurrently filed petition in IPR2022-00576. Pet. 79; Paper 4, 2.

Petitioner further indicates that the ’872 patent is related to a patent that is the subject of the following administrative proceeding:

Cisco Systems, Inc. v. Ramot at Tel-Aviv University Ltd., IPR2022-01283 (PTAB) (instituted). Paper 15, 2.

Patent Owner further indicates that the ’872 patent is also related to three patents that are the subject of the following district court proceedings:

Ramot at Tel Aviv University Ltd. v. Cisco Systems, Inc., 2:19-cv-00225 (E.D. Tex.) (pending); and

Ramot at Tel Aviv University Ltd. v. Acacia Communications, Inc., 1:21- cv-00295 (D. Del.) (pending). Paper 4, 2–3.

C. The ’872 Patent

The ’872 patent is titled “Linearized Optical Digital-to-Analog Modulator.” Ex. 1001, code (54). The ’872 patent discloses a system for converting digital data into a modulated optical signal, where an electrically controllable device having M actuating electrodes provides an optical signal that is modulated in response to binary voltages applied to the actuating electrodes. *Id.* at code (57). A digital-to-digital converter provides a mapping of input data words to binary actuation vectors of M bits and supplies the binary actuation vectors as M bits of binary actuation voltages to the M actuating electrodes, where M is larger than the number of bits in each input data word. *Id.* The digital-to-digital converter maps each digital input data word to a binary actuation vector by selecting a binary actuation vector from a subset of binary actuation vectors available to represent each of the input data words. *Id.*

Referring to Figure 1, reproduced below, the ’872 patent discloses modulator device 10 that has electronic input 12 for receiving an input data word D of N bits and electrically-controllable modulator 14 for modulating the intensity of an optical signal represented by arrow 16. Ex. 1001, 7:5–13.

FIG. 1

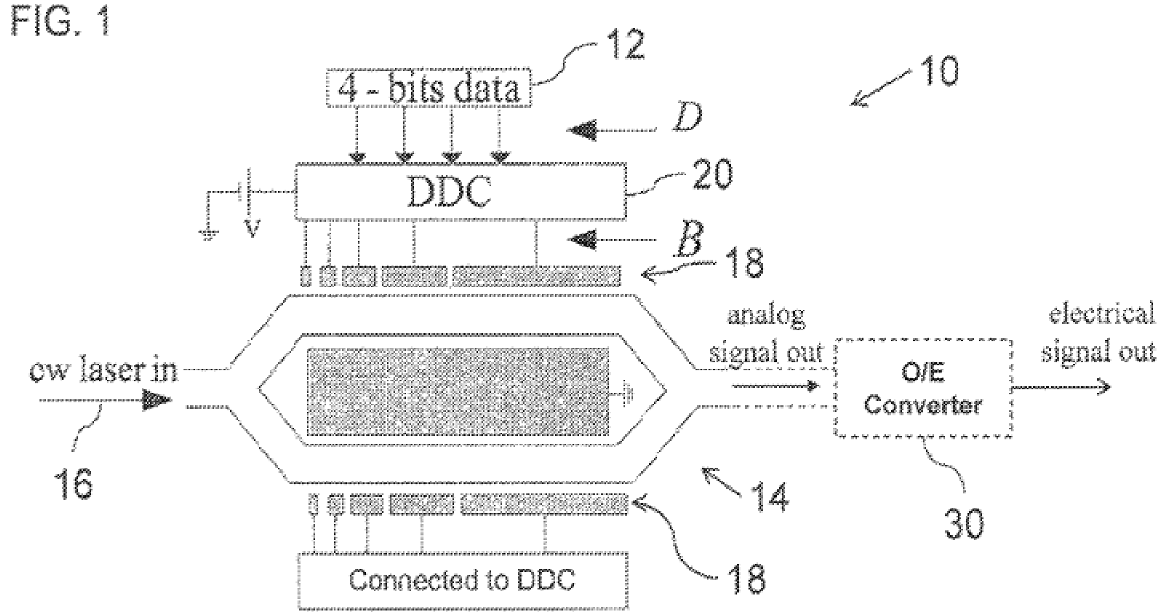

Figure 1 of the ’872 patent is a schematic representation of a modulator device for converting digital data into analog modulation of an optical or electrical signal.

Modulator 14 includes M actuating electrodes 18 where M≥N.[1] *Id.* at 7:13–14. Modulator device 10 also includes electrode actuating device 20 responsive to input data word D to supply an actuating voltage to actuating electrodes 18. *Id.* at 7:14–17. Thus, electrode actuating device 20 actuates at least one of actuating electrodes 18 as a function of values of more than one bit of the input data word D. *Id.* at 7:17–21. In other words, at least one of the electrodes is actuated in a manner differing from a simple one-to-one mapping of data bits to electrode voltage, thereby providing freedom to

[1] The ’872 patent actually recites “M N,” but it appears from the context of the rest of the disclosure of the ’872 patent that “M≥N” was intended.

choose the electrode actuation pattern which best approximates a desired ideal output for the given input. *Id.* at 7:21–25.

D. Illustrative Claim

Of challenged claims 1–12, 15–22, and 30, claims 1, 11, and 15 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A modulation system, the system comprising:
>
> an input for a plurality of N digital input data bits;
>
> an optical signal source for providing an input optical signal;
>
> a modulator for modulating the input optical signal to output a modulation of the power of the input optical signal, thereby generating one or more modulated optical signal outputs for transmission over one or more optical fibers; and
>
> a converter for:
>
> converting, based on a digital-to-digital mapping, the plurality N digital input data bits to M digital output data bits associated with M drive voltage values, and
>
> providing the M drive voltage values to the modulator for the modulating,
>
> wherein M>N and N>l,
>
> wherein the digital-to-digital mapping comprises, for each unique plurality of N digital input data bits, a mapping to a corresponding M digital output data bits,
>
> wherein, for a given plurality of N digital input data bits, the mapping to the corresponding M digital output data bits is determined based on a pattern for actuating drive voltages that alters the linearity of an optical response of the modulator.

Ex. 1001, 17:15–37.

E. Asserted Ground

Petitioner presents the following challenge as summarized in the chart below. Pet. 24. Petitioner supports its challenge with the Declaration of Dr. Daniel J. Blumenthal. Ex. 1003.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–12, 15–22, 30	103(a)[2]	Roberts[3], Taraschuk[4]

III. ANALYSIS

A. Legal Standards

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter 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). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of 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) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

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[2] The Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) ("AIA"), included revisions to 35 U.S.C. §§ 102 and 103 that became effective after the effective filing date of the challenged claims. The earliest possible filing date is June 13, 2007. Ex. 1001, code (60). Therefore, we apply the pre-AIA versions of 35 U.S.C. §§ 102 and 103(a).
[3] U.S. Patent No. 7,277,603 B1, filed February 22, 2006, and issued October 2, 2007, to Roberts et al. (Ex. 1005, "Roberts").
[4] U.S. Patent No. 6,781,537 B1, issued August 24, 2004, to Taraschuk et al. (Ex. 1006, "Taraschuk").

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). According to Petitioner,

> [a] Person of Ordinary Skill in The Art ("POSITA") in June of 2007 would have had a working knowledge of optical modulators and modulation schemes. A POSITA would have had a master's degree in electrical engineering, or an equivalent, and two years of professional experience relating to optical communications, and in particular, optical signal modulation. Lack of professional experience can be remedied by additional education, and vice versa.

Pet. 14–15 (citing Ex. 1003 ¶¶ 21–23). According to Patent Owner:

> a person of ordinary skill in the art as of the effective priority date in 2007 would have had a Master of Science degree in Electrical Engineering, or Electrical and Computer Engineering, and at least two years of academic or professional experience in engineering, specifically in the analysis and design of optoelectronic systems for optical communications.

PO Resp. 22 (citing Ex. 2018 ¶¶ 22–26).

We do not discern a substantial difference between the parties' definitions for the level of ordinary skill in the art. Instead, we determine that the parties' definitions are substantially similar. We adopt Petitioner's definition of the level of skill in the art, which is consistent with the disclosure of the '872 patent and asserted prior art of record. The findings and conclusions rendered in this Decision would not change had we adopted Patent Owner's definition.

C. Claim Construction

In *inter partes* review proceedings based on petitions filed on or after November 13, 2018, such as this one, we construe claims using the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b), as articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. *See* 37 C.F.R. § 42.100(b).

We need not construe any claim term in our Decision in order to resolve the issues before us. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (explaining that construction is needed only for terms that are in dispute, and only as necessary to resolve the controversy).

D. Obviousness over Roberts and Taraschuk

Petitioner argues that claims 1–12, 15–22, and 30 would have been obvious in view of Roberts and Taraschuk. Pet. 24–77. Patent Owner disagrees. PO Resp. 22–50. For the reasons that follow, we are not persuaded that Petitioner sufficiently establishes that claims 1–12, 15–22, and 30 would have been obvious in view of Roberts and Taraschuk.

1. Overview of Roberts

Roberts is entitled "Integrated Optical Waveform Modulation." Ex. 1005, code (54). Roberts discloses a method of modulating an optical carrier. *Id.* at code (57). A target carrier modulation is computed based on an input data signal. *Id.* An effective length of an optical modulator is then controlled based on the target carrier modulation. *Id.* Figure 4 of Roberts, reproduced below, depicts principal components and operation of a complex optical synthesizer.

Figure 4

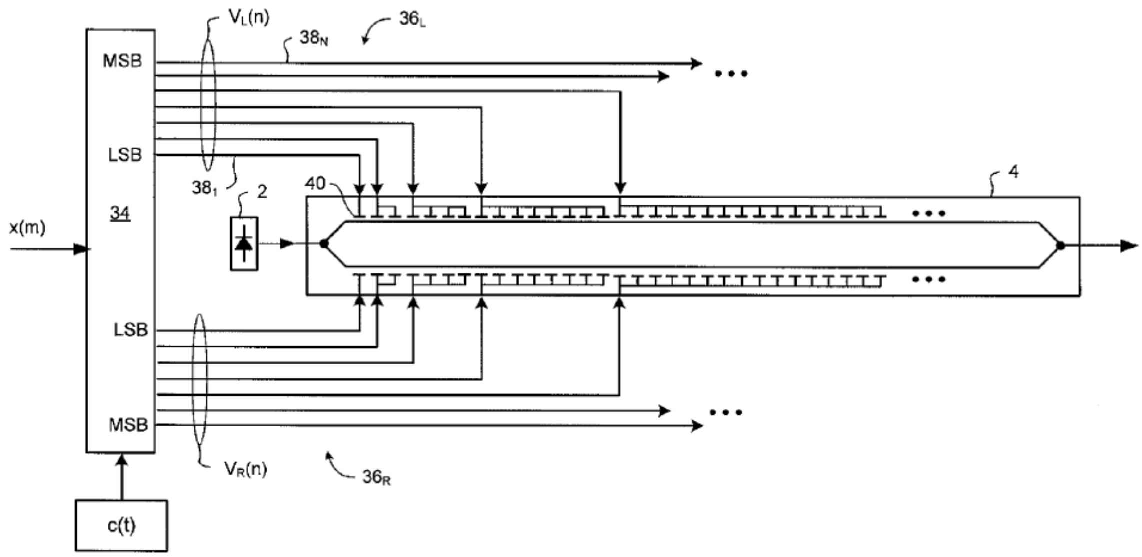

Figure 4 of Roberts depicts "principal components and operation of a complex optical synthesizer." *Id.* at 5:20–21, Fig. 4.

In general, the optical modulator operates by computing a target carrier modulation, and then varying the effective length of the control region of the optical modulator in accordance with the target modulation. *Id.* at 5:47–50. The electrodes of the modulator are configured such that the drive signals are the binary logic states output by the driver integrated circuit (IC) with no signal conditioning or power amplification required between the driver IC and the optical modulator. *Id.* at 5:50–54.

As illustrated in Figure 4, the driver IC is implemented as a digital signal processor (DSP) 34, which generates a pair of multi-bit sample streams $V_L(n)$ and $V_R(n)$, generally referred to as $V_X(n)$, which are representative of the desired phase modulation to be applied to each branch of MZ modulator 4. *Id.* at 5:56–60. Each multi-bit sample stream $V_X(n)$ may be an N-bit parallel binary signal output from DSP 34 on corresponding N-bit data bus 36. *Id.* at 6:40–42. In such a case, each line 38_i of N-bit bus 36 is connected to control a number of electrodes 40 corresponding to its binary weight. *Id.* at 6:42–44.

2. Overview of Taraschuk

Taraschuk is entitled "High Speed Digital to Analog Converter." Ex. 1006, code (54). Taraschuk discloses a high-speed D/A converter that includes a phase aligner and a vector summation block (*i.e.*, vector addition block). *Id.* at code (57). The phase aligner operates to ensure precise phase alignment between corresponding bits of a parallel N-bit digital signal having a data rate of at least 2 GHz. *Id.* The vector addition block performs a vector addition of the phase-aligned bits of the parallel N-bit digital signal. *Id.* Figure 5 of Taraschuk, reproduced below, depicts principal elements in a high-speed digital-to-analog converter.

Figure 5

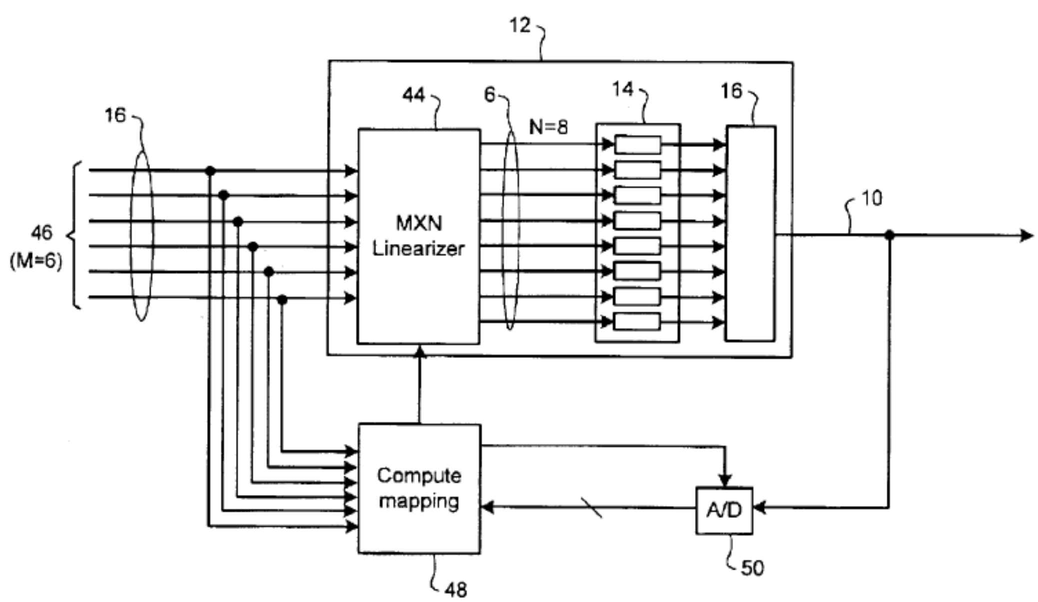

Figure 5 of Taraschuk depicts "principal elements in a high-speed digital-to-analog converter." *Id.* at 3:16–17, Fig. 5.

Figure 5 illustrates M=6-bit D/A converter 12 having linearizer 44 connected upstream of phase aligner 14 and vector addition blocks 16. *Id.* at 6:58–61. Linearizer 44 is designed to map the M-bit digital signal into N-bit parallel digital signal 6 for processing by phase aligner 14 and vector summation block 16. *Id.* at 6:61–65. In general, the number (M) of bits of input digital signal 46 will be less than the number (N) of bits of parallel digital signal 6 processed by phase aligner 14 and vector summation block 16. *Id.* at 6:65–7:1.

Figure 5 further illustrates a system for periodically re-calculating the mapping implemented in linearizer 44. *Id.* at 7:23–25. "[T]he M-bit digital signal 46 is tapped and provided to a signal processor 48". *Id.* at 7:26–27. "The analog output signal (S) is sampled by analog-to-digital converter 50 and supplied to signal processor 48." *Id.* at 7:27–29. "By controlling the timing of the sample detected by analog-to-digital converter 50, signal processor 48 can receive an M-bit word of input digital signal 46 and obtain a sample of the corresponding analog signal level (S) generated by D/A converter 12 based on that M-bit word." *Id.* at 7:29–34. "By calculating a difference between the received M-bit word and the sampled analog output signal level (S), signal processor 48 can readily compute a mapping between the received M-bit word of input digital signal 46 and an N-bit word required to obtain the desired output analog signal level." *Id.* at 7:34–39.

3. Independent Claim 1

a. Petitioner's Initial Contentions

[1.0] "A modulation system, the system comprising:"

Petitioner contends that "[t]o the extent the preamble is limiting, Roberts renders it obvious." Pet. 35 (citing Ex. 1003 ¶ 121). Specifically, Petitioner contends that "Roberts teaches modulation of optical waveforms within an optical communication system comprising an optical modulator and accompanying drive circuitry and signal sources (‘*modulation system*’).” *Id.* (citing Ex. 1005, 1:15–17; Ex. 1003 ¶ 122); *see id.* at 36 (citing Ex. 1003 ¶ 123).

[1.1] “an input for a plurality of N digital input data bits;”

Petitioner contends that, “[f]irst, Roberts teaches an ‘input digital data signal x(m)’ received by a digital signal processor (DSP) having an input.” Pet. 36 (citing Ex. 1005, 1:32–33, Fig. 4; Ex. 1003, ¶¶ 124–125) (emphasis omitted). Petitioner further contends that “[s]econd, data signal x(m) to include ‘*a plurality of N digital input data bits*’ as claimed” because “Roberts’ x(m) signal is used to ‘generate[] a pair of multi-bit sample streams V(n) which are representative of the desired phase modulation to be applied to each branch of an MZ modulator 4,’ which suggests that the x(m) signal is also multi-bit.” *Id.* at 37 (citing Ex. 1005, 6:57–59; Ex. 1003 ¶ 126). Petitioner further contends that “Roberts describes the x(m) signal as providing ‘input data’” and “[s]ince ‘data’ is the plural form of ‘datum,’ a person of ordinary skill in the art would have understood x(m) to include a plurality of bits.” *Id.* (citing Ex. 1005, 1:58–59; Ex. 1003 ¶ 126). According to Petitioner, “[w]hen implementing Taraschuk’s linearization mapping, it would have been obvious for a plurality of bits to be input to the DSP since Taraschuk expressly teaches a plurality of input bits,” and “[s]pecifically, Taraschuk teaches a 6-bit input signal.” *Id.* at 38 (citing Ex. 1003 ¶ 127; Ex. 1006, 6:56–7:4).

Petitioner contends that “Roberts’ DSP (comprising a ‘non-linear compensator’) and Taraschuk’s linearizer are both used to compensate for non-linearities of a Mach-Zehnder optical modulator, it would have been obvious to a POSITA for Roberts’ DSP to receive a 6-bit digital input signal as taught by Taraschuk." *Id.* (citing Ex. 1005, 6:34–37; Ex. 1006, 6:56–58, 7:59–67; Ex. 1003 ¶¶ 128–129).

> *[1.2] "an optical signal source for providing an input optical signal;"*

Petitioner contends that "Roberts teaches a laser ('*an optical signal source*') in communication with an optical modulator" because "Roberts' laser generates an optical carrier signal and provides it to the optical modulator ('*providing an input optical signal*')." Pet. 39–40 (citing Ex. 1005, 1:24–30, Fig. 4; Ex. 1003 ¶¶ 132–134).

> *[1.3] "a modulator for modulating the input optical signal to output a modulation of the power of the input optical signal, thereby"*

Petitioner contends that

> **First**, as discussed at [1.2], Roberts teaches an optical modulator ("*a modulator*"). Roberts further teaches that the optical modulator "modulate[s] the amplitude and/or phase [of] the carrier signal" ("*modulating the input optical signal*").
>
> **Second**, it was well known that amplitude and power have a proportional relationship (i.e., altering amplitude also alters power).
>
> **Third**, Roberts' modulating the amplitude of the optical carrier signal would have been understood by a POSITA to also result in a modulation of signal power ("*output a modulation of the power of the input optical signal*").
>
> Additionally, as discussed in Section V.B., the input-output transfer function of a Mach-Zehnder modulator moves between optical minimum and optical maximum output power responsive to changes in voltage applied to the modulator. In that regard, Roberts explains that adjustments are made to a drive voltage applied to the optical modulator in order to attain a desired modulation. Since Roberts' optical modulator is a Mach-Zehnder modulator, changes in voltage applied to Roberts' modulator (e.g., changes resulting from adjustments to the drive voltage) trigger modulations of output power.

Pet. 40–41 (citing Ex. 1005, 1:26–30, 1:41–52; Ex. 1003 ¶¶ 135–140).

[1.4] "generating one or more modulated optical signal outputs for transmission over one or more optical fibers; and"

Petitioner contends that "[t]he optical communications signal is transmitted from the optical modulator ('*transmission*') as shown in Roberts' Fig 4 below." Pet. 42. According to Petitioner, "it would have been obvious to a POSITA for Roberts' output optical communications signal to be transmitted over one or more optical fibers since such fibers had often been used in optical communications for decades." *Id.* (citing Ex. 1003 ¶¶ 28, 33, 35–39, 143). Petitioner further contends that "a POSITA would have known that optical modulators (such as that of Roberts) had for many years been a basic element of optic transmission links, including analog optical transmission links." *Id.* (citing Ex. 1005, Fig. 4 (annotated); Ex. 1003 ¶¶ 142–144).

[1.5] "a converter for: converting, based on a digital-to-digital mapping, the plurality N digital input data bits to M digital output data bits associated with M drive voltage values, and"

Petitioner contends that

> **First**, as discussed at [1.1], digital signal processor (DSP) comprises a non-linear compensator. Roberts' DSP may be considered to be the claimed "*converter*." Alternatively, Taraschuk's linearizer (discussed below and implemented within Roberts' DSP) may be considered to be the claimed "*converter*." The combination teaches the claimed "*converter*" regardless of whether Taraschuk's linearizer or Roberts' DSP is specifically mapped to the "*converter*."
>
> **Second**, Taraschuk teaches that "linearizer 44 is designed in a known manner (e.g., using a random access memory look-up table) to map an M-bit digital signal 46 into an N-bit parallel digital signal 6" where, in one embodiment, "M=6 and N=8."
>
> **Third**, Roberts teaches that the DSP outputs multi-bit $V_R(n)$ and $V_L(n)$ signals (represented generally as $V_X(n)$) and

> explains that the bits of those signals represent voltages to be applied to respective electrodes. Roberts explains that "each multi-bit sample stream Vx(n) may be an N-bit parallel binary signal output from the DSP 34 on a corresponding N-bit data bus 36" where "each line 38, of the N-bit bus 36 is connected to control a number of electrodes 40 corresponding to its binary weight." Ex. 1005, 6:40-54. Roberts goes on to explain that the electrodes are controlled by the Vx(n) streams where a voltage is applied to each electrode based on a corresponding binary value in the Vx(n) streams. For example, "each active electrode receives . . . [a] voltage (corresponding to logic state '1.'"

Pet. 43–44 (citing Ex. 1006, Fig. 5, 6:56–7:4; Ex. 1005, 5:50–54, 6:40–54, 7:35–44; Ex. 1003 ¶¶ 145–146, 148, 150); *see id.* at 46–47.

[1.6] "providing the M drive voltage values to the modulator for the modulating,"

Petitioner contends that "Roberts' DSP outputs parallel binary signals including binary values ('*M drive voltage values*') that indicate voltages to be applied to particular" ones of electrodes 40 of optical modulator 4." Pet. 47 (citing Ex. 1005, 7:39–40, Fig. 4; Ex. 1003 ¶¶ 154–155). According to Petitioner, "because Roberts teaches providing the binary values to electrodes of the optical modulator, Roberts renders obvious '*providing the M drive voltage values to the modulator for the modulating*,' as claimed." *Id.* at 48 (citing Ex. 1003 ¶ 156). Which specific ones of Roberts' electrodes 40 are driven by the M drive voltages values is determined by Taraschuk's mapping as set forth for limitation 1.6.

[1.7] "wherein M>N and N>l,"

Petitioner contends that "Taraschuk teaches that a 6-bit input signal (*N* = 6) is mapped to an 8-bit output signal (*M* = 8) by a linearizer." Pet. 48 (citing Ex. 1006, 6:56–7:4; Ex. 1003 ¶¶ 157–159).

> *[1.8] "wherein the digital-to-digital mapping comprises, for each unique plurality of N digital input data bits, a mapping to a corresponding M digital output data bits,"*

> Petitioner contends that

> > **First**, as discussed at [1.5], it would have been obvious to a POSITA for Roberts' DSP or Taraschuk's linearizer to map a certain number of digital input bits to a different number of digital output bits ("*digital-to-digital mapping*").
> >
> > **Second**, Taraschuk teaches "using a random access memory look-up table" for the mapping such that "each M-bit word of the input digital signal 46 [is] mapped to a corresponding N-bit word" ("*for each unique plurality of N digital input data bits, a mapping to a corresponding M digital output data bits*"). A POSITA would have understood Taraschuk's description of a mapping for "each" input bit word to suggest that multiple distinct ("*unique*") input bit words are possible. The term "look-up table" would suggest to a POSITA inclusion of multiple rows and columns of entries.

Pet. 49–50 (citing Ex. 1006, 6:61–7:10; Ex. 1003 ¶¶ 162–163).

> *[1.9] "wherein, for a given plurality of N digital input data bits, the mapping to the corresponding M digital output data bits is determined based on a pattern for actuating drive voltages that alters the linearity of an optical response of the modulator."*

> Petitioner contends that

> > **First**, as discussed at [1.5] and [1.8], it would have been obvious to a POSITA for Roberts' DSP or Taraschuk's linearizer to map ("*the mapping*") a certain number of digital input bits ("*a given plurality of N digital input data bits*") to a different number of digital output bits ("*M digital output data bits*") using a look-up table as taught by Taraschuk.
> >
> > **Second**, a POSITA would have found it obvious for the bits of Roberts' output signal to correspond to binary values since, as discussed at [1.5], Roberts teaches that the DSP's output is a multi-bit "parallel binary signal." A POSITA would have understood that the binary values would be made up of a pattern of 1s and 0s ("*pattern for actuating drive voltages*"). As discussed at [1.5], the binary value of each output bit indicates

> whether or not a specific voltage value ("*drive voltage*") is to be applied to electrodes of an optical modulator. Accordingly, a POSITA would have found it obvious to map input bits to output bits within the look-up table such that the output bits correspond to voltage values to be transmitted to electrodes of an optical modulator ("*mapping to the corresponding M digital output data bits is determined based on a pattern for actuating drive voltages*").
>
> **Third**, Taraschuk teaches that the mapping can be defined to compensate for the non-linear effects of the optical modulator ("*alters the linearity of an optical response of the modulator*"). Taraschuk recognizes that "conventional optical modulators, such as for example, a Mach-Zehnder modulator, display sinusoidal response to an input control signal" and notes that "linearizer 44 can also be used to compensate non-linearities of the optical modulator 52." Taraschuk explains that "a mapping can be defined between the M-bit input digital signal 46 and an N-bit signal . . . which compensates for the combined non-linear effects of . . . the sinusoidal response of the modulator 52" such that the response of the optical modulator is "more nearly linear."

Pet. 50–51 (citing Ex. 1003 ¶¶ 165–169; Ex. 1005, 6:40–42; Ex. 1006, 7:56–8:15).

In view of the above, Petitioner contends that it would have been obvious to a POSITA "for Roberts' DSP to map a given number of digital input bits to a different number of digital output bits using Taraschuk's look-up table where input bits are mapped to output bits such that the output bits compensate for the non-linear effects of the optical modulator," and thus, the combination teaches limitation 1.9. *Id.* at 51 (citing Ex. 1003 ¶ 170).

b. Patent Owner's Response Arguments

Patent Owner argues that

> the "determined based on a pattern . . . " limitations were added to the claims during prosecution, specifically to overcome an Examiner's rejection citing to the unexplained linear compensator disclosures of *Roberts*. The disclosures overcome

> by the Amendment included the Examiner's citation to *Roberts*' mention of a compensation function that resulted in a "pre-distorted signal."

PO Resp. 19 (citing Ex. 2003, 2 (May 27, 2021 Notice of Allowability at 2); Ex. 2008, 5–6 (citing Ex. 1005, 2:43–55)). Patent Owner points out that "'the use of an analog pre-distortion circuit to feed the modulator' is something the '872 Patent places in the inferior prior art." *Id.* at 20 (citing Ex. 1001, 2:3–7).

Patent Owner further contends that the "Petition tellingly attempts to obscure Taraschuk's own description of its mapping, constructing a quotation from language before and after [the description]." *Id.* at 29 (citing Pet. 52 (citing Ex. 1006, 7:61–67, 8:13–15)). According to Patent Owner, Taraschuk "explains, in between those citations, that [its] solution is based on obtaining an analog 'sample of the modulator output 56.'" *Id.* (citing Ex. 1006, 7:67–8:5, Fig. 6). Patent Owner contends that "[t]his is self-evidently not disclosure of 'mapping . . . determined based on a pattern for actuating drive voltages,'" and "[i]f anything, the cited disclosures of Taraschuk describe **analog pre-distortion** determined based on an analog sample feedback loop." *Id.* at 29–30 (citing Ex. 1006, 7:25–38, Fig. 5) (emphasis added).

c. Petitioner's Reply Arguments

Petitioner asserts that "Patent Owner mischaracterizes Taraschuk as using a 'real-time analog sample feedback approach.'" Pet. Reply 17 (citing PO Resp. 3). According to Petitioner, "Taraschuk's design is digital, not analog." *Id.* (citing Ex.1006, 6:57–58 ("digital signal . . . compensated by the use of a linearizer"), 6:61–65 ("map an M-bit digital signal . . . into an N-bit parallel digital signal")). Petitioner further asserts that "the '872 patent background makes no mention of using a feedback loop" and that, "[t]hus, even if Taraschuk's approach were an analog feedback loop, that would still be a different technique" from that which is disclosed as inferior in the '872 patent specification. *Id.* (citing Ex. 1001, 2:6–7 (disclosing "an analog pre-distortion circuit")). Petitioner further contends that

> Patent Owner's emphasis on Taraschuk's digital feedback loop is also misplaced because the Petition simply relied on Taraschuk's linearizer 44 as a discrete, known device for performing non-linear compensation of a Mach-Zehnder modulator. In the combination with Roberts, the linearizer 44 could be used either with or without a feedback loop. A feedback loop is not necessary because "the mapping implemented by the linearizer 44 may be calculated in advance." The Board correctly found that similar arguments in the [Patent Owner Preliminary Response] were "unavailing" and should do so again.

Id. at 17–18 (citing Pet. 43–45; Ex. 1006, 7:56–60; 7:15–16; Inst. Dec. 26, 37).

Petitioner also argues that the testimony of Dr. Dallesasse, Patent Owner's expert, should be afforded little weight because "Dr. Dallesasse provides no evidence as why a POSITA would understand the '872 patent as seeking to optimize the output of the digital-to-digital **converter** rather to than correct (linearize) the inherent sinusoidal response of the **modulator** as stated in the '872 patent." *Id.* at 30–31.

d. Analysis of the Parties' Arguments

In our Institution Decision, we determined that

> [a]t the time when Taraschuk's M-bit input digital signal 46 enters the digital-to-analog converter 12, the signal is in digital format and when it is converted to N-bit digital signal 6, it is still in digital format . . . Even assuming, *arguendo*, that Patent Owner is correct that Taraschuk teaches "analog pre-distortion based on an analog sample feedback loop," the claim does not require a

> digital feedback loop or exclude an analog feedback loop, and thus, Patent Owner's argument is unavailing.

Inst. Dec. 25–26 (citing Ex. 1006, 8:2, 8:8, 6:61–65; Ex. 1003 ¶ 147; Prelim. Resp. 46). Based on our review of the complete record developed during trial, we are persuaded to modify our preliminary determinations. For the reasons discussed below, we are persuaded that the scope of claim 1 does not encompass linear compensation methods effected by analog pre-distortion because the '872 patent specification distinguishes analog pre-distortion (*see* Ex. 1001, 1:55–2:34) and the prosecution history specifically distinguishes analog pre-distortion from the claimed approach (*see* Ex. 1002, 172).

We find persuasive Dr. Dallesasse's testimony that "a person of ordinary skill in the art reading the ['872] patent would understand that th[e] [claimed] approach differs from pre-distortion based on real-time measured analog modulator output." Ex. 2018 ¶ 33 (citing-in-part Ex. 1001, 2:3–7 ('872 patent disclosing common, prior art solutions such as "an analog pre-distortion circuit to feed the modulator")); *see also* Ex. 1001, (the '872 patent describing the need for a "digital to analog converter" that would "improve[] linearity of response without sacrificing efficiency or dynamic range" as in the common, prior art solutions). Dr. Dallesasse explains how "the prosecution history of the '872 patent [illustrates] that when [Patent Owner] changed 'correct for non-linearities' to the more specific language 'determined based on a pattern for actuating drive voltages that alters the linearity of an optical response of the modulator,'" "the Examiner then allowed the claims over a rejection based on *Roberts*, which "suggests that there are ways to 'correct for non-linearities' that do not meet the amended claims, as the '872 Patent itself admits." *Id.* at 78 (citing Ex. 1001, 2:3–7; Ex. 2009, 2; Ex. 2003). During prosecution, Patent Owner argued:

> Roberts does not disclose a "digital-to-digital mapping," where, "for a given plurality of N digital input data bits, the mapping to the corresponding M digital output data bits is determined based on a pattern for actuating drive voltages that alters the linearity of an optical response of the modulator," as recited in amended claim 1. *Instead*, the linear compensation in Roberts is performed pursuant to a compensation function c(t) when the $V_x(n)$ multi-bit sample streams are generated. *Importantly*, this linear compensation in Roberts occurs *before* the mapping of $V_x(n)$ to $S_x(n)$. As a result, the mapping between $V_x(n)$ to $S_x(n)$ in Roberts, such as the mapping shown in Table 1 of Roberts, is not a part of the linear compensation operation performed in Roberts.

Ex. 1002, 172 (emphasis added). We interpret the quoted passage to exclude analog pre-distortion because we interpret the argument distinguishing Robert's compensation as happening "before the mapping" to refer to pre-distortion techniques—in particular, those accomplished by analog compensation function, c(t). *Id.* Both the '872 patent and Patent Owner's arguments during prosecution support Dr. Dallesasse's testimony and Patent Owner's position that the scope of claim 1 does not encompass linear compensation methods effected by analog pre-distortion.

We find persuasive Patent Owner's distinction between analog pre-distortion and the invention recited in claim 1:

> [M]apping in the digital domain could compensate for modulator non-linearity or other signal degradations simpler and faster than prior solutions. Output range restrictions, complicated analog signal conditioning, or other inefficient aspects of prior solutions could be avoided. The digital mapping as claimed in the '872 Patent could improve "linearity of response without sacrificing efficiency or dynamic range" as prior solutions required.

PO Resp. 6 (citing Ex. 1001, 2:3–34, 7:60–62). More particularly, independent claim 1 recites that "alter[ing] the linearity of an optical response of the modulator," i.e., linear compensation, is performed in the claimed "converter"—this is in contrast to a conditioned, pre-distorted signal that is generated *before* the converter, as taught by Roberts and Taraschuk.

We agree with Patent Owner that "*Taraschuk* does not generate or choose a digital output word or constellation point at the output of a converter, but instead applies an analog feedback correction from the ***modulator*** output to the ***input*** word in order to make the intended input appear at the modulator output." PO Resp. 20 (citing Ex. 1006, 7:67–8:5, 7:7–11, 7:34–39, Fig. 6). Dr. Dellesasse's testimony supports Patent Owner's position by explaining that

> the only explanatory discussion of *Taraschuk*'s mapping suggests that it is instead determined based on "calculating a difference between the received M-bit word and the sampled analog output signal level (S)." In other words, if the *Taraschuk* mapping is "determined based on" anything, it is the real-time sampled analog modulator output.
>
> A person of ordinary skill reading this explanation of the mapping in *Taraschuk*, consisting of a sample of the analog modulator output fed back to alter the input, would likely equate it with the prior art "use of an analog pre-distortion circuit to feed the modulator" solution mentioned in the '872 Patent background.
>
> Finally, beginning at column 7, line 53 of *Taraschuk*, there is a paragraph on using the "analog signal output from the D/A converter" to drive an optical modulator. That discussion states that "in principle" a mapping can be defined to compensate for "the combined non-linear effects" of logic level mismatches and "the sinusoidal response of the modulator." These two sentences say only that the mapping can be obtained by comparing the *input* word to a sample of the *analog output* of the modulator. *Id.* In other words, this particular embodiment of *Taraschuk* applies

> a pre-distortion to the input word, based on feedback of an analog sample of the output of the modulator.

Ex. 2018 ¶¶ 48, 79, 80 (citing Ex. 1006, 7:34–39, 7:61–8:5, Fig. 6; Ex. 1001, 2:3–7); *see id.* ¶ 71. We disagree with Petitioner that the testimony of Dr. Dallesasse, Patent Owner's expert, should be afforded little weight because the point raised by Petitioner, that "Dr. Dallesasse provides no evidence as why a POSITA would understand the '872 patent as seeking to optimize the output of the digital-to-digital converter rather to than correct (linearize) the inherent sinusoidal response of the modulator as stated in the '872 patent," is not the dispositive inquiry. Pet. Reply 30–31 (emphasis omitted). Rather, the dispositive inquiry is whether the cited portions of Taraschuk support Dr. Dallesasse's testimony and Patent Owner's position that Petitioner "rel[ies] on art that only discloses pre-distortion of input, calculated from analog samples of the overall modulator output." Sur-reply 15; *id* at 2 (citing Ex. 1006, 7:34–39, 7:61–8:5, Figs. 5, 6) (Patent Owner arguing that "Taraschuk teaches an approach based on real-time analog feedback samples, digitized, subtracted from, and used to pre-distort the input words"). Based on the complete record developed during trial, we determine that the cited portions of Taraschuk support Dr. Dallesasse's testimony and Patent Owner's position.

Taraschuk discloses, with respect to Figure 5, that "calculating a difference between the received M-bit word and the sampled analog output signal level (S), the signal processor 48 can readily compute a mapping between the received M-bit word of the input digital signal 46 and an N-bit word required to obtain the desired output analog signal level." Ex. 1006, 7:34–39. Taraschuk further discloses that

> the process of sampling analog output signal level (S); determining a difference between the sampled signal level (S) and the corresponding M-bit word; recalculation of the mapping, and loading the new mapping into the linearizer 44 can be performed at a rate that is significantly slower than the line rate of the M-bit input digital signal 46.

Id. at 7:46–52. Taraschuk also describes a similar process with respect to Figure 6: "computation of the suitable mapping can be obtained by receiving an M-bit word of the input digital signal and comparing it to a detected sample of the modulator output in a manner directly analogous to that described above with reference to FIG. 5." *Id.* at 7:67–8:5.

Patent Owner's contention that Petitioner "denies that Taraschuk's mapping is based on an analog feedback loop, by . . . quoting from the reference and leaving out the very next sentence" has merit. Sur-Reply 8 (citing Pet. Reply 23). Petitioner does not sufficiently address the cited teachings and in particular, Taraschuk's teachings of calculating a difference between a "sampled analog output signal (S) and corresponding M-bit word" to a calculate a mapping "required to obtain the desired output analog signal level." Ex. 1006, 7:34–39. We are persuaded Petitioner does not sufficiently rebut Patent Owner's contention that Roberts' and Taraschuk's teachings of linear compensation are implemented by analog pre-distortion.

Petitioner cannot ignore these teachings of Taraschuk and consider only the portions that support its challenge. *See* Pet. Reply 17 (citing Pet. 43–45; Ex.1006, 7:56–60) ("Patent Owner's emphasis on Taraschuk's digital feedback loop is also misplaced because the Petition *simply relied on Taraschuk's linearizer 44* as a *discrete*, known device for performing non-linear compensation of a Mach-Zehnder modulator." (emphasis added)). Petitioner cannot set forth the teachings of Taraschuk in such a piecemeal fashion, and view these teachings in a vacuum. As Petitioner fails to sufficiently explain why the converter of Taraschuk relies on analog pre-distortion, or explain why analog pre-distortion is encompassed by the invention recited in independent claim 1, Petitioner does not sufficiently carry its burden.

Petitioner's Reply includes positions not supported by a Reply Declaration from Dr. Blumenthal. More particularly, Petitioner supports neither its contention that "[i]n the combination with Roberts, [Taraschuk's] linearizer 44 *could be used either with or without a feedback loop*," nor its contention that "[a] *feedback loop is not necessary* because 'the mapping implemented by the linearizer 44 may be calculated in advance'" with the testimony of Dr. Blumenthal or disclosures from Roberts, Taraschuk, or any other contemporaneous reference. *Id.* at 17–18 (citing Pet. 43–45; Ex. 1006, 7:56–60; 7:15–16; Inst. Dec. 26, 37) (emphasis added). Accordingly, Petitioner's arguments constitute attorney argument that is not sufficiently supported by evidence. *See In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984) (lawyer arguments and conclusory statements which are unsupported by factual evidence are entitled to little probative value).

For the foregoing reasons, we determine that Petitioner does not establish, by a preponderance of the evidence, that the combination of Roberts and Taraschuk teaches or suggests the combination of features recited in independent claim 1.

4. Independent Claim 11

With respect to independent claim 11, Petitioner cites, in large part, its analysis for independent claim 1. Pet. 64–67 (citing Ex. 1003 ¶¶ 203–212; Ex. 1005, 1:28–30). Patent Owner appears to address independent claims 1, 11, and 15 together. *See, e.g.*, PO Resp. 25. For these reasons, our analysis for independent claim 1 is substantially applicable to independent claim 11. Accordingly, we determine that Petitioner does not establish, by a preponderance of the evidence, that the combination of Roberts and Taraschuk teaches or suggests the combination of features recited in independent claim 11.

5. Independent Claim 15

With respect to independent claim 15, Petitioner cites, in large part, its analysis for independent claim 1. Pet. 67–73 (citing Ex. 1001, 14:1–4; Ex. 1003 ¶¶ 273–287; Ex. 1005, 1:23–24, 1:35–37, 5:60–67, Fig. 4; Ex. 1006, 7:53–61, 8:54–66, Fig. 6; Ex. 1015, 112–13; Ex. 1021, 4:11–13, claim 2). Patent Owner appears to address independent claims 1, 11, and 15 together. *See, e.g.*, PO Resp. 25. For these reasons, our analysis for independent claim 1 is substantially applicable to independent claim 15. Accordingly, we determine that Petitioner does not establish, by a preponderance of the evidence, that the combination of Roberts and Taraschuk teaches or suggests the combination of features recited in independent claim 15.

6. Dependent Claims 2–10, 12, 16–22, and 30

Petitioner's showing with respect to dependent claims 2–10, 12, 16–22, and 30 does not cure the deficiencies noted above with respect to independent claims 1, 11, and 15. As such, we determine that Petitioner does not establish, by a preponderance of the evidence, that the combination of Roberts and Taraschuk teaches or suggests the combination of features recited in dependent claims 2–10, 12, 16–22, and 30.

IV. CONCLUSION

In summary:

Claims Challenged	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–12, 15–22, 30	103(a)	Roberts, Taraschuk		1–12, 15–22, 30

V. ORDER

For the reasons given, it is:

ORDERED that Petitioner has not established, by a preponderance of evidence, that any of claims 1–12, 15–22, and 30 of the '872 patent are unpatentable as obvious under 35 U.S.C. § 103; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of this Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner,

v.

RAMOT AT TEL AVIV UNIVERSITY, LTD.,
Patent Owner.

IPR2022-00575
Patent 11,133,872 B2

Before CHRISTOPHER L. CRUMBLEY, MONICA S. ULLAGADDI, and JASON M. REPKO, *Administrative Patent Judges.*

REPKO, *Administrative Patent Judge*, concurring.

I concur in the determination that Petitioner has not shown that claims 1–12, 15–22, and 30 of the ’872 patent are unpatentable. I write separately to present an additional reason why I believe Petitioner’s analysis is deficient. I agree with Patent Owner’s argument that Petitioner “simply states that a person of skill would have somehow found the element obvious from the presence of a ‘look-up table’—with nothing to indicate why or how.” PO Resp. 27 (citing Pet. 51). In particular, Petitioner provides three rationales, but all are deficient. *See* Pet. 50–52.

First, Petitioner states that it would have been obvious to use Taraschuk’s look-up table to perform the recited mapping. *Id.* at 50. But Petitioner does not identify any teaching or suggestion that shows Taraschuk’s look-up table was used in that way. *See id.* at 50–51. Nor does Petitioner provide any other substantive reasoning to support this conclusion. *See id.*

Second, Petitioner concludes that “a POSITA would have found it obvious to map input bits to output bits within the look-up table such that the output bits correspond to voltage values to be transmitted to electrodes of an optical modulator,” but offers no support other than Robert’s teaching that the DSP’s output is a multi-bit parallel binary signal. *See id.* at 51 (citing Ex. 1005, 6:40–42). That is, the sole basis for Petitioner’s conclusion that it would have been obvious to perform the claimed method is that the output is the same. *Id.* This is impermissible hindsight.

Third, Petitioner essentially argues that a person would have found it obvious to perform the mapping because Taraschuk teaches a look-up table and non-linear compensation. *Id.* at 51–52. Yet the claim recites how the mapping is performed, which is left unaddressed by Petitioner. *Id.* That is, Petitioner has not shown where Taraschuck teaches mapping a given number of digital input bits to a different number of digital output bits using the look-up table, so that the output bits compensate for the non-linear effects of the optical modulator. *Id.* at 52. Rather, Petitioner provides a piecemeal analysis that uses the '872 patent's specification as a blueprint to pull together a look-up table, non-linear compensation, and a modulator to arrive at the claimed invention. *See id.* Thus, all three rationales for limitation 1.9 are deficient. *See* PO Resp. 27.

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner,

v.

RAMOT AT TEL AVIV UNIVERSITY, LTD.,
Patent Owner.

IPR2022-00575
Patent 11,133,872 B2

Before MONICA S. ULLAGADDI, CHRISTOPHER L. OGDEN, and JASON M. REPKO, *Administrative Patent Judges.*

Opinion for the Board filed by *Administrative Patent Judge* ULLAGADDI.

Opinion Dissenting filed by *Administrative Patent Judge* OGDEN.

ULLAGADDI, *Administrative Patent Judge*.

DECISION
Denying Petitioner's Request on Rehearing
of the Final Written Decision
37 C.F.R. § 42.71

I. BACKGROUND

Cisco Systems, Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1–12, 15–22, and 30 ("the challenged claims") of U.S. Patent No. 11,133,872 B2 (Ex. 1001, "the '872 patent"), accompanied by the supporting Declaration of Dr. Daniel J. Blumenthal (Ex. 1003). Ramot at Tel Aviv University Ltd. ("Patent Owner") filed a Preliminary Response. Paper 8. In our Institution Decision, we instituted an *inter partes* review of each of the challenged claims on the ground set forth in the Petition. Paper 10.

Patent Owner filed a Response (Paper 18, "Patent Owner's Response" or "PO Resp.") accompanied by the supporting Declaration of Dr. John Dallesasse (Ex. 2018), Petitioner filed a Reply to Patent Owner's Response (Paper 24, "Petitioner's Reply" or "Pet. Reply"), and Patent Owner filed a Sur-Reply (Paper 28). On July 5, 2023, we held an oral hearing. A transcript of the hearing is of record. Paper 32. We issued a Final Written Decision. Paper 33 ("FWD").

Petitioner requests Rehearing of our Final Written Decision. Paper 34 ("Req. Reh'g"). Patent Owner's filed an Opposition. Paper 36 ("Opp."). For the reasons set forth below, Petitioner's Rehearing Request is denied.

II. LEGAL STANDARDS

A party requesting rehearing bears the burden of showing that a decision should be modified. 37 C.F.R. § 42.71(d). The party must specifically identify all matters it believes the Board misapprehended or overlooked, and the place where each matter was addressed previously in a motion, an opposition, or a reply. *Id.* "A party may request rehearing on a decision by the Board on whether to institute a trial" and "[w]hen rehearing a decision on petition, a panel will review the decision for an abuse of discretion." *Id.* § 42.71(c). A request for rehearing, therefore, is not an opportunity merely to disagree with the Board's assessment of the arguments or weighing of the evidence, or to present new arguments or evidence. *See, e.g.*, *Presidio Components, Inc. v. AVX Corporation,* IPR2015-01332, Paper 21 at 4 (PTAB Feb. 18, 2016) ("Patent Owner's arguments in this regard amount to a mere disagreement with our analysis or conclusion. But mere disagreement with our analysis or conclusion is not a sufficient basis for rehearing. It is not an abuse of discretion to provide analysis or conclusion with which Patent Owner disagrees.").

III. PETITIONER'S REHEARING ARGUMENTS

According to Petitioner, "Roberts' compensation function c(t) is **not** what performs linear compensation of the modulator." Req. Reh'g 3. Instead, Petitioner argues that "[c]ompensation of the modulator is performed by Roberts' all-digital (i.e., digital in and digital out) non-linear compensator 18, which the petition identified in analyzing the claimed '*digital-to-digital mapping*.'" *Id.* Petitioner further argues that "Roberts' compensation function c(t) is used by the digital filter 16—not non-linear compensator 18—'to compute the desired target modulation' and 'to compensate impairments of an optical link.'" *Id.* at 4 (citing Ex. 1005, 6:35, 1:58–61, 1:50–52; Pet. 53 (footnote omitted)).

According to Petitioner, our reliance on "misstatements [by Patent Owner]" led us "to two erroneous conclusions: (1) that Roberts' compensation of the modulator occurs **before** the mapping, and (2) that Roberts' compensation of the modulator is **analog**." Req. Reh'g 5 (citing FWD 22). Petitioner explains that

> Petitioner does not dispute the Board's finding "that the scope of claim 1 does not encompass linear compensation methods effected by analog predistortion." But this finding is not dispositive because Roberts describes a linear compensation method effected by *digital* predistortion. Roberts' non-linear compensator—both alone and in combination with Taraschuk's digital linearizer—is unlike the analog pre-distortion disparaged by the '872 patent.

Id. at 10 (citing FWD 22).

Petitioner contends that "[t]he combination actually proposed merely implements Roberts' all-digital non-linear compensator 18 (which performs the mapping **and** the non-linear compensation of the modulator) with more output bits than input bits by using the linearizer look-up table technique of Taraschuk." Req. Reh'g 10–11. "Because Roberts already describes digital pre-distortion ('*digital-to-digital mapping*') with a non-linear compensator, the addition of Taraschuk merely provides the implementation detail of having more output bits than input bits, which may be done through a lookup table." *Id.* at 15. Petitioner also contends that "[t]he Board's statements . . . overlooked that Taraschuk's linearizer—like Roberts' non-linear compensator—is purely digital (digital inputs and digital outputs). As the proposed combination merely proposes implementing Roberts' non-linear compensator with a known-suitable option—Taraschuk's all-digital linearizer—the proposed combination teaches *digital* compensation as claimed." *Id.* at 16–17.

IV. PATENT OWNER'S OPPOSITION ARGUMENTS

Patent Owner contends that

> [t]he Board didn't look to *Taraschuk* because it "misapprehended the proposed combination" or "misapprehended *Roberts*' c(t) function." *See generally*, Request. The Board looked at *Taraschuk*, in combination,

> ***because that is what Cisco pointed at***. Petition, 51-52 ("Taraschuk teaches that the mapping can be defined to compensate for the non-linear effects of the optical modulator" and "using Taraschuk's look-up table"). And Cisco pointed to *Taraschuk* because *Roberts* says next to nothing about "non-linear compensator 18"—and what it does say is unhelpful to Cisco's argument. *See* FWD at 18 (quoting Ramot on "the unexplained linear compensator disclosures of *Roberts*"). Now that the Board has credited Prof. Dallesasse's evidence that *Taraschuk* instead teaches a different end-to-end, analog sampling, feedback approach (FWD at 19, 21), Cisco apparently wishes to discuss *Roberts* again. But it presents only more argument, not a showing of error.

Opp. 2. Patent Owner further contends that

> The Board quoted at length Cisco's arguments about *Roberts*' DSP and its "non-linear compensator," in combination. FWD at 13 ("Petitioner contends that "Roberts' DSP (comprising a 'non-linear compensator') and Taraschuk's linearizer are both used to compensate for non-linearities of a Mach-Zehnder optical modulator"), 15-16. There was no overlooking or misapprehension. Cisco's is simply a bad argument that the Board did not credit—justifiably, because of "the unexplained linear compensator disclosures of *Roberts*" and the Petition's corresponding lack of explanation.

Id. at 2–3.

V. ANALYSIS

The record does not clearly and sufficiently support Petitioner's position—Petitioner's rehearing arguments *attempt* to bring to the record a clarity not seen in its briefing during trial. A portion of Roberts cited in Petitioner's Rehearing Request states that

> a complex driver circuit 14 comprises a digital filter 16 which uses the input data signal x(m) and a compensation function c(t) to calculate multi-bit In-Phase and Quadrature component values I(n) and Q(n) of a target optical E-field modulation. A non-linear compensator 18 uses the I(n) and Q(n) components to compute multi-bit sample streams $V_R(n)$ and $V_L(n)$.

Ex. 1005, 1:57–63. Another portion of Roberts cited in Petitioner's Rehearing Request states that

> [i]f desired, the DSP 34 may incorporate the functionality of the digital filter 16 and non-linear compensator 18 of the complex driver 14 described above with reference to FIG. 2. This arrangement is advantageous in that the digital filter 16 can be used to compute the desired target modulation, and the non-linear compensator 18 used to compensate non-linearities of the optical modulator 4.

Id. at 6:31–37.

From these cited, above-quoted portions of Roberts, it is unclear if Petitioner is relying on Roberts' Figure 2—labeled as prior art—or Roberts' Figure 4. In its Rehearing Request, Petitioner points us to the Petition at pages 26–27, 30–34, and 48. Most of the cited portions are in Sections X.B.1–3 of the Petition (Summary of Roberts, Summary of Taraschuk, and Reasons to Combine Roberts and Taraschuk). These cited portions reference Roberts' DSP 34, which is described with respect to Figure 4–7 of the invention. These cited portions also reference column 1 and 2 of Roberts' Specification that describe Figures 1, 2, 3*a*, and 3*b*—which are labeled as prior art to the invention—of which Figure 2 depicts complex driver 14, not DSP 34. In the Petitioner's limitation-by-limitation claim mapping (*see* Pet. 35–52), only Figure 4 is annotated and reproduced in the Petition. Figure 4 references DSP 34, which has analog compensation function c(t) as an input. Petitioner's DSP 34 does not depict a separate non-linear compensator 18 and digital filter 16 in which compensation function c(t) is applied to only digital filter 16. *See* Ex. 1005, Fig. 2 (prior art depicting compensation function c(t) inputted to digital filter 16).

The cited and above-quoted portions of Roberts do not sufficiently and clearly support Petitioner's position that compensation in non-linear compensator 18 is not in some way effected or affected by compensation function c(t). Req. Reh'g 3. Nor do the cited and above-quoted portions in column 1 and 6 of Roberts indicate that compensation function c(t) is *only* used to compensate for impairments of the optical link, either with respect to non-linear compensator 18 shown in Roberts' Figure 2 or DSP 34 shown in Roberts' Figure 4, as Petitioner contends. *Id.* at 4 (citing Ex. 1005, 6:35, 1:58–61, 1:50–52; Pet. 53 (footnote omitted)). Despite Petitioner's contention that "Roberts' all-digital non-linear compensator 18 (which performs the mapping **<u>and</u>** the non-linear compensation of the modulator)," (Req. Reh'g 11), Patent Owner has the better position that "[Petitioner] pointed to *Taraschuk* because *Roberts* says next to nothing about 'non-linear compensator 18'—and what it does say is unhelpful to [Petitioner's] argument." Opp. 2.

Even Petitioner's arguments on rehearing introduce uncertainty into just what exactly Petitioner's proposed combination relies on. First, Petitioner asserts that "Roberts already describes digital pre-distortion ('*digital-to-digital mapping'*) with a non-linear compensator, the addition of Taraschuk merely provides the implementation detail of having more output bits than input bits, *which may be done through a lookup table*." Req. Reh'g 15 (emphasis added). But on the very next page of its Rehearing Request, Petitioner contends that "[t]he Board's statements . . . overlooked that Taraschuk's linearizer—like Roberts' non-linear compensator—is purely digital (digital inputs and digital outputs)" and that Petitioner "merely proposes implementing Roberts' non-linear compensator with a known-suitable option—Taraschuk's all-digital linearizer—the proposed combination teaches *digital* compensation as claimed." *Id.* at 16–17.

If Petitioner intended to rely on Taraschuk only for its teaching of a lookup table, and even if the concept of populating the lookup table values is not explicitly recited in the claims, Petitioner's proposed combination constitutes piecemeal analysis predicated on hindsight if it discards Roberts' feedback loop and ignores Taraschuk's feedback loop in favor of an empty table populated only by Dr. Blumenthal's analysis. Req. Reh'g 3, 10, 14; *see id.* at 15 ("Taraschuk's feedback loop is *not* what performs compensation of the modulator," but "is merely the mechanism by which the linearizer lookup table values are populated.").

Even assuming, *arguendo*, that we were to agree with Petitioner's argument that "the claims do not recite the mechanism by which the values of the '*digital-to-digital mapping*' . . . are populated," and, "[i]nstead, . . . the claims recite what the digital-to-digital mapping *produces*," as argued in the reply (Req. Reh'g 15–16), the prosecution history indicates that the method by which compensation occurs is indeed relevant. *See* Ex. 1002, 172. But Petitioner does not dispute that the claims exclude analog pre-distortion compensation techniques. Req. Reh'g 10 (citing FWD 22). As discussed in the preceding paragraphs, Petitioner does not sufficiently show that we misapprehended or overlooked its proposed compensation and how c(t) is received and used by DSP 34.

VI. CONCLUSION

For the foregoing reasons, we are not persuaded that we misapprehended or overlooked any matter in the Final Written Decision.

VII. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner's Request for Rehearing is *denied*.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner,

v.

RAMOT AT TEL AVIV UNIVERSITY, LTD.,
Patent Owner.

IPR2022-00575
Patent 11,133,872 B2

Before MONICA S. ULLAGADDI, CHRISTOPHER L. OGDEN, and JASON M. REPKO, *Administrative Patent Judges.*

OGDEN, *Administrative Patent Judge*, dissenting.

I respectfully dissent. Considering the Petition as a whole, I agree with Petitioner that it does not rely on Roberts's c(t) function for performing linear compensation of the modulator, and instead relies on the embodiment of DSP 34, in which non-linear compensator 18 performs that compensation. Non-linear compensator 18 performs digital-to-digital mapping because it receives "multi-bit" (i.e., digital) inputs from digital filter 16 and outputs digital "multi-bit sample streams" which are sent to digital-to-analog converters 20. *See* Ex. 1005, 1:57–2:2.

In my view, this argument is sufficiently clear in the Petition. In its overview of Roberts, Petitioner points to non-linear compensator 18 as the element in Roberts that performs the digital-to-digital linear compensation.

See Pet. 26–27 (citing Ex. 1005, 1:61–64, 2:43–50, 6:31–33; Ex. 1003 ¶¶ 103–105). In context, I think it is clear that Petitioner's rationale for combining Roberts and Taraschuk relies on this non-linear compensator or linearizer (i.e., item 18) of Roberts's DSP 34 in combination with Taraschuk's look-up table. Pet. 29–35.

Although the limitation-by-limitation part of the Petition (pages 35–52) refers to DSP 34 in Figure 4 and does not mention Figure 2, DSP 34 is just a block element in Figure 4 and I believe that Petitioner is clearly relying on the embodiment of DSP 34 that comprises non-linear compensator 18. *See, e.g.*, Pet. 38 ("Roberts' DSP (comprising a 'non-linear compensator,')"), 39 ("the non-linear compensation function of the DSP"), 43 ("Roberts' digital signal processor (DSP) comprises a non-linear compensator"), 45 ("Roberts' DSP (having a non-linear compensator)").

It is also my view, in the context of claim 2, that the Petition relies on compensation function c(t) to compensate for non-linear characteristics of only the *optical fiber*, not the *modulator*, and that the latter compensation is already the function of non-linear compensator 18 as set forth in Petitioner's arguments for claim 1. *See* Pet. 53–55 ("a [person of ordinary skill in the art] would have found it obvious for Roberts['s] DSP to compensate for both the non-linear characteristics of the modulator and the non-linear characteristics of the optical fiber."); Ex. 1003 ¶¶ 174–175.

For the above reasons, I would grant Petitioner's Request for Rehearing.

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