UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MARVELL SEMICONDUCTOR, INC.,
Petitioner,

v.

CREDO TECHNOLOGY GROUP LTD.,
Patent Owner.

Case IPR2025-01219
U.S. Patent No. 11,012,252

PATENT OWNER'S RESPONSE

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I. INTRODUCTION

Petitioner Marvell Semiconductor, Inc., challenges the patentability of U.S. Patent No. 11,012,252 (the "'252 patent"). The invention described and claimed in the '252 patent, assigned to Patent Owner Credo Technology Group Limited, arose from Credo's creation of a brand new category of Ethernet cables now known as Active Electrical Cables ("AECs"). Credo coined the term Active Electrical Cable when it released its first AEC in 2019. EX-2033. Until then, data centers typically used optical cables for high-speed connections between components in a server rack. Traditional Ethernet cables could not support the increased demand for data speed, leaving optical cables as the only choice. Pioneering an entirely new market, Credo introduced AECs that are less expensive to buy, require less power to operate, and perform more reliably than optical cables. EX-2034. Within months, Credo's AECs won the 2019 Gold Award from the Cabling Installation & Maintenance Innovators. EX-2005. Since then, Forbes magazine reports that Credo's distinctive purple AECs, pictured below, "have become indispensable in the AI infrastructure buildout." EX-2038.

Recognizing Credo's success, competitors have since entered the AEC market with their own AECs, many of which are now licensed to Credo's patents. Petitioner designs and supplies components that may be used in AECs and is now challenging the '252 patent as well as two other Credo patents related to AECs. For multiple reasons, Petitioner has failed to meet its burden of showing that any claim of the '252 patent is unpatentable.

Ground 1. The claims of the '252 patent are directed to active Ethernet cables. In Ground 1, Petitioner relies on two references, neither of which describes or suggests an active Ethernet cable. Indeed, the lead reference, Cornelius, does not even *mention* Ethernet anywhere in its substantive disclosure. In this proceeding focused on the patentability of an active Ethernet cable, Petitioner's lead reference—the primary reference in Ground 1—does not even substantively mention the word Ethernet.

The deficiencies do not stop there. Cornelius also provides no disclosure of the "fixed, cable independent equalization parameters" recited in every claim of the '252 patent. Petitioner fares no better with the secondary reference in Ground 1, Samaan, which teaches *away* from fixed equalization parameters. And, although Samaan does mention Ethernet, it does not address Ethernet *cables* at all.

Beyond these deficiencies, Petitioners fail to explain how or why one of ordinary skill in the art would have been motivated to combine the teachings of Cornelius and Samaan, which would have required substantial reconfiguring of Cornelius's functionality.

<u>Ground 2</u>. For claims 5 and 10, Petitioner requires a third reference—and chose to rely on Lugthart, which contains exactly the teachings that the Examiner expressly considered and concluded did not teach the claimed features.

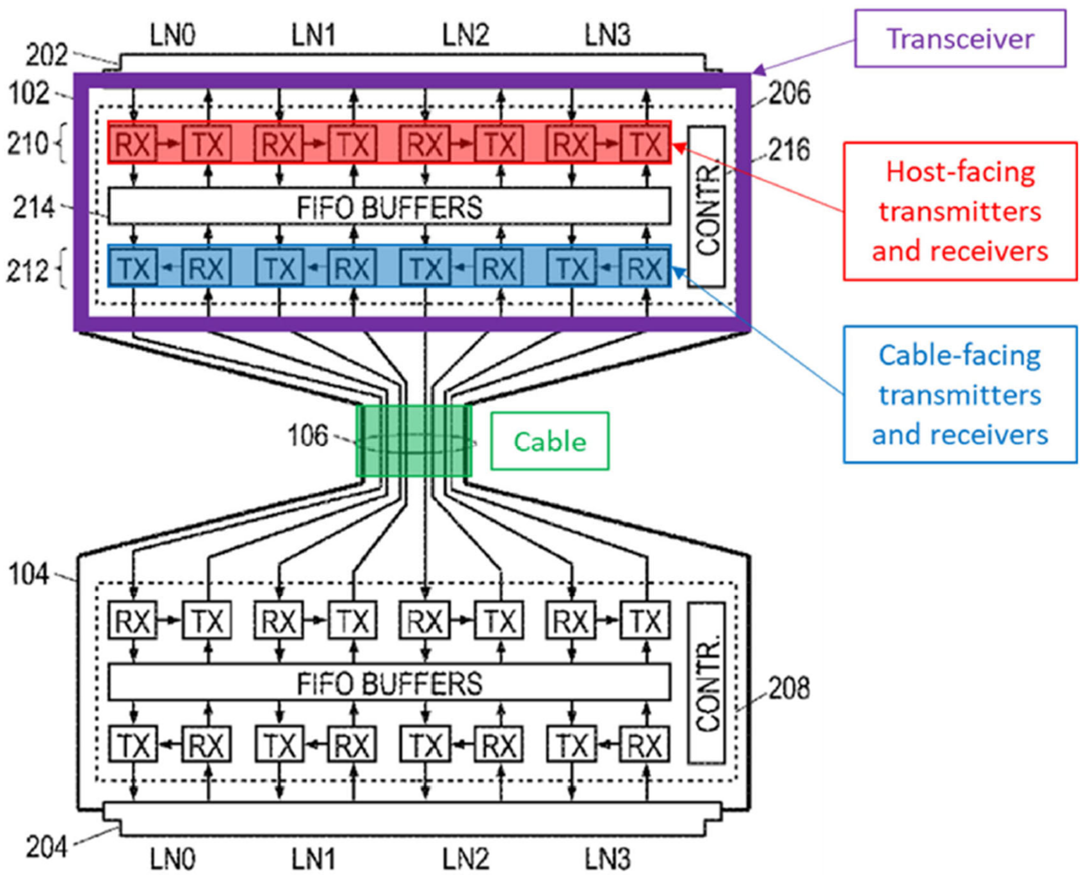
<u>Ground 3</u>. In its final ground, Petitioner doubles down on cited disclosures. Technically, the Examiner did not consider the *specific* Lugthart and Aronson references that Petitioner has chosen to assert in Ground 3. But Petitioner cannot deny that the Examiner considered other Lugthart and Aronson references that contain *exactly* the same teachings upon which Petitioner now relies. Petitioner and its expert assert that the Examiner must not have considered the Aronson

teachings. Petitioner fails to address the more plausible explanation: the Examiner *did* fully consider the Lugthart and Aronson teachings (as indicated by the Examiner's initials on each IDS), and the Examiner rightly concluded that there was no motivation to combine these disparate references. Beyond its failure to show any motivation to combine these references, Petitioner also fails to show that either reference disclosed the particular fixed equalization parameters and functionality recited in every claim of the '252 patent.

For all of these reasons, Petitioner has failed to meet its burden of proving that any challenged claim is unpatentable.

II. THE '252 PATENT

The '252 Patent is directed to an active ethernet cable (AEC) that provides "a high-bandwidth communications link between devices in a routing network." EX-1001, Abstract, 3:44-46. The AEC of the '252 Patent includes connectors 102, 104 that each "include a powered transceiver that performs clock and data recovery (CDR) and re-modulation of data streams in each direction" thus providing "consistently robust data transfer over extended cable lengths … without consideration of the electronics manufacturers of the network interfaces." *Id.*, 3:61-4:26, FIG. 2 (reproduced below). A "host-facing transmitter and receiver set 210 employ fixed equalization parameters that are cable-independent, i.e., they are not customized on a cable-by-cable basis." *Id.*, 4:60-5:5. These equalization parameters can include "filter coefficient values for pre-equalizer filters in the transmitters, and gain and filter coefficient values for the receivers." *Id.*; EX-2029, ¶ 36.



EX-1001 ('252 Patent), FIG. 2 (annotated)

The transceiver sets 210 and 212 are described as follows:

> In at least some contemplated embodiments, the host-facing transmitter and receiver set 210 employ fixed equalization parameters that are cable-independent, i.e., they are not customized on a cable-by-cable basis. The center-facing transmitter and receiver set 212 preferably employ cable-dependent equalization parameters that are customized on a cable-by-cable basis. The cable-dependent equalization parameters may be adaptive or fixed, and initial values for these parameters may be determined during manufacturer tests of the cable. The equalization

> parameters may include filter coefficient values for pre-equalizer filters in the transmitters, and gain and filter coefficient values for the receivers.

EX-1001 ('252 patent), 4:60-5:5; EX-2029, ¶¶ 36-37.

The application that issued as U.S. Patent No. 11,012,252 was filed on August 13, 2019, and claims priority to a Chinese application filed March 1, 2019. EX-1001, 1. During initial examination, the Examiner allowed the then-pending claims and explained that the prior art of record failed to teach or suggest the claimed active Ethernet cable architecture, including first and second connector transceivers that perform clock-and-data recovery and re-modulation for transit over the cable. EX-1002, 000506-09.

The Applicant subsequently submitted an IDS with additional references for the Examiner's consideration, specifically identifying U.S. Patent No. 9,337,993 to Lugthart et al. ("Lugthart-993"), which the Examiner initialed and marked as considered on October 1, 2020. EX-1002, 000591-93. The Office reopened prosecution following consideration of the IDS, and the Examiner issued a non-final Office Action rejecting then-pending claims 1, 2, 8, 9, 15, and 16 as anticipated by Lugthart-993. EX-1002, 000590-91, 000611-18. In response, Applicant amended the claims to incorporate the limitations of then pending claim 3, 10, and 17 (reciting "fixed, cable-independent equalization parameters"). EX-1002, 000629-38. Applicant also submitted an IDS identifying U.S. Patent

No. 7,401,985 to Aronson ("Aronson-985") and an IDS identifying U.S. Patent Application Publication No. 2007/0237464 to Aronson ("Aronson-464"), which the Examiner signed on October 3, 2020, and December 19, 2020, respectively, initialing and marking both references as considered. EX-1002, 000651-52, 000688-89.[1]

The Examiner thereafter allowed claims 3-7, 10-14, and 17-20, explaining that, "[u]pon further consideration and comparison with prior art of record (closest reference — Lugthart et al. - US 9,337,993)," the amended claims were "allowed over prior art of record." EX-1002, 000672-74.

III. PETITIONER'S CHALLENGE TO THE '252 PATENT

Ground	Claims	Combination
1	1-4, 6-9, 11-14	§103: Cornelius and Samaan
2	5, 10	§103: Cornelius, Samaan, and Lugthart
3	1-14	§103: Lugthart and Aronson

A. Cornelius (EX-1006)

Cornelius is directed to "[c]ircuits, methods, and apparatus that allow signals that are compliant with multiple standards to share a common connector on an

[1] The Applicant also cited other references in each IDS, but those other references are not at issue in this proceeding.

electronic device." EX-1006, Abstract. The reference addresses the problem of accommodating a legacy standard (DisplayPort) and newer standards (such as "HSIO" or "T29") on the same physical connector. EX-1006, 3:54-4:9, 5:33-39. Cornelius discloses active cables in Figures 5 and 6 that include "two active plugs…one on each end of cable," each with "dual clock and data recovery circuits for retiming data" and a cable microcontroller to configure those circuits. *Id.*, 6:6-24, Figs. 5-6.

The core teaching of Cornelius is a connector pinout arrangement and associated circuitry that enables signals from two different standards to share common connector pins without interfering with one another. EX-1006 at 2:20-26. Cornelius describes how pins for a newer high-speed standard may be arranged to reduce crosstalk and interference among themselves, and how additional circuitry—such as resistors, PiN diodes, multiplexers, coupling capacitors, and inductors—may be used to isolate the signal paths of the two standards from each other. *Id.*

B. Samaan (EX-1007)

Samaan is a technical paper titled "High-speed Serial Bus Repeater Primer," authored by Samie B. Samaan, Dan Froelich, and Samuel Johnson of Intel Corporation. EX-1007, Title, Cover. The paper provides an overview of SerDes repeaters—specifically re-drivers and re-timers—describing their micro-architecture, properties, applications, and limitations in the context of high-speed serial bus standards such as PCIe 3.0. EX-1007, ¶¶ 1-8.

Samaan is fundamentally a reference on adaptive equalization—not preset equalization. The central theme of Samaan is that equalization coefficients are determined dynamically through link training and adaptation protocols, where transmitters and receivers negotiate optimal TxEQ settings in real time. For PCIe 3.0, Samaan describes a four-phase TxEQ adaptation protocol in which both link partners exchange information about their supported equalization ranges (Phase 0), establish initial communication (Phase 1), and then iteratively request coefficient changes from each other until each receiver finds an optimal setting (Phases 2 and 3). EX-1007, ¶¶ 83-87. The "intent of adaptation is to allow both agents to adjust the link partner's TxEQ to an optimal value for their receiver, and for the specific channel and operating conditions at hand." EX-1007, ¶ 78.

C. Lugthart (EX-1004)

The Lugthart teachings upon which Petitioner relies were cited and considered by the Examiner during prosecution, and the Examiner allowed all challenged claims over those teachings. The face of the '252 Patent identifies a Lugthart reference Examiner considered during prosecution: U.S. Patent No. 9,337,993 to Lugthart *et al.* ("Lugthart-993"). EX-1001 at Page 000002. Lugthart-933 (EX-2021) is substantively identical to the Lugthart reference upon which

Petitioner now relies, with the primary differences appearing in the face, background, and claims of the respective publications. EX-2029, ¶ 47.

Lugthart is directed to "[s]ystems and methods for high speed communications," including "transceiver architectures and techniques for retiming, multiplexing, de-multiplexing and transmitting data." EX-1004, Abstract. Specifically, Lugthart describes a transceiver system that interfaces between a host electronic device (e.g., electronic device 101a) and a line-side medium such as copper cable lines (e.g., cable conducting lines 111). *Id.*, FIGS. 1A, 2A, 4A, 4B.

Lugthart, FIG. 2A depicts a high-speed point-to-point communication system 100 that includes an active cable 110 connecting a first electronic device 101a and a second electronic device 101b. EX-1004, 14:9-11. The cable 110 has "first and second transceiver assemblies 105a, 105b," including first and second transceivers 107a, 107b, respectively, positioned at either end of conductive lines 111. *Id.*, 14:31-34, 14:48-50.

To maintain signal integrity over the cable conducting lines 111, Lugthart specifically provides a transceiver structure (e.g., transceiver 107a) that compensates for signal degradation. EX-1004, 6:41-45 ("[t]he performance of communication systems is limited . . . by factors including intersymbol interference (ISI) and other characteristics . . . associated with the cable including loss, noise, dispersion and non-linear response"), 6:55-57 ("ISI can be reduced by

... designing the transceivers to compensate for or reduce the effects of ISI"), 15:5-10 ("[i]ntegrating transceivers into a cable can achieve a wide variety of advantages . . . an active cable [having integrated transceiver(s)] can permit communication over longer distance . . . with a thinner cable . . . using an active cable [having integrated transceiver(s)] can decrease jitter, noise, and/or ISI relative to a configuration using a passive cable.").

Lugthart focuses on compensating for loss in the cable conducting lines 111. EX-1004, 6:41-45, 6:55-57, 15:5-10; 9:10-12, 9:65-10:2, 23:59-24:2. According to Lugthart, implementations of the transceivers include "adaptive and configurable signal conditioning features such as an integrated continuous time linear equalizer (CTLE), output pre-emphasis, self-adaptive digital equalization, by-passable forward error correction (FEC)." *Id.*, 29:21-28. Therefore, Lugthart explains that for purposes of establishing a high-speed communication link between two electronic devices, the operating parameters for the equalizers are adjusted during one or more training phases after a start-up phase. *Id.*, 47:53-64, 48:64-49:37.

D. Aronson (EX-1005)

As with Lugthart, the Aronson teachings upon which Petitioner relies were cited and considered by the Examiner during prosecution, and the Examiner allowed all challenged claims over those teachings. The face of the '252 Patent identifies two Aronson references as considered by the Examiner during prosecution: U.S. Patent No. 7,401,985 to Aronson ("Aronson-985") and U.S. Patent Publication No. 2007/0237464 to Aronson ("Aronson-464"). EX-1001 at Page 000002. Aronson-985 (EX-2022) and Aronson-464 (EX-2023) are substantively identical to the Aronson reference (the primary differences appearing in the face, background, and claims of the respective publications). EX-2029, ¶ 50.

Aronson (U.S. Patent No. 7,445,389), titled "Active Optical Cable with Integrated Eye Safety," is primarily directed to an active optical cable, which communicates over much of its length using optical fibers while presenting integrated electrical connectors at one or both ends. EX-1005, Abstract, 2:22–31. Aronson's core innovation is enabling network nodes to use standard electrical ports (such as SFP, XFP, or X2) while benefiting from optical communication over the cable's length, along with integrated eye safety controls that disable or reduce optical power if the cable is severed. *Id.*, 2:22–31, 4:35-5:15, 12:33-45.

Aronson's primary architecture is an optical cable, and its equalization discussion is limited to a secondary copper patchcord variant designed for short (1–5 meter) connections between host equipment and patch panels. EX-1005, 2:22-31, 4:35-5:15, 14:58-15:2. In Aronson's embodiments, signal integrity over the cable span is maintained by the optical medium itself—not by electrical equalization circuits within the cable. EX-1005, 6:12–35, 7:1–25. Aronson's brief copper equalization teachings are ancillary to the patent's primary optical cable disclosure and directed to a fundamentally different signal transmission medium than conductive copper cables. EX-1005, 13:54–56, 14:54–57.

IV. LEGAL STANDARDS

A patent claim is unpatentable for obviousness 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). In *Graham v. John Deere Co.*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness that requires consideration of four factors: (1) the "level of ordinary skill in the pertinent art," (2) the "scope and content of the prior art," (3) the "differences between the prior art and the claims at issue," and (4) "secondary considerations" of non-obviousness such as "commercial success, long felt but unsolved needs, failure of others, etc." 383 U.S. at 17-18.

V. LEVEL OF SKILL IN THE ART

Petitioner defines a person of ordinary skill in the art ("POSITA") as an individual who "would have been a person with a bachelor's degree in electrical or computer engineering with at least three years of experience in the field. A person with less practical experience but more relevant education may also meet this standard." Pet. at 16. Because the ordinary level of skill in the art does not affect the ultimate analysis, neither Patent Owner nor Dr. Williams takes a position in general with respect to Petitioner's proposed level of ordinary skill in the art. Solely for the purposes of this proceeding, however, Patent Owner and Dr. Williams employ the same level of skill in the art that Petitioner has proposed. *See also* EX-2029, ¶¶ 17-18.

VI. CLAIM CONSTRUCTION

In an *inter partes* review filed on or after November 13, 2018, claim terms are construed based on their ordinary and customary meaning. 37 C.F.R. § 42.100(b). Further, the Board should always construe claims to sustain their validity, if possible. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1329 (Fed. Cir. 2005). Patent Owner requests that the Board adopt the ordinary and customary meaning of the claim terms as understood by one of ordinary skill in the art.

VII. THE CHALLENGED CLAIMS ARE NOT UNPATENTABLE

A patent claim "is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, 550 U.S. at 418. An obviousness determination based on a combination of references also requires finding "both 'that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.'"

Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd., 821 F.3d 1359, 1367-68 (Fed. Cir. 2016) (citation omitted); *see KSR*, 550 U.S. at 418.

Petitioner has failed to show that the cited prior art renders obvious the Challenged Claims and has not articulated any meaningful motivation to combine or a reasonable expectation of success. Petitioner also fails to account for secondary indicia of non-obviousness, which further demonstrate that the original claims of the '252 Patent were patentable. For these and the reasons stated below, the Petition fails.

A. Ground 1: Cornelius in view of Samaan (Claims 1-4, 6-9, 11-14)

Claim 1 of the '252 Patent recites "[a]n active Ethernet cable" comprising, among other elements, electrical conductors connected between first and second connectors, each connector adapted to fit into an Ethernet port of a corresponding host device, each including a transceiver that performs clock and data recovery and re-modulation of inbound and transit data streams. EX-1001, 9:10–26. Claim 1 further requires "the respective transceivers each employing fixed, cable-independent, equalization parameters for each of: the remodulation of the transit data stream as the outbound data stream, and the clock and data recovery performed on the electrical input signal" (*see* Claim [1e]). Similar limitations appear in independent claims 6 and 11 (*see* Claim [6k] and [11d]).

As a threshold matter, neither Cornelius nor Samaan teaches an active Ethernet cable. Those deficiencies alone are fatal to Ground 1, but they are not the only deficiencies. The following sections address Petitioner's Ground 1 arguments concerning Cornelius and Samaan, explaining why Petitioner has failed to meet its burden of proving unpatentability in Ground 1.

1. Neither Cornelius Nor Samaan Teaches an "Active Ethernet Cable"

As explained above, Cornelius is directed to "[c]ircuits, methods, and apparatus that allow signals that are compliant with multiple standards to share a common connector on an electronic device." EX-1006, Abstract. In particular, Cornelius addresses the problem of accommodating a legacy standard (DisplayPort) and newer standards (such as "HSIO" or "T29") on the same physical connector. EX-1006, 3:54-4:9. At no point does Cornelius describe, suggest, or contemplate an active cable for Ethernet communications. *See* EX-2029, ¶ 53.

A POSITA reviewing Cornelius would understand that its active cable is specifically designed for HSIO/DisplayPort connectivity. *See* EX-2029, ¶ 55. For example, the connector pinouts described in Figure 3 of Cornelius are tailored to share pins between DisplayPort signals and HSIO signals—not Ethernet signals. EX-1006, 4:22–54, Fig. 3. Additionally, the configuration detection methods described in Figure 4 rely on pull-up and pull-down resistors on DisplayPort configuration pins CFG1 and CFG2 to determine whether a connected device is a DisplayPort device or an HSIO device. EX-1006, 5:1–36, Fig. 4. None of this infrastructure has any relevance to Ethernet communications. *See* EX-2029, ¶ 55.

Apparently recognizing this critical deficiency, Petitioner asserts that Cornelius "teaches or suggests using Ethernet with its active cable" because Cornelius "cites known standards including 'Ethernet.'" Pet. at 22; *see* EX-1006 at Page 2. The word "cites" is doing a lot of work in that sentence, and it is misleading at best. Cornelius contains no substantive mention of Ethernet at all. Recognizing that the word "Ethernet" appears nowhere in the substantive teachings of Cornelius, Petitioner resorts to searching the titles of cited references for this key disclosure.

In particular, Petitioner identifies a single, generic Wikipedia article about Ethernet listed among the many "Other Publications." Other than this disparate citation, Cornelius does not mention Ethernet once in its entire disclosure. This Wikipedia listing, hidden amongst numerous other references, does not provide the requisite motivation for a POSITA to wholly redesign the Cornelius disclosure to include Ethernet capabilities. *See William Wesley Carnes, Sr., Inc. v. Seaboard Int'l Inc.*, IPR2019-00133, Paper 10 at 18 (PTAB May 8, 2019) (a mere "statement of similarity, however, does not constitute an articulated reasoning with rational underpinning as to why a POSITA would combine elements of one reference with another, and why a POSITA would modify the teachings of the references to arrive at the claimed invention."); *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017) (Saying that references could be combined "does not imply a motivation to pick [the references] and combine them to arrive at the claimed invention."); *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1074 (Fed. Cir. 2015) ("Obviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed inventions.").

The fact that Petitioner's primary reference lacks any substantive mention of Ethernet should end the analysis for this ground. The claims are directed to *active Ethernet cables*, and Cornelius neither mentions Ethernet nor discloses connectors or circuitry that would be compatible with active Ethernet cables. The Petition next attempts to combine Cornelius with Samaan, a publication directed to re-driver and re-timer micro-architecture. Pet at 22-26; EX-1006, 1:19–22, 4:1–9. Here again, Thunderbolt is not Ethernet. Thunderbolt is a proprietary high-speed I/O protocol that can tunnel DisplayPort and PCIe signals. EX-1006, 1:19–22, 4:1–9. Samaan provides no motivation for a POSITA to fundamentally redesign Cornelius's purpose-built HSIO/DisplayPort active cable to arrive at an active Ethernet cable. *See* EX-2029, ¶¶ 56, 59.

Petitioner also asserts that "Samaan teaches Ethernet support in retimers." Pet. at 22. This teaching has nothing to do with Ethernet cables. The paragraphs Petitioner cites in Samaan address "10G-KR." *See*, *e.g.*, *id.* (citing EX-1007, ¶¶ 250-251). The 10G-KR standard is a form of "Backplane Ethernet" that does not use cables at all. Instead, Backplane Ethernet (including 10G-KR) involves communications over a single copper trace on the printed circuit board of a server backplane. EX-2029, ¶ 56. Samaan cannot cure Cornelius's failure to teach, describe, or even mention Ethernet, as Samaan also does not relate to active Ethernet cables.

Dr. Chen's reliance on PCIe fares no better. *See* EX-1003, ¶¶ 54-56. For example, EX-1028 is an Intel marketing white paper from September 2005 titled "PCI Express Ethernet Networking." EX-1028, p. 1. It discusses how PCI Express—as a host bus slot architecture on a motherboard—provides better I/O bandwidth for Ethernet network adapter cards than the older PCI and PCI-X parallel bus slots. EX-1028, pp. 1–2. EX-1028 at best shows that Ethernet NICs *reside in* PCIe slots—it does not show that PCIe *cables* should carry Ethernet traffic. EX-1028, pp. 1, 4; *see* EX-2029, ¶¶ 57-58. Many types of I/O device sit in PCIe slots (graphics cards, NVMe drives, sound cards, RAID controllers). Under this logic, the mere fact that a reference discusses PCIe would motivate combining it with *any* protocol that uses a PCIe host interface—which would encompass virtually every modern communication standard for devices like GPUs, storage controllers, or any other peripheral device. This renders the alleged "motivation to combine" meaningless. *See* EX-2029, ¶¶ 57-58.

To arrive at the "active Ethernet cable" of Claim 1, a POSITA would have needed to re-engineer the entirety of Cornelius's connector design—its pinouts, its configuration detection circuitry, its signaling rates, and its protocol-layer operations—to conform to the IEEE 802.3 Ethernet standard. The Petition identifies no teaching in Cornelius or Samaan that would guide or motivate such a fundamental redesign, nor does it explain how this redesign would be accomplished. *See* EX-2029, ¶ 59.

2. Cornelius Does Not Teach Fixed Equalization Parameters That Remain Unchanged During Normal Cable Usage

Limitations [1e], [6k] and [11d] require the equalization parameters to be "fixed." The '252 Patent specification explains that the host-facing transmitter and receiver sets "employ fixed equalization parameters that are cable-independent, i.e., they are not customized on a cable-by-cable basis." EX-1001, 4:60–63. The specification distinguishes these fixed parameters from "cable-dependent equalization parameters" that "may be adaptive or fixed." EX-1001, 4:63–5:2. In the context of the '252 Patent, "fixed" parameters are values that do not change during normal operation of the cable—they are established once and remain constant thereafter. EX-1001, 4:60–5:2.

The Petition asserts that Cornelius teaches "fixed" equalization parameters based on the following passage from column 11, lines 52–55: "parameters for these circuits may be calibrated or otherwise determined by the manufacture[r] and stored as presets for loading during operation." Pet. at 44; EX-1006, 11:51–55. This statement says nothing about whether or not the alleged equalization parameters remain fixed during runtime. In the field of high-speed serial communications, the term "presets" typically refers to *initial* starting values that are loaded at the commencement of operation. *See* EX-2029, ¶ 62. The use of the word "loading" indicates that these values are loaded into operational registers when the cable begins operation. *See* EX-2029, ¶ 62. Read in context, Cornelius describes determining parameters "while the system is connected," which "may occur during power up, restart, or other periodical or event-based time." EX-1006, 11:55–59. A POSITA reading this approach would understand that this describes a *dynamic* adjustment process*, not fixed parameters*. *See* EX-2029, ¶ 63.

Cornelius's calibration procedure further emphasizes this point. Cornelius describes a method involving placing the near end in loopback mode, transmitting and receiving a signal via the loopback path, and then "optimiz[ing] TX and RX parameters for near end circuits." EX-1006, Fig. 11, 11:62–12:10. Cornelius further states that "a host may put a near end of the cable in loopback mode, transmit data, and receive the data, and then *adjust* transmit and receive parameters accordingly." EX-1006, 11:64–66 (emphasis added). These teachings indicate a *dynamic* optimization process. *See* EX-2029, ¶ 64.

Accordingly, Cornelius does not teach equalization parameters that are "fixed" in the sense required by the independent claims of the '252 Patent.

3. Samaan Teaches Away from Fixed, Cable-Independent Equalization Parameters

Even if a POSITA were to look to Samaan for guidance on how to implement equalization in Cornelius's *non-Ethernet* active cable, Samaan's teachings would lead that POSITA *away* from using fixed, cable-independent parameters. Samaan's overarching focus is on the challenges of adaptive equalization training and the critical importance of adjustable, programmable equalization parameters in high-speed serial links. *See* EX-2029, ¶ 66.

Samaan repeatedly emphasizes that equalization parameters must be programmable. *Id.* For example, in the context of retimer TxEQ (transmit equalization), Samaan explicitly states that "TxEQ…settings have to be *programmable by the re-timer itself*, in order to allow the device to participate in the PCIe 3.0 or KR TxEQ adaptation or training." EX-1007, ¶ 225 (emphasis added). This teaching makes clear that in Samaan's architecture, TxEQ parameters are not fixed—they must be dynamically settable by the retimer to support equalization training. Samaan discloses similar functionality on the receiver side. Samaan teaches that a Finite State Machine (FSM) manages "adjusting the input Gain (AGC), CTLE, DFE settings, and other parameters, in such a way as to open the eye as widely as possible." EX-1007, ¶ 221. This FSM may "continue to train [the equalization] throughout operation, depending on the sophistication of the design." EX-1007, ¶ 221.

Indeed, Samaan suggests that fixed equalization settings are "suboptimal" and unreliable. Samaan explains that "[s]emiconductor process, voltage, and temperature (PVT) variations cause a re-driver's equalization to vary part to part, and system to system" and that "such variations might range from approximately +/-0.5 to +/-1.5 dB." EX-1007, ¶¶ 62-63. Samaan concludes that these variations "render a re-driver's fixed settings suboptimal, eventually." EX-1007, ¶ 63. This teaching directly suggests that fixed equalization parameters are technically inferior and prone to failure over time. *See* EX-2029, ¶ 70.

If a POSITA were to look to Samaan for guidance on implementing equalization in an active cable's retimers, the POSITA would be led to implement programmable, *adaptive* equalization—not fixed, cable-independent parameters. Samaan thus teaches away from the "fixed, cable-independent, equalization parameters" required by the independent claims of the '252 Patent. *See* EX-2029, ¶ 71.

4. Samaan Does not Teach How to Implement Retimer Technology in a Cable

Independent of the question of whether Samaan's equalization parameters are fixed or adaptive, Samaan does not teach a POSITA how to implement retimer technology—or any repeater technology—within a cable assembly. Samaan describes SerDes devices as discrete semiconductor components that reside on printed circuit boards (PCBs) within host systems, backplanes, or add-in cards. EX-1007, pp. 1–5. Samaan's entire discussion of re-drivers and re-timers is framed in the context of PCB-based signal integrity extension—extending the reach of traces on motherboards, backplanes, and across connectors—not in the context of embedding active electronics within a cable itself. EX-1007, ¶¶ 5–8, ¶¶ 153–162.

Samaan's sole reference to a "cable" in the context of retimer usage is a single parenthetical remark in Section 14.2, where Samaan states that information in training sets allows "a standard re-timer to be usable in a reversible cable (where either end can be plugged into the upstream or downstream component)." EX-1007, p. 58 (§14.2). This passing reference does nothing more than explain how a PCIe retimer determines its upstream/downstream orientation when placed in a link that happens to use a reversible cable connector. *See* EX-2029, ¶ 73. It does not describe how a retimer would be physically integrated into a cable assembly, how equalization parameters should be configured for a cable-embedded retimer, what form factor the retimer silicon should take within a cable connector, or how power would be delivered to such a device. *See* EX-2029, ¶ 73.

A POSITA reviewing Samaan would not find any guidance on: (a) the physical integration of retimer circuitry into a cable connector housing; (b) the selection or configuration of equalization parameters for a retimer that is permanently embedded within a fixed-length cable (as opposed to one on a PCB that must accommodate varying channel lengths); (c) the thermal, power, or mechanical constraints of placing active silicon within a cable assembly; or (d) any design methodology for an "active cable" as that term is understood in the art. Samaan's brief mention of a "reversible cable" merely acknowledges that cables with reversible connectors exist in PCIe systems—it provides no teaching whatsoever about how to design or build such a cable with embedded retimer electronics. *See* EX-2029, ¶ 74.

Accordingly, to the extent the Petition relies on Samaan to supply the implementation details for Cornelius's cable—including how equalization parameters should be selected and configured for cable-embedded transceivers—Samaan does not provide the necessary teachings.

B. Ground 2: Cornelius in view of Samaan and Lugthart (Claims 5, 10)

Claim 5 depends from Claim 4, which depends from Claim 2, which depends from Claim 1. Claim 5 adds the limitation: "wherein the inbound data stream and the outbound data stream each have a per-lane symbol rate in excess of 50 GBd." EX-1001, 9:50-52. Claim 10 recites the same per-lane symbol rate limitation in the context of the communication method of Claim 9. EX-1001, 10:43-45.

Conceding that this element is not taught by Cornelius or Samaan, Petitioner attempts to further combine Lugthart. Petitioner, however, omits the fact that a substantively identical reference—U.S. Patent No. 9,337,993 ("Lugthart-993", EX-2021)—was before the Office during prosecution. Lugthart (EX-1004) is a continuation of U.S. Application No. 14/581,934, filed December 23, 2014. EX-1004, p. 1 (Related U.S. Application Data). The same application (No. 14/581,934) issued as U.S. Patent No. 9,571,308. EX-1004, p. 1. Lugthart claims priority to three provisional applications: No. 61/921,360, filed December 27, 2013; No. 61/927,404, filed January 14, 2014; and No. 61/982,233, filed April 21, 2014. EX-1004, p. 1. Lugthart-933 claims priority to these same provisional applications. *See* EX-2021, Page 1. Lugthart-993 also shares the same inventor team and the same assignee. EX-1004, p. 2. Lugthart-933 is substantively identical to the Lugthart reference cited in the Petition.

During prosecution of the '252 Patent, the Examiner applied Lugthart-993 to reject the as-filed independent claims (which corresponded to limitations [1pre]–[1d]). EX-1002, 000547–558. In response to a rejection based on Lugthart-933, the applicant amended the claims to incorporate limitation [1e]. EX-1002, 000629-38. After this amendment, the Examiner allowed the claims. EX-1002, 000672-74. The Office has already considered the disclosure of Lugthart and found it to be lacking. Accordingly, the Board should find the Ground 2 does not render the challenged claims unpatentable.

C. Ground 3: Lugthart in view of Aronson (Claims 1-14)

Ground 3 relies entirely on teachings that the Examiner considered when allowing the claims of the '252 Patent. It begins with Lugthart, which is substantively identical to the Lugthart-993 reference over which the Examiner expressly allowed every single challenged claim. Petitioner then adds Aronson, which is substantively identical to *two* references that the Examiner considered during prosecution: Aronson-985 and Aronson-464. Petitioner and Dr. Chen baselessly assert that the Examiner did not consider Aronson-985 or Aronson-464. They acknowledge that the Applicant cited both Aronson-985 and Aronson-464 by

IDS and that the Examiner initialed each IDS and thereby indicated that these two references were considered. Pet. at 14-15; EX-1003, ¶ 32. However, contrary to the procedures of MPEP § 609, Petitioner and Dr. Chen assert that the Examiner "failed" to consider the relevant teachings.[2] Neither Petitioner nor Dr. Chen provides any basis for accusing the Examiner of disregarding or violating Patent Office procedures.

1. The Examiner Considered the Lugthart and Aronson Disclosures During Prosecution

Neither Petitioner nor Dr. Chen cites to any disclosure in Lugthart or Aronson that the Examiner had not already considered in the cited references Lugthart-993 (EX-2021), Aronson-985 (EX-2022), and Aronson-464 (EX-2023). *See* EX-1001 at Page 000002. Nor can they, as Lugthart-993, Aronson-985, and Aronson-464 contain exactly the same disclosure as the Lugthart and Aronson references that Petitioners chose to assert here. As such, the Examiner had all of

[2] Dr. Chen's declaration further asserts that "[t]he examiner also ran raw patent numbers from the IDS in searches, but failed to consider them for this limitation." EX-1003, ¶ 32. When asked about this statement during cross examination, it was clear that Dr. Chen neither wrote nor understood the meaning of this statement. EX-2030 at 79:4 – 83:7; *see generally* EX-2030 at 58:1 – 79:3.

the information necessary to consider the combination of Lugthart and Aronson during prosecution, yet did not base any rejection on the combination of these two references. *See generally*, EX-1002. This is not surprising as neither Lugthart nor Aronson disclose fixed, cable-independent equalization parameters, and a POSITA would not have been motivated to combine the two references.

Petitioner and Dr. Chen seem to conclude that the Examiner's decision not to reject any claims based on a combination of the Lugthart and Aronson teachings *must* mean that the Examiner did not consider them. This conclusion necessarily rests on the assumption that the Examiner violated MPEP § 609 by initialing each IDS and marking Aronson-985 and Aronson-464 as considered. Petitioner and Dr. Chen fail to consider the other, more plausible explanation: the Examiner *did* consider Aronson-985 and Aronson-464 (just as indicated by the initials on each IDS) and concluded that there was no motivation to combine the Lugthart and Aronson teachings. Patent Owner respectfully submits that the Board should reach the same conclusion here for the reasons explained below.

2. Lugthart Does Not Disclose Fixed, Cable-Independent Equalization Parameters

Lugthart's active cable does not teach that any equalization parameters are "fixed" and "cable-independent" in the sense required by the independent claims of the '252 Patent. To the contrary, Lugthart teaches a multi-phase channel negotiation process in which equalization parameters are *dynamically* adjusted. Lugthart's channel negotiation process explicitly contemplates adjusting equalization parameters during the training phases to account for the specific channel conditions present at the time—including losses attributable to the particular cable connecting the transceivers. *See* EX-2029, ¶ 86. The parameters are determined adaptively each time a link is established, and they are tailored to the specific channel characteristics of the individual communication link. This the opposite of "fixed" parameters that do not change during normal cable operation and "cable-independent" parameters that are not customized on a cable-by-cable basis. *See* EX-2029, ¶ 86.

Specifically, Lugthart describes a three-phase startup sequence: (a) a start-up phase; (b) a full speed training phase; and (c) a full functional training phase. EX-1004, 47:53–65, Fig. 15. During the full speed training phase, Lugthart teaches that "the parameters of the components in the transceivers connected to the first and second electronic devices [including operating parameters for the equalizers] are *adjusted* such that NRZ modulated signals at the full baud rate can be transmitted and received at an error rate that is below or equal to a threshold error value." EX-1004, 49:3–8 (block 902), 49:8–14. Similarly, during the full functional training phase, Lugthart teaches that "the parameters of the components in the transceivers at the first and second electronic devices are *further adjusted* such that signals modulated using a multi-level modulation format at the full baud rate can be transmitted and received at an error rate that is below or equal to a threshold error value." EX-1004, 49:20–30 (block 903). These teachings are fundamentally inconsistent with "fixed, cable-independent" equalization parameters. *See* EX-2029, ¶¶ 84-86.

The Petition acknowledges that Lugthart teaches "equalization to compensate for transmission line losses on the host side" and argues that because these parameters address host-side paths, they "do not depend on the characteristics of any particular connecting cable." Pet. at 81–83; EX-1003, ¶ 225. However, this argument conflates the physical location of a signal path with the independence of equalization parameters from cable characteristics. *See* EX-2029, ¶ 87. Lugthart's training phases adjust "operating parameters for the equalizers"—the specification does not distinguish between host-side and cable-side equalization parameters in the context of its training procedure. EX-1004, 49:8–14, 49:30–34.

Furthermore, Lugthart teaches that its transceivers have "electronic device side interfaces that are capable of *adaptive operation* over high loss PCB channels permitting flexibility in board and connector design for low cost solutions." EX-1004, 29:39–43 (emphasis added). Again, this contemplates dynamically adjusting host-side equalization to accommodate varying host channel conditions—not using fixed, cable-independent parameters. *See* EX-2029, ¶ 88. Thus, Lugthart does not disclose “fixed, cable-independent, equalization parameters” as required by the independent claims of the ’252 Patent.

3. Aronson Does Not Cure Lugthart’s Deficiency

The Petition relies on Aronson to supply the “fixed, cable-independent” aspect of limitation [1e]. Pet. at 81–86; EX-1003, ¶¶ 226–237. Specifically, the Petition points to Aronson’s teaching that the “first block in this IC would provide equalization to compensation for high frequency loss in the host board traces” and that “[s]uch equalization could be fixed.” EX-1005, 13:49–56. For the receive direction, the Petition cites Aronson’s teaching that “for driving the host PCB traces at this end of the cable, an output driver is provided with optional preemphasis” and that “[t]he preemphasis could be fixed.” EX-1005, 14:50–57.

Aronson does not teach equalization parameters that are employed for both the remodulation of a transit data stream and the CDR performed on an electrical input signal. Aronson’s Figure 12A describes a “Cable Driver IC” that provides equalization for the host-side input and preemphasis for the cable-side output. EX-1005, 13:49–14:5, Fig. 12A. Aronson’s Figure 12B describes a “Cable Receiver IC” that provides equalization for the cable-side input and preemphasis for the host-side output. EX-1005, 14:22–57, Fig. 12B. These are separate ICs with separate functions—a driver IC and a receiver IC—not a single transceiver that performs both CDR on an input signal from the host and remodulation of a transit data stream for output to the host, as Claim 1 requires. Aronson does not teach a single transceiver architecture in which "fixed, cable-independent" equalization parameters are employed for both of these functions simultaneously.

4. A POSITA Would Not Have Been Motivated to Combine Lugthart with Aronson

The Petition argues that a POSITA would have been motivated to combine Lugthart with Aronson because "Aronson teaches fixed equalization parameters," and "there are only two possibilities for setting those fixed parameters: (1) use the same parameters across different cables, or (2) customize the parameters on a cable-by-cable basis." Pet. at 84-85; EX-1003, ¶ 229. This alleged motivation is based on an improperly reductive framing of the design choices available to a POSITA. *See* EX-2029, ¶ 92.

As an initial matter, the Petition's framing ignores the third—and most prominent—option taught by both references: adaptive equalization. *See* EX-2029, ¶ 93. Lugthart's entire architecture is built around multi-phase channel negotiation with adaptive equalization training. EX-1004, 47:53–49:34, Fig. 15. Aronson likewise teaches "automatically adaptive" equalization as one of its options. EX-1005, 13:54–56. A POSITA starting from Lugthart's adaptive architecture would have had no reason to abandon Lugthart's sophisticated training approach in favor of Aronson's simpler "fixed" option—particularly for high-speed active cables, where channel conditions vary significantly and adaptive equalization provides substantial performance benefits. *See* EX-2029, ¶ 93.

The Petition attempts to justify the combination by arguing that "host-side parameters do not vary between different connecting cables" and therefore "there was little justification for the extra complication or cost of customizing these parameters for properties of individual cables." Pet. at 85; EX-1003, ¶ 229. However, this argument ignores that Lugthart's host-side equalization must account for variations in the host systems to which the cable is connected. Indeed, Aronson itself acknowledges this reality: "[d]ifferent host systems may require different degrees of equalization and/or preemphasis because of the particular length or other nature of the electrical interconnect between the cable receptacle and the next IC elements." EX-1005, 11:41-45. If different host systems require different equalization settings, then using the same fixed parameters across all connections is not a straightforward design choice. It requires a deliberate decision to sacrifice optimality for simplicity, which a POSITA working with Lugthart's already-sophisticated adaptive architecture would not have been motivated to make. *See* EX-2029, ¶ 94.

Furthermore, the combination would change the principle of operation of Lugthart. Lugthart's transceiver architecture is designed around its multi-phase channel negotiation process: the transceivers establish a start-up link, train at full speed with NRZ, and then further train with multi-level modulation. EX-1004, 47:53–49:34, Fig. 15. This negotiation process adjusts all equalizer operating parameters—including host-side parameters—to achieve acceptable error rates for the specific link. EX-1004, 49:8–14, 49:30–34. Replacing Lugthart's adaptive host-side equalization with fixed parameters would require fundamentally redesigning Lugthart's channel negotiation to skip or bypass host-side equalization training—a modification that would defeat the purpose of Lugthart's training architecture and could degrade link performance. *See* EX-2029, ¶ 95.

Finally, Aronson's equalization teachings are directed to a fundamentally different cable architecture than those of the '252 Patent. Aronson is primarily directed to an active *optical* cable with integrated electrical connectors. EX-1005, Abstract, 2:22–31. Indeed, Finisar Corporation, the assignee of Aronson, was also focused on optical cables, and announced an Active Optical Cable ("AOC") as early as 2008. *See* EX-2024. Yet neither Finisar Corporation nor anyone else combined the teachings of Lugthart or Aronson to create a commercial Active Ethernet Cable—despite industry need for a less expensive option than AOCs. Accordingly, a POSITA would not have been motivated to combine Lugthart and Aronson.

D. Grounds 1-3: Secondary Indicia of Non-obviousness Further Undermine Petitioner's Challenges to the '252 Patent

Secondary indicia of non-obviousness further show that it would not have been obvious at the time of the invention to selectively combine particular teachings from the cited references, as Petitioner urges. "Objective indicia of nonobviousness must be considered in every case where present." *Apple Inc. v. Samsung Elecs. Co., Ltd.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016). Here, Patent Owner Credo Technology Group has licensed its AEC technology, including the '252 patent, to multiple manufacturers of active cables. *See* EX-2031, EX-2032, EX-2035, EX-2036, EX-2037, EX-2039. Licensing activity provides "strong probative value" when evaluating secondary considerations of non-obviousness. *See Institut Pasteur & Universite Pierre Et Marie Curie v. Focarino*, 738 F.3d 1337, 1347 (Fed. Cir. 2013). Accordingly, Petitioner's challenges to the claims of the '252 Patent should be rejected.

VIII. CONCLUSION

For the reasons stated above, Patent Owner respectfully asks the Board to find that the challenged claims of the '252 Patent are not unpatentable.

Date: May 8, 2026

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATIONS

I, the undersigned, do hereby certify that the foregoing Patent Owner Response, including footnotes, contains 7,389 words, as measured by the Word Count function of Microsoft Word as specified by 37 C.F.R. § 42.24(b)(2).

/Charles M. McMahon/
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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e)(4), I hereby certify that on May 8, 2026, a true and correct copy of the foregoing was served by electronic mail upon the following counsel of record for Petitioner:

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