United States Court of Appeals for the Federal Circuit

QUANERGY SYSTEMS, INC.,
Appellant

v.

VELODYNE LIDAR USA, INC., FKA VELODYNE LIDAR, INC.,
Appellee

2020-2070, 2020-2072

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2018-00255, IPR2018-00256.

Decided: February 4, 2022

ERIK BENTON MILCH, Cooley LLP, Reston, VA, argued for appellant. Also represented by JENNIFER VOLK; ELIZABETH SHRIEVES, Washington, DC; PRIYA B. VISWANATH, Palo Alto, CA.

DOUGLAS ETHAN LUMISH, Latham & Watkins LLP, Menlo Park, CA, argued for appellee. Also represented by BRETT MATTHEW SANDFORD; GABRIEL K. BELL, JONATHAN M. STRANG, Washington, DC; ANN MARIE WAHLS, Chicago, IL.

Before NEWMAN, LOURIE, and O'MALLEY, *Circuit Judges*.

O'MALLEY, *Circuit Judge*.

This appeal is about a laser-based system for measuring distances. While useful for a number of purposes, the system is best known for helping autonomous cars sense their surroundings. U.S. Patent No. 7,969,558 ("the '558 patent") claims such a system, and appellee Velodyne Lidar USA, Inc. markets products incorporating such systems. Appellant Quanergy Systems, Inc. also markets products employing laser systems. Unsurprisingly, Quanergy challenged the validity of multiple claims in the '558 patent in two *inter partes* review ("IPR") proceedings before the Patent Trial and Appeal Board ("Board").

Quanergy now appeals the two final written decisions of the Board in those proceedings. In its decisions, the Board held that claims 1–4, 8, 9, 16–19, and 23–25 of the '558 patent are not unpatentable as obvious. *Quanergy Sys., Inc. v. Velodyne Lidar, Inc.* (*Quanergy I*), No. IPR2018-00255, 2019 WL 2237114 (P.T.A.B. May 23, 2019); *Quanergy Sys., Inc. v. Velodyne Lidar, Inc.* (*Quanergy II*), No. IPR2018-00256, 2019 WL 2237137 (P.T.A.B. May 23, 2019). We affirm both decisions.

I. BACKGROUND

A. The '558 Patent

The '558 patent, entitled "High Definition Lidar System," relates to a lidar-based 3-D point cloud measuring system. '558 patent, at [54]; *id.* at col. 3, ll. 3–4. Lidar, or ladar, is an acronym for "Laser Imaging Detection and Ranging." *Id.* at col. 3, ll. 65–66. Think radar—"Radio Detection and Ranging"—but employing light rather than radio waves.

The specification begins by describing the well-known use of a pulse of light to measure distance. *Id.* at col. 1,

ll. 11–12. First, a laser emitter pulses, emitting a burst of light. *Id.* at col. 1, ll. 13–14. A system then measures the time it takes for the pulse of light to return to a detector mounted near the laser emitter. *Id.* at col. 1, ll. 15–17. Using that measurement, the system can derive a distance with high accuracy. *Id.* at col. 1, ll. 17–18. The parties refer to this technique of measuring distance as pulsed time-of-flight (or "ToF") lidar.

The specification explains that each distance measurement is a "pixel," and a collection of pixels is called a "point cloud." *Id.* at col. 1, ll. 19–23. Systems may render a point cloud as an image or analyze it for other reasons, including detecting obstacles. *Id.* at col. 1, ll. 22–24. According to the specification, a number of commercial products are capable of rendering a 2-D point cloud. *Id.* at col. 1, ll. 32–34. Most of these devices capture distance measurements using a single laser emitter and detector, as well as a moving mirror. *Id.* at col. 1, ll. 36–39. These devices can also provide for a 3-D point cloud by, *e.g.*, mounting the instrument on a gimbal that "nods" the unit up and down to increase the field of view or using a prism to divide the laser pulse into multiple layers with different vertical angles. *Id.* at col. 1, ll. 47–64.

The specification criticizes these existing 3-D point cloud systems because "the needs for autonomous vehicle navigation place unrealistic demands on" them. *Id.* at col. 2, ll. 35–37. According to the specification, some systems take excellent pictures but are unsuitable for highway use because they take several minutes to collect a single image. *Id.* at col. 2, ll. 37–40. Others suffer from a limited field of view. *See id.* at col. 2, ll. 40–45. The specification explains that "it is necessary to see everywhere around the vehicle, almost a full 360 degrees, in order to safely navigate today's highways," as well as "to have a minimum of delay between the actions happening in the real world and the imaging/reaction to it." *Id.* at col. 2, ll. 45–49. The specification estimates that the update rate

of the point cloud—or "refresh rate"—should be at least 5 times per second and specifies that the vertical field of view should extend from above the horizon to as close to the ground in front of the vehicle as possible. *See id.* at col. 2, ll. 53–57.

In this context, the specification discloses its invention of a lidar-based 3-D point cloud measuring system, which rotates a plurality of laser emitters and detectors. *See id.* at col. 3, ll. 3–9. The invention "provides a more compact and rugged unit for gathering 3-D point cloud information." *Id.* at col. 3, ll. 28–30. The preferred embodiment is a lidar system that uses 64 pairs of laser emitters and detectors, has a 360-degree horizontal field of view and a 26.8-degree vertical field of view, and rotates at a rate of up to 200 Hz. *Id.* at col. 3, l. 67–col. 4, l. 7. The system can collect approximately 1 million time-of-flight distance points per second, and it provides the unique combination of a 360-degree field of view, a broad vertical field of view, a high point cloud density, and a high refresh rate. *Id.* at col. 4, ll. 9–13; *id.* at col. 6, ll. 37–41.

Independent claim 1 is illustrative. It recites:

> A lidar-based 3-D point cloud system comprising:
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> > a support structure;
> >
> > a plurality of laser emitters supported by the support structure;
> >
> > a plurality of avalanche photodiode detectors supported by the support structure; and
> >
> > a rotary component configured to rotate the plurality of laser emitters and the plurality of avalanche photodiode detectors at a speed of at least 200 RPM.

Id. at col. 7, ll. 59–67.

B. The Prior Art

Two prior art references are relevant to this appeal.

1. Mizuno

Japanese Patent Application No. H3-6407 ("Mizuno") describes a device that measures the outer peripheral shape of an object. J.A. 4285. According to Mizuno, conventional devices determined an object's shape by revolving around the object, scanning a light toward it, and using a light detector opposite the light source to measure where the object blocks the light. J.A. 4285–86. Mizuno explains that these conventional devices could not accurately measure the object's outer peripheral shape because they could not measure or detect a recessed portion of the object. J.A. 4286.

To solve this problem, Mizuno teaches the use of a "reflected light-type distance measuring instrument" that is on a rotating member and oriented toward the centerline of the rotating member, where a measured object is placed. J.A. 4286. The instrument emits light toward the centerline and measures the distance to the object by detecting the reflected light. J.A. 4286. In one embodiment of the claimed invention, Mizuno explains that the instrument measures the distance to the location of the reflection "based on the location at which the light is detected." J.A. 4287. Mizuno further teaches that its device can measure surface defects "because the detection position for the reflected light will shift." J.A. 4288.

Quanergy asserts that Mizuno renders the challenged claims of the '558 patent obvious because "Mizuno . . . teaches and renders obvious a pulsed ToF 'lidar' system." Appellant's Reply Br. 16.

2. Berkovic

Berkovic is an article published in 2012, entitled "Optical Methods for Distance and Displacement

Measurements." J.A. 6985–7007. It reviews various techniques for measuring distance to objects, including triangulation and time-of-flight sensing. *See* J.A. 6985. According to Berkovic, triangulation is "a procedure in which a distance or position is determined from considerations based on the geometries of similar triangles." J.A. 6990. Berkovic reports that commercially available triangulation sensors "are generally applicable for distance measurements in ranges of approximately 10 mm to 1 m." J.A. 6991–92. Meanwhile, problems arise when using laser time-of-flight sensors to obtain accurate measurements at distances shorter than tens of meters.[1] J.A. 6993.

C. Procedural History

Quanergy filed two petitions for *inter partes* review. In one petition, Quanergy challenged claims 1–4, 8, and 9 of the '558 patent as obvious over Mizuno. In the other petition, Quanergy challenged claims 16–19 and 23–25 of the '558 patent, also asserting obviousness over Mizuno.[2] The Board instituted review on both petitions. In substantially similar final written decisions, the Board held that

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[1] Although Quanergy never asserted the combination of Mizuno and Berkovic, it argued that Berkovic showed what was known in the state of the art at the time and what technologies a skilled artisan might use in a system like Mizuno, including time-of-flight technology. *Quanergy I*, 2019 WL 2237114, at *8.

[2] While Quanergy also asserted that the challenged claims were obvious over Mizuno in combination with other prior art references, it only appeals the Board's findings relating to its Mizuno-only based challenges. We accordingly do not discuss either the art mentioned in the other asserted combinations or the Board's reasons for rejecting those challenges.

Quanergy had not shown that the challenged claims were unpatentable.

Four of the Board's determinations are pertinent to these appeals.[3] First, the Board construed the term "lidar" to mean "pulsed time-of-flight (ToF) lidar." *Quanergy I*, 2019 WL 2237114, at *5. The Board explained that the specification exclusively focuses on pulsed time-of-flight lidar: "That basic concept of deriving distance by measuring the 'time' of travel (i.e., flight) of the laser pulse to and from an object underlies the entire description of the '558 patent." *Id.* The Board noted that its construction of the term "lidar" was consistent with the testimony of both parties' experts. *Id.* at *6. It found no support in the record for the testimony of Quanergy's expert that the term "lidar" included triangulation systems because the only contemporaneous article that the expert cited clearly distinguished between triangulation-based and time-of-flight sensors. *Id.*

Second, the Board found that Mizuno does not disclose or suggest a lidar system as construed. *Id.* at *7. The Board relied not only on its own reading of Mizuno, but also on the testimony of both parties' experts, who agreed that Mizuno's system is not a time-of-flight lidar system. *Id.* at *6–7.

Third, the Board found that a skilled artisan would not have used pulsed time-of-flight lidar in Mizuno's short-range measuring device. *Id.* at *8. According to the Board, Berkovic suggests that the accuracy of pulsed time-of-flight lidar measurements degrades in shorter ranges. *Id.*

Even assuming that Berkovic had suggested the use of pulsed time-of-flight lidar for short-range measurement,

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[3] For brevity, we cite to *Quanergy I*. Unless otherwise noted, all citations to *Quanergy I* should be understood to reference the analogous passage in *Quanergy II*.

moreover, the Board found that a skilled artisan would not have had a reasonable expectation of success in modifying Mizuno's device to use pulsed time-of-flight lidar. *See id.* at *8, *10, *12. The Board was unpersuaded by Quanergy's assertion that the modification was obvious to try because "[t]he only evidence that Quanergy proffers of an expectation of success is speculation from its expert about the endless possibilities of Mizuno's teachings." *Id.* at *9. The Board faulted Quanergy's expert for not explaining "how or why a skilled artisan would have had an expectation of success in overcoming [the] problems in implementing a pulsed [time-of-flight] sensor into a short-range measurement system such as Mizuno's" that Berkovic identifies. *Id.* at *10. And it went on to find that other state-of-the-art evidence supported its finding that a skilled artisan would not reasonably expect to succeed in using pulsed time-of-flight lidar in short-range measurement devices like Mizuno's system. *See id.* at *9.

Fourth, the Board found that, even if Quanergy had satisfied the first three of the four factors established in *Graham v. John Deere Co.*, 383 U.S. 1 (1966), "Velodyne's objective evidence clearly outweighs any presumed showing of obviousness by Quanergy."[4] *Id.* at *17. The Board presumed a nexus between the claimed invention and Velodyne's evidence of unresolved long-felt need, industry praise, and commercial success. *See id.* at *12–13. It explained that Velodyne's expert had provided a detailed analysis mapping claim 1 of the '558 patent to each of Velodyne's commercial products, testimony that Quanergy

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[4] The obviousness inquiry requires examination of the four *Graham* factors: (1) the scope and content of the prior art, (2) the differences between the prior art and the claims at issue, (3) the level of ordinary skill in the pertinent art, and (4) any objective indicia of nonobviousness. *See* 383 U.S. at 17–18.

never disputed. *Id.* at *13. The Board noted that Quanergy identified a 360-degree horizontal field of view, a wide vertical field of view, and a dense 3-D point cloud as unclaimed features such that Velodyne's products were not coextensive with the claimed invention. *Id.* But the Board found that those features were "clearly supported by the challenged claims." *Id.* For instance, the claims expressly call for a 3-D point cloud, and "the density of the [point] cloud and 360-degree field of view result directly from 'rotat[ing] the plurality of laser emitters and the plurality of avalanche photodiode detectors at a speed of at least 200 RPM,' as also called for by the claims." *Id.* Moreover, the "3-D" limitation "necessarily infers both a horizontal and vertical field of view." *Id.* at *13 n.8.

The Board denied Quanergy's requests for rehearing, and Quanergy timely appealed to this court. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(4)(A).

II. DISCUSSION

We review the Board's legal determinations *de novo* and its factual findings for substantial evidence. *In re Van Os*, 844 F.3d 1359, 1360 (Fed. Cir. 2017). Substantial evidence supports a finding if a reasonable mind might accept the evidence to support the finding. *Nobel Biocare Servs. AG v. Instradent USA, Inc.*, 903 F.3d 1365, 1374 (Fed. Cir. 2018).

Claim construction is a question of law with underlying questions of fact. *Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1278 (Fed. Cir. 2017). We review the Board's ultimate claim construction and any supporting determinations based on intrinsic evidence *de novo*. *Personalized Media Commc'ns, LLC v. Apple Inc.*, 952 F.3d 1336, 1339 (Fed. Cir. 2020). We review any subsidiary factual findings involving extrinsic evidence for substantial evidence. *Id.*

Obviousness is also a question of law with underlying questions of fact. *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1358 (Fed. Cir. 2017). These facts include the scope and content of the prior art and any objective indicia of nonobviousness. *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1045 (Fed. Cir. 2019).

On appeal, Quanergy argues that the Board erred in its construction of the term "lidar." Quanergy also challenges the Board's obviousness analysis. We address each argument in turn.

A. Claim Construction

Claim 1 of the '558 patent requires a "lidar-based" 3-D point cloud system. '558 patent, col. 7, l. 59. The intrinsic evidence makes clear that the broadest reasonable interpretation of "lidar" as used in the '558 patent is pulsed time-of-flight lidar.

The broadest reasonable interpretation standard applies in these IPR proceedings, because Quanergy filed its petitions on November 29, 2017, and the '558 patent is unexpired. *See Eli Lilly & Co. v. Teva Pharms. Int'l GmbH*, 8 F.4th 1331, 1340 (Fed. Cir. 2021).[5] Under that standard, we give claims their broadest reasonable construction in light of the specification as a person of ordinary skill in the

[5] For petitions filed on or after November 13, 2018, the Board applies the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,340–41 (Oct. 11, 2018). The Board also applies the *Phillips* standard to claims of an expired patent. *Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1279 (Fed. Cir. 2017).

art would interpret them. *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1061–62 (Fed. Cir. 2016).

The term "lidar" is an acronym for "Laser Imaging Detection and Ranging." '558 patent, col. 3, ll. 65–66. Quanergy proposes that the acronym simply requires the use of laser light to perform imaging, detection, and ranging. According to Quanergy, lidar broadly encapsulates not only pulsed time-of-flight techniques, but also techniques like triangulation. Velodyne disagrees. Velodyne asserts that, like radar, lidar determines distance based on the time-of-flight of the transmitted wave.

We agree with Velodyne. In light of the specification, a skilled artisan would interpret lidar to mean pulsed time-of-flight lidar. Indeed, the written description focuses exclusively on pulsed time-of-flight lidar. It begins by describing the well-known use of a pulse of light to measure distance, deriving distance from the pulse's time-of-flight. *See* '558 patent, col. 1, ll. 11–18. This technique is foundational to the written description's ensuing description of commercial point cloud systems, their operation, and their inability to meet the demands of autonomous vehicle navigation. *Id.* at col. 1, l. 32–col. 2, l. 45. For example, the patent describes an existing point cloud system that employs "a single beam lidar unit" and a gimbal to capture a 3-D array of distance points. *Id.* at col. 1, ll. 49–53. It then teaches that such a system is limited by the number of pulses per second that a single laser can emit. *Id.* at col. 2, ll. 1–3.

The pulsed time-of-flight technique is also foundational to the claimed invention, which purports to be an improvement on existing 3-D point cloud systems that are inadequate for autonomous vehicle navigation. *See id.* at col. 2, ll. 35–67; *id.* at col. 6, ll. 37–41. Indeed, when describing a particular configuration of lasers and detectors in its lidar system, the patent boasts that its preferred embodiment "can collect approximately 1 million *time of flight* (TOF)

distance points per second." *Id.* at col. 4, ll. 9–11 (emphasis added); *see also id.* at col. 4, ll. 13–14 (providing the standard deviation of the collected *time-of-flight* measurements); *id.* at col. 5, ll. 11–15 (explaining that a processor in the lidar system controls the laser emitters and detectors and "records the *time-of-flight*" (emphasis added)). The intrinsic evidence makes clear that the term "lidar" means pulsed time-of-flight lidar.[6]

We are unpersuaded by Quanergy's arguments on appeal. First, Quanergy argues that the claims and specification do not restrict the term "lidar" to pulsed time-of-flight lidar. Analogizing to *Veritas Technologies LLC v. Veeam Software Corp.*, 835 F.3d 1406 (Fed. Cir. 2016), Quanergy contends that the "indications in the specification that 'lidar' may involve pulsed [time-of-flight] measurements" do not preclude a broader construction that includes triangulation and other techniques. Appellant's Br. 22–23 (citing *Veritas*, 835 F.3d at 1411).

We disagree with Quanergy's characterization of the specification as merely indicating that lidar *may* involve

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[6] Given the clarity of the intrinsic evidence, resort to extrinsic evidence is unnecessary. *Seabeds Geosolutions (US) Inc. v. Magseis FF LLC*, 8 F.4th 1285, 1290 (Fed. Cir. 2021). We note, however, that the Board's findings based on extrinsic evidence are consistent with the Board's construction. Quanergy failed to challenge these findings in its opening brief, and its attempt to do so in its reply brief is untimely. *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1319 (Fed. Cir. 2006) ("Our law is well established that arguments not raised in the opening brief are waived."); *see In re Google Tech. Holdings LLC*, 980 F.3d 858, 862 (Fed. Cir. 2020) ("[I]t is evident that the court mainly uses the term 'waiver' when applying the doctrine of 'forfeiture.'").

pulsed time-of-flight measurements. As noted, the specification focuses exclusively on pulsed time-of-flight lidar.

Quanergy's reliance on *Veritas* is misplaced. There, we affirmed the Board's construction of the phrase "starting a restore of a set of files" as encompassing both file-level and block-level restoration.[7] *See id.* at 1411. We explained that "nothing in the specification states or fairly implies a limitation to file-level restoration." *Id.* at 1412. While the specification generally described starting a restore of files (and not blocks), it did not exclude restorations that operate at the block-level but result in restoring files. *Id.* And, although the specification discussed certain steps that would be difficult or impossible to perform at the block-level, it couched those references "in terms of specific embodiments, not general requirements of the invention." *Id.* Critically, the specification did not explain any material differences between file-level and block-level restoration. *Id.*

By contrast, here, the specification fairly implies that the term "lidar" only means pulsed time-of-flight lidar. The patent describes measuring distance using a pulsed time-of-flight technique, identifies the shortcomings of existing point cloud systems that collect distance points by pulsing light and detecting its reflection, and discloses a lidar system that collects time-of-flight measurements. Because *Veritas* is factually distinguishable, we reject Quanergy's broader construction of the term "lidar."

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[7] A file is essentially a named collection of blocks, which contain all of the data of the file. *Veritas*, 835 F.3d at 1408. An application restores at the file-level by requesting a file and receiving the data in the blocks corresponding to the file. *See id.* An application restores at the block-level by requesting the block it needs and receiving the data in that block. *See id.*

Second, Quanergy argues that the Board improperly limited the meaning of the term "lidar" to a preferred embodiment. Not so. The Board did not read limitations from a preferred embodiment into the claims. Instead, it considered the entire disclosure, which introduces the concept of pulsed time-of-flight lidar "[r]ight from the start," a concept that "underlies the entire description of the '558 patent." *Quanergy I*, 2019 WL 2237114, at *5.

Third, Quanergy emphasizes that Velodyne chose to claim only "lidar" instead of "pulsed time-of-flight lidar." But this argument assumes its conclusion—that the term "lidar" is broader than the Board's construction "pulsed time-of-flight lidar." As noted, in light of the intrinsic evidence, a skilled artisan would interpret the term "lidar" to mean pulsed time-of-flight lidar.

Finally, Quanergy argues that its broader construction of "lidar"—to include triangulation—is reasonable because the '558 patent at most expands the acronym to "Laser Imaging Detection and Ranging." As the Board did, we find that simply restating what the "lidar" acronym stands for does little to explain the term's meaning in light of the specification. Because Quanergy's broader construction is inconsistent with the specification, we find it to be unreasonable. *See Trivascular*, 812 F.3d at 1062 ("Construing individual words of a claim without considering the context in which those words appear is simply not 'reasonable.'").

For these reasons, we affirm the Board's construction of the term "lidar" to mean pulsed time-of-flight lidar.

B. Obviousness

Quanergy also appeals several of the factual findings underlying the Board's nonobviousness determination. First, Quanergy asserts that Mizuno discloses a pulsed time-of-flight lidar system. Second, Quanergy challenges the Board's presumption of a nexus between the claimed

invention and Velodyne's evidence of an unresolved long-felt need, industry praise, and commercial success. Quanergy adds that Velodyne cannot prove a nexus either. We address these challenges in turn.

1. Mizuno

The Board made several findings as to Mizuno based on the expert testimony of both parties and subsidiary findings as to Berkovic and other state-of-the-art references. It found that Mizuno does not disclose or suggest a pulsed time-of-flight lidar system. *See Quanergy I*, 2019 WL 2237114, at *7. It further found that a skilled artisan (a) would not have used pulsed time-of-flight lidar in Mizuno's short-range measuring device and (b) would not have had a reasonable expectation of success in modifying Mizuno's device to use pulsed time-of-flight lidar. *See id.* at *8, *10, *12.

On appeal, Quanergy only disputes the Board's findings that Mizuno neither discloses nor suggests the use of a pulsed time-of-flight lidar system. Substantial evidence supports those findings. Notably, the testimonies of *both* Velodyne's and Quanergy's experts support the Board's findings. Velodyne's expert opined that a skilled artisan "would immediately recognize Mizuno as a triangulation system." J.A. 8065 (¶ 127). He explained that Mizuno detects light reflected at an angle using position or image sensors, neither of which are used in pulsed time-of-flight lidar systems. And, while Quanergy's expert described Mizuno's device as a specular reflection system instead of a triangulation system, he agreed that Mizuno's device is not a time-of-flight lidar system. He also conceded that Mizuno measures distance to the target based on where it receives a reflected laser beam, not when as lidar systems do.

Quanergy disagrees with the Board's analysis of its expert testimony. According to Quanergy, its expert was describing only one particular embodiment of Mizuno's device when he stated that Mizuno's device was not a pulsed

time-of-flight lidar system. The Board rejected this argument as an attempt to draw an arbitrary distinction in the testimony of its expert between one of Mizuno's figures and Mizuno's disclosure as whole. *Quanergy Sys., Inc. v. Velodyne LiDAR, Inc.* (*Quanergy III*), No. IPR2018-00255, 2020 WL 2595492, at *8–9 (P.T.A.B. May 21, 2020) (denying Quanergy's request for rehearing); *Quanergy Sys., Inc. v. Velodyne LiDAR, Inc.* (*Quanergy IV*), No. IPR2018-00256, 2020 WL 2595636, at *8–9 (P.T.A.B. May 21, 2020) (same). We are similarly unpersuaded by Quanergy's attempt to downplay its expert's admission that Mizuno's device is not a time-of-flight lidar system.

Quanergy finally relies on its expert's testimony on redirect that "Mizuno could use a time-of-flight pulsed LiDAR system,"[8] as well as its expert's ultimate conclusion that a person of ordinary skill in the art reading Mizuno would have found it obvious to use a pulsed time-of-flight system. Appellant's Br. 25–26 (citing J.A. 9114–15); *see also, e.g.*, *Quanergy III*, 2020 WL 2595492, at *9. Under our standard of review, we sustain a finding of the Board that may reasonably be drawn from the evidence in record, even if the Board reasonably could have drawn other inconsistent findings from the same record. *See Elbit Sys. of Am., LLC v. Thales Visionix, Inc.*, 881 F.3d 1354, 1356 (Fed. Cir. 2018). Here, we agree with the Board that the testimony of Quanergy's expert on redirect is "incomplete, unspecific, and ultimately conclusory." *E.g.*, *Quanergy III*, 2020 WL 2595492, at *10. The Board acted within its discretion when it chose not to credit that testimony. *See id.* On the entirety of the record, substantial evidence supports the Board's finding that one of skill in the art would not have been motivated by Mizuno to use a pulsed time-of-flight system.

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[8] Quanergy misattributes this testimony to Velodyne's expert.

2. Objective Indicia of Nonobviousness

The Board gave substantial weight to Velodyne's objective evidence of unresolved long-felt need, industry praise, and commercial success. Substantial evidence supports the Board's presumption of a nexus and its thorough analysis of each objective indicia.

Evidence of objective indicia of nonobviousness, if present, must always be considered before reaching a determination on the issue of obviousness. *E.g.*, *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538–39 (Fed. Cir. 1983); *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litigation*, 676 F.3d 1063, 1076–77 (Fed. Cir. 2012). To accord substantial weight to such evidence, it "must have a 'nexus' to the claims, *i.e.*, there must be 'a legally and factually sufficient connection' between the evidence and the patented invention." *Teva Pharms.*, 8 F.4th at 1360 (quoting *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019)).

We presume a nexus "when the patentee shows that the asserted objective evidence is tied to a specific product and that product 'embodies the claimed features, and is coextensive with them.'" *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)). The coextensive requirement does not require a patentee to prove perfect correspondence between the product and a patent claim. *Teva Pharms.*, 8 F.4th at 1361. Rather, it requires the patentee to demonstrate that "the product is essentially the claimed invention." *Id.* As part of the presumption analysis, the fact finder must consider the unclaimed features of the stated products to determine their level of significance and their impact on the correspondence between the claim and the products. *Id.* Some unclaimed features "amount to nothing more than additional insignificant features," such that presuming nexus is still appropriate. *Id.* Other unclaimed features, like "a

'critical' unclaimed feature that is claimed by a different patent and that materially impacts the product's functionality," indicate that the claim is not coextensive with the product. *Id.*

The presumption of nexus is rebuttable. *Demaco Corp. v. F. von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1393 (Fed. Cir. 1988). A patent challenger may present evidence showing that the proffered objective evidence was "due to extraneous factors other than the patented invention." *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016). These extraneous factors include additional unclaimed features and external factors, like improvements in marketing or superior workmanship. *Id.*; *see also Demaco*, 851 F.2d at 1393. A patent challenger may not rebut the presumption of nexus with argument alone. *WBIP*, 829 F.3d at 1329.

Here, the Board presumed a nexus because Velodyne provided "ample evidence" that its commercial products "embody the full scope of the claimed invention, and that the claimed invention is not merely a subcomponent of those products." *Quanergy I*, 2019 WL 2237114, at *12. The Board credited the testimony of Velodyne's expert, who provided "a detailed analysis mapping claim 1" to the descriptions in Velodyne's product literature. *Id.* at *13. The Board noted that Quanergy never disputed this testimony. *Id.*

The Board then rejected Quanergy's attempt to rebut a presumption of nexus because the unclaimed features Quanergy identified—"360[-]degree horizontal field of view, wide vertical [field of view], and a dense 3-D point cloud"—were clearly supported by the challenged claims. *Id.* (quoting J.A. 1023). For example, the claims call for a "3-D point cloud," and the density of the cloud and the 360-degree horizontal field of view "result directly" from the claim limitation "rotat[ing] the plurality of laser emitters and the plurality of avalanche photodiode detectors at

a speed of at least 200 RPM." *Id.* Further, the "3-D" limitation "necessarily infers both a horizontal and vertical field of view." *Id.* at *13 n.8. The Board noted that Quanergy's assertion that Velodyne's commercial success resulted from unclaimed software was "nothing more than conclusory attorney argument without evidentiary support." *Id.* at *13.

The Board gave substantial weight to Velodyne's evidence of an unresolved long-felt need, industry praise, and commercial success. *Id.* at *14–17. This evidence included (1) contemporaneous news articles describing a long-felt need for a lidar sensor that could capture distance points rapidly in all directions and produce a sufficiently dense 3-D point cloud for use in autonomous navigation, (2) articles praising both Velodyne as the top lidar producer in the automotive industry and Velodyne's products, and (3) financial information and articles reflecting Velodyne's revenue and market share. *Id.*

On appeal, Quanergy argues that the Board erred in three ways. First, Quanergy contends that the Board must, but failed to, consider the issue of unclaimed features before presuming nexus. Second, Quanergy asserts that the Board failed to provide an adequate factual basis or reasoned explanation when it dismissed the unclaimed features Quanergy identified. Third, Quanergy attempts to show that the unclaimed features it identified to the Board—a 360-degree horizontal field of view, a wide vertical field of view, a dense 3-D point cloud, and software—are critical and materially impact the functionality of Velodyne's products. Quanergy also contends that Velodyne's evidence of unresolved long-felt need, industry praise, and commercial success relate primarily to those critical unclaimed features. None of these arguments are persuasive.

First, the Board did not err in its analysis of whether Velodyne is entitled to a presumption of nexus. There is no dispute that the Board must consider unclaimed features

as part of its presumption analysis when they are raised. *See Teva Pharms.*, 8 F.4th at 1361; *Fox Factory*, 944 F.3d at 1374. Here, Quanergy, at best, presented only a skeletal, undeveloped argument to the Board. In total, Quanergy stated that Velodyne's "evidence focuses on unclaimed [sic] that are not coextensive with the patented claims," and that Velodyne "fail[ed] to show that the claimed elements are not merely a component of its product, by failing to address the configuration, software and other components that form its product, and apparently allow it to perform the praised features." J.A. 1023–25. As the Board found, Quanergy only raised the issue of unclaimed features to rebut the presumption of nexus. *See Quanergy I*, 2019 WL 2237114, at *13; *see also* J.A. 1025–1026 (arguing that the presumption of nexus is rebutted because Velodyne's "evidence relies on unclaimed features"). Based on Velodyne's product literature and expert testimony, the Board reasonably found that Velodyne's products embody the full scope of the claimed invention and that the claimed invention is not merely a subcomponent of those products. *See Quanergy I*, 2019 WL 2237114, at *12–13.

Second, we disagree with Quanergy's assertion that the Board failed to provide an adequate factual basis or reasoned explanation when it dismissed the unclaimed features Quanergy identified to rebut a presumption of nexus. The Board's analysis of those unclaimed features is commensurate with Quanergy's presentation of the issue. *See Paice LLC v. Ford Motor Co.*, 881 F.3d 894, 905 (Fed. Cir. 2018); *Novartis AG v. Torrent Pharms. Ltd.*, 853 F.3d 1316, 1327 (Fed. Cir. 2017) ("Thus, we are not persuaded that Novartis presented its arguments against the use of mannitol in such a way that it would be appropriate to find fault in the Board's arguably limited treatment of those arguments in the Final Written Decision.").

In total, Quanergy argued:

> [Velodyne's] evidence relies on unclaimed features. *See, e.g.*, Response, 58-62 (rooting long-felt need in autonomous driving context requiring "high frame-rate, dense 3D point cloud with a wide [field of view]" and collecting measurements in an outward facing lidar for 360 degree azimuth and 26 degree vertical arc); 62-65 (describing praise due to unclaimed features such as "distance and point density," "360-degree horizontal field-of-view," "26-degree vertical spread," and "one million points per second[)]."

J.A. 1025–26. We find the Board's explanation of how each alleged unclaimed feature results directly from claim limitations—such that Velodyne's products are essentially the claimed invention—both adequate and reasonable. *See Fox Factory, Inc. v. SRAM, LLC*, 813 F. App'x 539, 543 (Fed. Cir. 2020) (holding that the alleged unclaimed features were "to some extent incorporated" into a claim limitation).

Finally, Quanergy's attempts to show that (1) the unclaimed features it identified to the Board are critical and materially impact the functionality of Velodyne's products and (2) Velodyne's evidence of unresolved long-felt need, industry praise, and commercial success relate to those unclaimed features rest on new arguments not presented to the Board. For example, Quanergy contends that, to obtain a dense 3-D point cloud, Velodyne's products contain the critical unclaimed features of (1) more than 2 laser emitters, (2) a high pulse rate, (3) a vertical angular separation between pairs of emitters and detectors, and (4) a rotation speed significantly greater than 200 RPM. We hold that Quanergy has forfeited these new arguments. *See, e.g.*, *In re Google Tech. Holdings LLC*, 980 F.3d 858, 863 (Fed. Cir. 2020).

III. CONCLUSION

For the reasons discussed above, we affirm the Board's decisions holding that claims 1–4, 8, 9, 16–19, and 23–25 of the '558 patent are not unpatentable as obvious.

AFFIRMED