

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM, INC. and
AMAZON.COM SERVICES LLC,
Petitioner,

v.

NOKIA TECHNOLOGIES OY,
Patent Owner.

IPR2024-01141
Patent 8,036,273 B2

Before SCOTT B. HOWARD, STEVEN M. AMUNDSON, and
JASON M. REPKO, *Administrative Patent Judges*.

AMUNDSON, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Amazon.com, Inc. and Amazon.com Services LLC (collectively “Petitioner”) filed a Petition requesting an *inter partes* review of claims 1, 4–17, 19–26, 28, 29, 31–33, 36–49, 51–59, 61, 62, and 64–83 in U.S. Patent No. 8,036,273 B2 (“the ’273 patent”) (Exhibit 1001) under 35 U.S.C. §§ 311–319. Paper 3 (“Pet.”). Nokia Technologies Oy (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”).

Under 37 C.F.R. § 42.4(a), we have authority to determine whether to institute an *inter partes* review. We may institute an *inter partes* review only if “the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a) (2024). The “reasonable likelihood” standard is “a higher standard than mere notice pleading” but “lower than the ‘preponderance’ standard to prevail in a final written decision.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13 (PTAB Dec. 20, 2019) (precedential).

Based on the current record and for the reasons explained below, Petitioner has shown that there is a reasonable likelihood that it would prevail with respect to at least one of the challenged claims. Thus, we institute an *inter partes* review of claims 1, 4–17, 19–26, 28, 29, 31–33, 36–49, 51–59, 61, 62, and 64–83 in the ’273 patent on all challenges included in the Petition.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies the following entities as the real parties in interest: Amazon.com, Inc. and Amazon.com Services LLC. Pet. 127. Patent Owner identifies itself as the sole real party in interest. Paper 4 (Patent Owner's Mandatory Notices Under 37 C.F.R. § 42.8(a)(2)), 2. The parties do not raise any issue about real parties in interest.

B. Related Matters

Petitioner and Patent Owner identify the following civil actions as related matters:

- *Nokia Technologies Oy v. Apple Inc.*, No. 2-16-cv-01440 (E.D. Tex. filed Dec. 21, 2016);
- *Nokia Technologies Oy v. Lenovo Group Ltd.*, No. 5-19-cv-00427 (E.D.N.C. filed Sept. 25, 2019);
- *Nokia Technologies Oy v. Amazon.com, Inc.*, No. 1:23-cv-01236 (D. Del. filed Oct. 31, 2023) (the "Delaware case"); and
- *Nokia Technologies Oy v. HP Inc.*, No. 1:23-cv-01237 (D. Del. filed Oct. 31, 2023).

Pet. 127; Paper 4, 2.

Petitioner and Patent Owner identify the following Board proceedings as related matters:

- *Lenovo (United States) Inc. v. Nokia Technologies Oy*, IPR2021-00040 (Patent 8,036,273 B2);
- *Lenovo (United States) Inc. v. Nokia Technologies Oy*, IPR2021-00041 (Patent 8,036,273 B2);
- *Lenovo (United States) Inc. v. Nokia Technologies Oy*, IPR2021-00042 (Patent 8,036,273 B2); and

- *Lenovo (United States) Inc. v. Nokia Technologies Oy*, IPR2021-00043 (Patent 8,036,273 B2).

Pet. 127–28; Paper 4, 2.

C. The '273 Patent (Exhibit 1001)

The '273 patent, titled “Method for Sub-Pixel Value Interpolation,” issued on October 11, 2011, from U.S. patent application no. 11/839,205 filed on August 15, 2007. Ex. 1001, codes (21), (22), (45), (54). The patent claims the benefit of priority to U.S. patent application no. 09/954,608 filed on September 17, 2001. *Id.* at 1:7–12, code (63). The patent states that the invention “relates to a method for sub-pixel value interpolation in the encoding and decoding of data,” e.g., the “encoding and decoding of digital video.” *Id.* at 1:13–17.

The '273 patent explains that modern video-compression standards use motion-compensated temporal prediction to reduce redundant information. Ex. 1001, 2:62–65. In motion-compensated temporal prediction, a video frame’s content is predicted from other frames based on the frame-to-frame motion of objects or regions. *Id.* at 2:65–3:2. Methods for doing so derive motion information by determining the relationship between the current frame’s pixels and the corresponding pixels in another frame, called the “reference frame.” *Id.* at 3:55–60. Those methods use motion information to transform the reference frame’s prediction pixels to construct an approximate representation of the current frame, called the “prediction frame.” *Id.* at 3:47–62. The difference between the prediction frame and the current frame is the “prediction error.” *Id.* at 3:62–66.

According to the '273 patent, the “basic advantage provided by video encoders that use motion compensated prediction arises from the fact that a

comparatively compact description of the current frame can be obtained by representing it in terms of the motion information required to form its prediction together with” the prediction error. Ex. 1001, 3:66–4:5.

The ’273 patent discusses motion estimation at both the pixel level and the sub-pixel level. *See, e.g.*, Ex. 1001, 6:20–51. Motion estimation “with sub-pixel resolution is usually performed as a two-stage process” for a video-coding scheme that “allows motion vectors to have full- or half-pixel resolution.” *Id.* at 6:48–51. In the first stage, “a motion vector having full-pixel resolution is determined using any appropriate motion estimation scheme, such as [a] block-matching process.” *Id.* at 6:51–54. In the second stage, “the motion vector determined in the first stage is refined to obtain the desired half-pixel resolution.” *Id.* at 6:56–57. Because “only the pixel values of original image pixels are known, the values (for example luminance and/or chrominance values) of the sub-pixels residing at half-pixel locations must be estimated” using “some form of interpolation scheme.” *Id.* at 6:63–67.

The ’273 patent describes two interpolation schemes “developed as part of the work ongoing in the ITU-Telecommunications Standardization Sector, Study Group 16, Video Coding Experts Group (VCEG),” and “implemented in test models (TML) for the purposes of evaluation and further development”: Test Model 5 (TML5) and Test Model 6 (TML6). Ex. 1001, 8:38–47; *see id.* at 8:47–13:18.

TML5 estimates $\frac{1}{4}$ resolution sub-pixel values using $\frac{1}{2}$ resolution sub-pixel values. Ex. 1001, 11:7–10. Thus, “the values of some of the $\frac{1}{4}$ resolution sub-pixels depend upon the interpolated values obtained for other $\frac{1}{4}$ resolution sub-pixels.” *Id.* at 11:13–15. Due to truncation and clipping,

however, some of the $\frac{1}{4}$ resolution sub-pixel values are “less precise than they would be if calculated from values that had not been truncated and clipped.” *Id.* at 11:13–20. Additionally, a “disadvantage of TML5 is that the decoder is computationally complex.” *Id.* at 11:6–7.

Interpolation in TML6 “works like” interpolation in TML5, except that “maximum precision is retained throughout” by “using intermediate values which are neither rounded nor clipped.” Ex. 1001, 11:27–31. In TML6, the $\frac{1}{4}$ resolution sub-pixel values are “obtained directly” using intermediate values and “not derived from rounded and clipped values for $\frac{1}{2}$ resolution sub-pixels.” *Id.* at 12:65–13:1. Thus, “TML6 is computationally less complex than TML5, as fewer truncating and clipping operations are required.” *Id.* at 13:9–11. But a “disadvantage of TML6 is that high precision arithmetic is required both in the encoder and in the decoder.” *Id.* at 13:11–13. Also, TML6 “has a high memory requirement.” *Id.* at 13:15–17.

According to the '273 patent, “the sub-pixel value interpolation method according to the invention provides advantages over each of TML5 and TML6.” Ex. 1001, 43:44–46. Unlike TML5, “in the method according to the invention, all $\frac{1}{4}$ resolution sub-pixels are calculated from original image pixels or $\frac{1}{2}$ resolution sub-pixel positions using linear interpolation.” *Id.* at 43:47–52. Thus, “the reduction in precision of those $\frac{1}{4}$ resolution sub-pixel values which occurs in TML5 due to the intermediate truncation and clipping of the other $\frac{1}{4}$ resolution sub-pixels from which they are calculated, does not take place in the method according to the invention.” *Id.* at 43:52–57.

Unlike TML6, “the method according to the invention does not require high precision arithmetic to be used in the calculation of all sub-pixels.” Ex. 1001, 44:9–11. Specifically, because “all of the $\frac{1}{4}$ resolution sub-pixel values are calculated from original image pixels or $\frac{1}{2}$ resolution sub-pixel values using linear interpolation, lower precision arithmetic can be used in their interpolation.” *Id.* at 44:11–16.

Additionally, to “reduce memory usage” in a preferred embodiment where “motion vector accuracy is $\frac{1}{4}$ pixel resolution in both the horizontal and vertical dimensions,” “all $\frac{1}{2}$ resolution sub-pixels can be interpolated before-hand and $\frac{1}{4}$ resolution sub-pixels can be calculated on-demand, that is, only when they are needed.” Ex. 1001, 46:17–25.

D. The Challenged Claims

The '273 patent includes 83 claims. Ex. 1001, 51:5–68:26. Petitioner challenges the following claims:

- independent claim 1 for a “method for sub-pixel value interpolation”;
- claims 4–17, 19–26, 28, and 29 that depend directly or indirectly from claim 1;
- independent claim 31 for a “method for quarter resolution sub-pixel value interpolation”;
- independent claim 32 for a “method for eighth resolution sub-pixel value interpolation”;
- independent claim 33 for an “interpolator for sub-pixel value interpolation”;
- claims 36–49, 51–59, 61, and 62 that depend directly or indirectly from claim 33;
- independent claim 64 for a “video encoder comprising an interpolator for sub-pixel value interpolation”;

- claims 65–67 that depend directly or indirectly from claim 64;
- independent claim 68 for a “still image encoder comprising an interpolator for sub-pixel value interpolation”;
- claims 69 and 70 that depend directly from claim 68;
- independent claim 71 for a “video encoder comprising an interpolator for sub-pixel value interpolation”;
- claim 72 that depends directly from claim 71;
- independent claim 73 for a “still image decoder comprising an interpolator for sub-pixel value interpolation”;
- claim 74 that depends directly from claim 73;
- independent claim 75 for an “interpolator for sub-pixel value interpolation”;
- independent claim 76 for an “interpolator for quarter resolution sub-pixel value interpolation”;
- claims 77 and 78 that depend directly or indirectly from claim 76;
- independent claim 79 for an “interpolator for eighth resolution sub-pixel value interpolation”;
- claims 80 and 81 that depend directly or indirectly from claim 79;
- independent claim 82 for a “computer program for sub-pixel value interpolation, embodied on a computer readable storage medium”; and
- independent claim 83 for a “network apparatus comprising an interpolator for sub-pixel value interpolation.”

Pet. 1–2, 21–123.

Claim 1 exemplifies the challenged claims and reads as follows (with formatting added for clarity and with bracketed letters added for reference purposes):¹

1. [pre][a] A method for sub-pixel value interpolation to determine values for sub-pixels situated within a rectangular bounded region defined by four corner pixels with no intermediate pixels between the corners, the pixels and sub-pixels being configured for display in rows and columns,

[pre][b] pixel and sub-pixel locations in the rows and columns being representable mathematically within the rectangular bounded region using the co-ordinate notation $K/2^N$, $L/2^N$, K and L being positive integers having respective values between zero and 2^N , N being a positive integer greater than one and representing a particular degree of sub-pixel value interpolation, the method comprising causing an apparatus to:

[a] interpolate a sub-pixel value for a sub-pixel having co-ordinates with odd values of K and L, according to a predetermined choice of either a weighted average of the value of a nearest-neighbouring pixel and the value of the sub-pixel situated at co-ordinates $\frac{1}{2}$, $\frac{1}{2}$, or a weighted average of the values of a pair of diagonally-opposed sub-pixels having co-ordinates with even values of K and L, including zero, situated within a quadrant of the rectangular bounded region, the quadrant being defined by the sub-pixel having co-ordinates $\frac{1}{2}$, $\frac{1}{2}$ and the nearest neighbouring pixel;

[b] interpolate sub-pixel values for sub-pixels having co-ordinates with K equal to an even value and L equal to zero and sub-pixels having co-ordinates with K equal to zero and L equal to an even value, used in the interpolation of the sub-pixels having co-ordinates with odd values of K and L, using weighted sums of the values of pixels located in rows and columns respectively; and

¹ We use the same reference letters that Petitioner uses to identify the claim language. See Pet. v–vi (Listing of Challenged Claims).

[c] interpolate sub-pixel values for sub-pixels having co-ordinates with even values of K and L, used in the interpolation of sub-pixel values for the sub-pixels having co-ordinates with odd values of K and L, using a predetermined choice of either a weighted sum of the values of sub-pixels having co-ordinates with K equal to an even value and L equal to zero and the values of sub-pixels having corresponding co-ordinates in immediately adjacent rectangular bounded regions, or a weighted sum of the values of sub-pixels having co-ordinates with K equal to zero and L equal to an even value and the values of sub-pixels having corresponding co-ordinates in immediately adjacent rectangular bounded regions.

Ex. 1001, 51:5–48.

E. The Asserted References

For its challenges, Petitioner relies on the following references:

Name	Reference	Exhibit
TML6	Test Model Long Term Number 6 source code	1005
Fandrianto	US 5,594,813, issued January 14, 1997 (based on an application filed February 19, 1992)	1006

Pet. 1–2, 21–123.

Petitioner asserts that (1) TML6 qualifies as prior art “at least under § 102(a)” and (2) Fandrianto qualifies as prior art “at least under § 102(b).” Pet. 1; *see* 35 U.S.C. § 102(a)–(b) (2006).²

At this stage of the proceeding, Patent Owner does not dispute that Fandrianto qualifies as prior art or that the source-code files comprising TML6 were publicly accessible before the effective filing date for the

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011), amended 35 U.S.C. § 102 and § 103 effective March 16, 2013. Because the filing date of the challenged claims predates the AIA’s amendments to § 102 and § 103, this decision refers to the pre-AIA versions of § 102 and § 103.

challenged claims, i.e., September 17, 2001. *See, e.g.*, Prelim. Resp. 1, 38–65. As discussed in more detail below, however, Patent Owner disputes that an ordinarily skilled artisan would have been motivated to combine the source-code files comprising TML6. *Id.* at 1, 39–41; *see infra* Section V.D.3(a).

F. The Asserted Challenges to Patentability

Petitioner asserts the following challenges to patentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 4–17, 19–26, 28, 29, 31, 33, 36–49, 51, 53–59, 61, 62, 64–78, 82, 83	103(a)	TML6, Fandrianto
32, 52, 79–81	103(a)	TML6, Fandrianto, an ordinarily skilled artisan’s knowledge

Pet. 1–2, 21–123.

G. Testimonial Evidence

To support its challenges, Petitioner relies on the declaration of Kannan Ramchandran, Ph.D. (Exhibit 1003). Dr. Ramchandran states, “I have been retained as an expert in this proceeding by counsel for” Petitioner. Ex. 1003 ¶ 2. Dr. Ramchandran explains that he “received [his] M.S. in electrical engineering in 1984 and [his] Ph.D. in electrical engineering in 1993, both from Columbia University,” and currently is “a Professor of Electrical Engineering and Computer Science at the University of California Berkeley.” *Id.* ¶¶ 1, 4.

Further, Petitioner relies on the declaration of Dr. Stephan Wenger (Exhibit 1008) to establish the authenticity and public accessibility of TML6 before the effective filing date for the challenged claims.

To support its positions, Patent Owner relies on the declaration of Douglas A. Chrissan, Ph.D. (Exhibit 2001). Dr. Chrissan states, “I have been retained as a technical expert on behalf of Patent Owner.” Ex. 2001 ¶ 1. Dr. Chrissan explains that he “earned a B.S. and M.S. in Electrical Engineering from the University of Southern California in 1988 and 1990, respectively, and a Ph.D. in Electrical Engineering from Stanford University in 1998.” *Id.* ¶ 8.

III. DISCRETIONARY DENIAL UNDER 35 U.S.C. § 314(a) IN VIEW OF PARALLEL LITIGATION

A. Background

Under § 314(a), the Director possesses “broad discretion” in deciding whether to institute an *inter partes* review. *See* 35 U.S.C. § 314(a); *Saint Regis Mohawk Tribe v. Mylan Pharms. Inc.*, 896 F.3d 1322, 1327 (Fed. Cir. 2018). The Director is “permitted, but never compelled,” to institute an *inter partes* review. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1367 (Fed. Cir. 2016). The Board decides whether to institute an *inter partes* review on the Director’s behalf. 37 C.F.R. § 42.4(a) (2024).

Based on *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential), Patent Owner argues that we should exercise our discretion under § 314(a) to deny institution in view of the Delaware case. *See* Prelim. Resp. 1–2, 28, 66–69; *supra* Section II.B. Petitioner argues that we should decline to exercise our discretion under § 314(a) to deny institution. *See* Pet. 125.

B. Nonexclusive Factors to Consider

When deciding whether to exercise discretion under § 314(a) to deny institution, the Board has considered the status of litigation involving the

challenged patent in light of the AIA’s objective “to provide an effective and efficient alternative to district court litigation.” *NHK Spring Co. v. Intriplex Techs., Inc.*, IPR2018-00752, Paper 8 at 12, 19–20 (PTAB Sept. 12, 2018) (precedential). The Board has set forth the following nonexclusive factors to consider when determining whether to exercise discretion under § 314(a) to deny institution due to the advanced state of parallel litigation:

- (1) whether the court granted a stay or evidence exists that one may be granted if the Board institutes a trial;
- (2) the proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision;
- (3) the investment in the parallel litigation by the court and the parties;
- (4) the overlap in the issues raised by the petition and the issues in the parallel litigation;
- (5) whether the petitioner and the defendant in the parallel litigation are the same party; and
- (6) other circumstances that impact the Board’s exercise of discretion, including the merits.

Fintiv, IPR2020-00019, Paper 11 at 5–6.

These factors “relate to whether efficiency, fairness, and the merits support the exercise of authority to deny institution in view of an earlier trial date in the parallel proceeding.” *Fintiv*, IPR2020-00019, Paper 11 at 6. Further, *Fintiv* instructs that the Board should take “a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review.” *Id.*; see PTAB Consolidated Trial Practice Guide at 55–56, 58 (Nov. 2019) (“CTPG”).³

³ Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

We also follow the Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (June 21, 2022) (“Interim Procedure”).⁴

C. Analysis

1. FACTOR (1): STAY OF PARALLEL LITIGATION

“A district court stay of the litigation pending resolution of the PTAB trial allays concerns about inefficiency and duplication of efforts. This fact has strongly weighed against exercising the authority to deny institution under *NHK*.” *Fintiv*, IPR2020-00019, Paper 11 at 6.

Patent Owner asserts that factor (1) favors discretionary denial because the Delaware case “will not be stayed pending the result of an IPR.” Prelim. Resp. 67. Patent Owner asserts that Petitioner has not requested a stay. *Id.*

Absent specific evidence, the Board typically “will not attempt to predict how the district court in the related district court litigation will proceed because the court may determine whether or not to stay any individual case . . . based on a variety of circumstances and facts beyond our control and to which the Board is not privy.” *Sand Revolution II, LLC v. Cont’l Intermodal Grp.-Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) (informative). We decline to speculate here. Hence, we consider factor (1) neutral.

⁴ Available at https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

2. FACTOR (2): TRIAL DATE IN PARALLEL LITIGATION

“If the court’s trial date is earlier than the projected statutory deadline, the Board generally has weighed this fact in favor of exercising authority to deny institution under *NHK*.” *Fintiv*, IPR2020-00019, Paper 11 at 9.

For factor (2), the Interim Procedure states as follows:

Parties may present evidence regarding the most recent statistics on median time-to-trial for civil actions in the district court in which the parallel litigation resides for the PTAB’s consideration. Where the parties rely on time-to-trial statistics, the PTAB will also consider additional supporting factors such as the number of cases before the judge in the parallel litigation and the speed and availability of other case dispositions.

. . . The PTAB will weigh this factor against exercising discretion to deny institution under *Fintiv* if the median time-to-trial is around the same time or after the projected statutory deadline for the PTAB’s final written decision.

Interim Procedure at 8–9 (footnote omitted).

Patent Owner asserts that factor (2) is neutral because the district court has not set a trial date and “prognosticating about a trial date would be speculative.” Prelim. Resp. 67.

Petitioner asserts that factor (2) does not favor discretionary denial because Patent Owner initiated the Delaware case in late 2023, no schedule has been entered in the Delaware case, and a trial “would therefore be expected well after” the Board’s projected statutory deadline for a final written decision. Pet. 125.

Neither party has submitted statistics on median time-to-trial for civil actions in the District of Delaware. *See* Pet. 125; Prelim. Resp. 66–69. Because the district court has not set a trial date, however, factor (2) does not favor discretionary denial.

3. FACTOR (3): INVESTMENT IN PARALLEL LITIGATION

Fintiv instructs the Board to consider “the amount and type of work already completed in the parallel litigation by the court and the parties at the time of the institution decision.” *Fintiv*, IPR2020-00019, Paper 11 at 9.

“[M]ore work completed by the parties and court in the parallel proceeding tends to support the arguments that the parallel proceeding is more advanced, a stay may be less likely, and instituting would lead to duplicative costs.” *Id.* at 10.

Patent Owner asserts that factor (3) favors discretionary denial because instituting review would “waste the investment made by” the parties and the district court relating to Petitioner’s § 101 motion. Prelim. Resp. 67.

Other than Petitioner’s § 101 motion, neither party identifies progress in the Delaware case. *See* Pet. 125; Prelim. Resp. 66–69. In *NHK*, the Board determined that the parallel litigation was in an “advanced state” when expert discovery was scheduled to end in less than two months and a jury trial was scheduled to begin in six months. *NHK*, IPR2018-00752, Paper 8 at 20. By contrast, the district court in the Delaware case has not yet construed any claim language, set a trial date, or made other determinations on the merits. *See* Pet. 125; Prelim. Resp. 66–69. Considering “the amount and type of work already completed in the parallel litigation by the court and the parties,” factor (3) does not favor discretionary denial.

4. FACTOR (4): OVERLAPPING ISSUES

Fintiv instructs the Board to consider whether another proceeding presents “the same or substantially the same” claims, grounds, arguments, evidence, and issues to avoid “redoing the work” of a district court and “the

possibility of conflicting decisions.” *Fintiv*, IPR2020-00019, Paper 11 at 12–14; *see* Interim Procedure at 6.

Patent Owner asserts that factor (4) is neutral because the issues Petitioner will raise in the Delaware case are unknown, except for the § 101 issues. Prelim. Resp. 68.

Petitioner asserts that “it is unclear whether any overlap exists between” the issues in this proceeding and the issues “that might be raised in the district court, as the parties have not yet exchanged preliminary infringement or invalidity contentions.” Pet. 125.

Because any overlap between the issues in this proceeding and the issues in the Delaware case is unknown, factor (4) does not favor discretionary denial. But our decision on discretionary denial would not change even under Patent Owner’s view that factor (4) is neutral.

5. FACTOR (5): PETITIONER’S STATUS IN PARALLEL LITIGATION

“If a petitioner is unrelated to a defendant in an earlier court proceeding, the Board has weighed this fact against exercising discretion to deny institution under *NHK*.” *Fintiv*, IPR2020-00019, Paper 11 at 13–14.

Patent Owner asserts that factor (5) favors discretionary denial because “the parties in the co-pending litigation are identical.” Prelim. Resp. 68.

The parties do not dispute that Petitioner is the defendant in the Delaware case. *See* Pet. 125; Prelim. Resp. 68. But the district court has not set a trial date in the Delaware case. *See supra* Section III.C.2. Thus, factor (5) is neutral.

6. FACTOR (6): OTHER CIRCUMSTANCES

Factor (6) concerns other circumstances and recognizes that a decision whether to exercise discretion under § 314(a) to deny institution should rest on “a balanced assessment of all the relevant circumstances in the case, including the merits.” *Fintiv*, IPR2020-00019, Paper 11 at 14; *see* CTPG at 58; Interim Procedure at 4. For example, “if the merits of a ground raised in the petition seem particularly strong on the preliminary record, this fact has favored institution.” *Fintiv*, IPR2020-00019, Paper 11 at 14–15.

Also, Congress gave the Office “significant power to revisit and revise earlier patent grants” as a way to “improve patent quality and restore confidence in the presumption of validity that comes with issued patents.” *Cuozzo Speed Techs., LLC v. Lee*, 579 U.S. 261, 272 (2016) (quoting H.R. Rep. No. 112-98, pt. 1, at 45, 48). “Consistent with Congress’s giving the Office the authority to revisit issued patents, the PTAB will not deny institution based on *Fintiv* if there is compelling evidence of unpatentability.” Interim Procedure at 5; *see id.* at 2, 4, 9.

If factors (1) through (5) do not favor discretionary denial, “the Board shall decline to discretionarily deny under *Fintiv* without reaching the compelling merits analysis.” *CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 at 4–5 (Vidal Feb. 27, 2023) (precedential). But if factors (1) through (5) favor discretionary denial, “the Board shall then assess compelling merits.” *Id.* at 5.

Patent Owner asserts that factor (6) favors discretionary denial based on the following circumstances:

- (a) the ’273 patent has already expired and there is “limited public interest” in the patent’s validity;

- (b) earlier *inter partes* reviews, ITC investigations, and civil actions have been filed that “raise the same art and similar arguments”; and
- (c) the “Brazil patent office provided an opinion” that TML6, Fandrianto, and two other references did not “constitute grounds for modifying the scope of protection and rights conferred by” a Brazilian counterpart to U.S. Patent No. 6,950,469 B2 (“the ’469 patent”) (Exhibit 2003), i.e., an ancestor of the ’273 patent.

Prelim. Resp. 68–69.

For the reasons discussed above, factors (1) through (5) do not favor discretionary denial. *See supra* Sections III.C.1–III.C.5. Thus, we do not reach “the compelling merits analysis.” *See CommScope*, IPR2022-01242, Paper 23 at 4–5. Further, the circumstances Patent Owner identifies do not warrant exercising discretion under § 314(a) to deny institution. *See* Prelim. Resp. 68–69.

We disagree with Patent Owner that the expiration of the ’273 patent favors discretionary denial in this case. Prelim. Resp. 68. Although a patentee has fewer rights when its patent has expired, “it nevertheless maintains some rights, such as bringing an action for past damages.” *Apple Inc. v. Gesture Tech. Partners, LLC*, Nos. 2023-1501, 2023-1554, 2025 WL 299939 at *3 (Fed. Cir. Jan. 27, 2025) (citing *Keranos, LLC v. Silicon Storage Tech., Inc.*, 797 F.3d 1025, 1033 (Fed. Cir. 2015); *Genetics Inst., LLC v. Novartis Vaccines & Diagnostics, Inc.*, 655 F.3d 1291, 1299 (Fed. Cir. 2011)). For example, in the Delaware case, Patent Owner alleges that Petitioner infringed the ’273 patent, and Patent Owner seeks damages for past infringement. *See* Ex. 1010, 213–42 (¶¶ 301–319), 589–90 (§§ I, III, VIII). Also, the ’273 patent expired less than six years ago. *See* Ex. 1001,

code (63). So Patent Owner may seek damages for past infringement from others. *See* 35 U.S.C. § 286. Both the Federal Circuit and the Supreme Court “have recognized that there is a significant public policy interest in removing invalid patents from the public arena.” *SmithKline Beecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1354 (Fed. Cir. 2005).

As for the earlier *inter partes* reviews, ITC investigations, and civil actions that Patent Owner references, Patent Owner does not assert that any of those proceedings resulted in a decision on the merits regarding the obviousness of the challenged claims. *See* Prelim. Resp. 68–69. For example, the earlier *inter partes* reviews were terminated due to settlement before the Board decided whether to institute review. *See* IPR2021-00040, Paper 18; IPR2021-00041, Paper 18; IPR2021-00042, Paper 20; IPR2021-00043, Paper 18; *supra* Section II.B.

As for the proceeding in the “Brazil patent office” relating to the Brazilian counterpart to the ’469 patent, Patent Owner does not explain the relevance of that proceeding in view of, among other things, any differences in claim scope and any differences in patentability requirements. *See* Prelim. Resp. 69. Different countries have “varying legal and procedural requirements for obtaining patent protection.” *See Caterpillar Tractor Co. v. Berco, S.p.A.*, 714 F.2d 1110, 1116 (Fed. Cir. 1983). Accordingly, the Court of Appeals for the Federal Circuit has “cautioned against indiscriminate reliance on foreign file histories.” *Starhome GmbH v. AT&T Mobility LLC*, 743 F.3d 849, 858 (Fed. Cir. 2014).

Thus, there are no circumstances under factor (6)—or any other factor—that would lead us to conclude that we should exercise our discretion under § 314(a) to deny institution.

7. CONCLUSION CONCERNING DISCRETIONARY DENIAL
IN VIEW OF PARALLEL LITIGATION

After analyzing the *Fintiv* factors with a holistic view of whether the efficiency and integrity of the system are best served by denying or instituting review, we determine that, on balance, the factors do not favor denying an *inter partes* review. Hence, we decline to exercise our discretion under § 314(a) to deny institution.

IV. DISCRETIONARY DENIAL UNDER 35 U.S.C. § 325(d)

A. Background

Section 325(d) provides that “[i]n determining whether to institute” an *inter partes* review, “the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office.” 35 U.S.C. § 325(d).

When deciding whether to exercise our discretion under § 325(d), we follow the two-part framework set forth in *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020) (precedential). Specifically, we must first determine “whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office.” *Id.* at 8. That determination involves “two separate issues”:

- (1) “whether the petition presents to the Office the same or substantially the same art previously presented to the Office”; and
- (2) “whether the petition presents to the Office the same or substantially the same arguments previously presented to the Office.”

Id. at 7.

If “either condition of first part of the framework is satisfied,” we must then determine “whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *Advanced Bionics*, IPR2019-01469, Paper 6 at 8. “An example of a material error may include misapprehending or overlooking specific teachings of the relevant prior art where those teachings impact patentability of the challenged claims.” *Id.* at 8 n.9.

When deciding whether to exercise our discretion under § 325(d) in view of the *Advanced Bionics* framework, we weigh the following nonexclusive factors:

- (a) the similarities and material differences between the asserted references and the prior art involved during prosecution;
- (b) the cumulative nature of the asserted references and the prior art evaluated during prosecution;
- (c) the extent to which the asserted references were evaluated during prosecution, including whether a rejection rested on any reference;
- (d) the extent of overlap between the arguments made during prosecution and Petitioner’s reliance on the asserted references or Patent Owner’s contentions concerning them;
- (e) whether Petitioner has pointed out sufficiently how the Examiner erred in analyzing the asserted references; and
- (f) the extent to which additional evidence and facts presented in the petition warrant reconsideration of the asserted references or arguments.

See Becton, Dickinson & Co. v. B. Braun Melsungen AG, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential as to § III.C.5, first paragraph) (“*Becton*”).

Under the *Advanced Bionics* framework, *Becton* factors (a), (b), and (d) relate to “whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office.” *Advanced Bionics*, IPR2019-01469, Paper 6 at 8, 10. *Becton* factors (c), (e), and (f) relate to “whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *See id.* at 7–8, 10.

B. Patent Owner’s Position

Patent Owner argues that we should exercise our discretion under § 325(d) to deny institution because “the substance of TML6 and Fandrianto was expressly disclosed and considered during examination.” Prelim. Resp. 30 (citing Ex. 1001, 11:25–13:27; Ex. 1002, 383–87). Patent Owner explains that the ’273 patent describes TML6 and the Examiner “would have read” the specification. *Id.* at 31; *see id.* at 36. Patent Owner asserts that there are no material differences between the ’273 patent’s description of TML6 and the TML6 source-code files comprising Exhibit 1005. *Id.* at 32.

Patent Owner also explains that the Examiner reviewed U.S. Patent No. 5,901,248 (“Fandrianto ’248”) (Exhibit 2007) and Fandrianto ’248 includes the same disclosures as Fandrianto. Prelim. Resp. 31, 33, 36. According to Patent Owner, § 325(d) “does not require that a document was presented to the Office verbatim and in identical form to how it is later presented to the Board in a Petition.” *Id.* at 32 (citing *Universal Imaging Indus., Inc. v. Lexmark Int’l, Inc.*, IPR2019-01383, Paper 7 at 17 (PTAB Feb. 27, 2020)).

Patent Owner also argues that Petitioner “does not explain how the Examiner erred in evaluating these references, nor does Petitioner try to

provide additional evidence or facts to justify reconsideration.” Prelim. Resp. 30; *see id.* at 35–37. According to Patent Owner, Petitioner “asserts conclusory statements, lacking sufficient support, as to why the Examiner erred or overlooked any issue related to TML6 and Fandrianto.” *Id.* at 35.

C. Petitioner’s Position

Petitioner argues that we should decline to exercise our discretion under § 325(d) to deny institution because the “Examiner did not substantively consider either TML6 or Fandrianto during prosecution.” Pet. 125. Regarding TML6, Petitioner admits that the ’273 patent “accurately summarizes certain portions of the TML6 sub-pixel interpolation scheme.” *Id.* at 125–26 (citing Ex. 1001, 11:25–13:27). But Petitioner asserts that the TML6 source-code files comprising Exhibit 1005 include “far greater coverage of the components and functionalities of the TML6 codec” and were “not considered by the Examiner.” *Id.* at 126. According to Petitioner, the ’273 patent’s description of TML6 lacks the detail found in the “nearly 10,000 lines of code” in Exhibit 1005, such as “how the `oneforthpix()` function interacts with the `imgY`, `img4Y_tmp`, and `mref` data structures.” *Id.* (emphases omitted).

Further, Petitioner asserts that Fandrianto ’248 “was cited in an [information-disclosure statement] but never applied against the claims nor discussed by the Examiner.” Pet. 127 (citing Ex. 1002, 206). In light of little or no evaluation during prosecution, Petitioner asserts that Fandrianto “does not weigh in favor of exercising the Board’s discretion under § 325(d)” to deny institution. *Id.*

Additionally, Petitioner contends that “denial under § 325(d) is unwarranted because the Examiner did not consider the specific combination of TML6 and Fandrianto.” Pet. 126.

D. Analysis

As explained in more detail below, we have analyzed the *Becton* factors in view of the *Advanced Bionics* framework and the record before us, and we determine that, on balance, the factors do not weigh against an *inter partes* review.

1. THE FIRST PART OF THE *ADVANCED BIONICS* FRAMEWORK

Under the *Advanced Bionics* framework, we initially consider *Becton* factors (a), (b), and (d) in determining “whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office.” *Advanced Bionics*, IPR2019-01469, Paper 6 at 8, 10. *Becton* factors (a) and (b) “broadly provide guidance as to whether the art presented in the petition is the ‘same or substantially the same’ as the prior art previously presented to the Office during *any* proceeding.” *Id.* at 10 (emphasis in the original). “Previously presented art includes art made of record by the Examiner, and art provided to the Office by an applicant,” e.g., with an information-disclosure statement. *Id.* at 7–8.

For the “same or substantially the same art” inquiry under the *Advanced Bionics* framework, we agree with Patent Owner that the ’273 patent describes TML6 and the Examiner “would have read” the specification. *See* Ex. 1001, 8:38–47, 11:25–13:27, 28:36–41, Figs. 13a–13c; Prelim. Resp. 31.

As for Fandrianto, the Examiner initialed an information-disclosure statement next to an entry for Fandrianto '248. Ex. 1002, 206, 383. The '273 patent lists Fandrianto '248 in the “References Cited” section. Ex. 1001, code (56). The application that issued as Fandrianto '248 is a continuation of the application that issued as Fandrianto. Ex. 2007, 1:4–6, code (63). Fandrianto '248 includes the same disclosures as Fandrianto. *Compare* Ex. 1006, 1:4–20:51, *with* Ex. 2007, 1:7–20:45.

For these reasons, the Petition “presents to the Office the same or substantially the same art previously presented to the Office.”

2. THE SECOND PART OF THE *ADVANCED BIONICS* FRAMEWORK

Because the Petition “presents to the Office the same or substantially the same art previously presented to the Office,” we turn to the second part of the *Advanced Bionics* framework and consider *Becton* factors (c), (e), and (f) in determining “whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *See Advanced Bionics*, IPR2019-01469, Paper 6 at 7–8, 10. For the reasons explained below, Petitioner has demonstrated a material error by the Office.

Becton factor (c) concerns the extent to which the asserted references were evaluated during prosecution, including whether a rejection rested on any reference. *Becton*, IPR2017-01586, Paper 8 at 17. For instance, “if the record of the Office’s previous consideration of the art is not well developed or silent, then a petitioner may show the Office erred by overlooking something persuasive under factors (e) and (f).” *Advanced Bionics*, IPR2019-01469, Paper 6 at 10.

Under *Becton* factor (c), evaluating the '273 patent’s description of TML6 differs significantly from evaluating the source code itself. As

Petitioner asserts, the TML6 source-code files comprising Exhibit 1005 include “far greater coverage of the components and functionalities of the TML6 codec” and were “not considered by the Examiner.” *See* Ex. 1001, 8:38–47, 11:25–13:27, 28:36–41, 44:9–11, 46:31–41, 47:27–48:6, 49:24–50:63, Figs. 13a–13c; Ex. 1005; Pet. 126. As explained in the patentability analysis below, Petitioner relies on details in the source code about how the oneforthpix() function works and interacts with the imgY, img4Y_tmp, and mref data structures to establish unpatentability. *See infra* Sections V.D.4(a)–(d). The ’273 patent does not discuss those software instrumentalities. *See, e.g.*, Ex. 1001, 8:38–47, 11:25–13:27, 44:9–11, 46:31–41, 47:27–48:6, 49:24–50:63.

Based on the current record, we see no evidence that the Examiner evaluated the source code itself, which forms the foundation for Petitioner’s challenges.

Moreover, the Examiner did not rely on TML6 or Fandrianto ’248 during prosecution to reject any claim. *See* Ex. 1002, 197–202, 241–47, 296–303. Also, the Examiner said nothing about Fandrianto ’248 during prosecution, *e.g.*, when commenting on the prior art of record. *See id.* at 197–202, 241–47, 296–303, 372–78, 424–30, 472–78, 521–28, 563–64, 571–76. Under *Becton* factor(c), these circumstances weigh against exercising discretion under § 325(d) to deny institution. *See Becton*, IPR2017-01586, Paper 8 at 17–18.

Additionally, even assuming that evaluating the ’273 patent’s description of TML6 equates to evaluating the source code itself, Petitioner has shown under *Becton* factors (e) and (f) that the Office erred by overlooking the TML6-Fandrianto combination by pointing to “specific

teachings of the relevant prior art,” i.e., TML6 and Fandrianto, that render at least one claim unpatentable, as explained in the patentability analysis below. *See infra* Sections V.D.4(a)–(f); *Advanced Bionics*, IPR2019-01469, Paper 6 at 8 n.9. That is, we disagree with Patent Owner that Petitioner has failed to meet its burden to demonstrate that the Office erred in a manner material to the patentability of challenged claims. *See* Prelim. Resp. 30, 35–37.

For these reasons, *Becton* factors (c), (e), and (f) do not favor denying an *inter partes* review.

3. CONCLUSION CONCERNING DISCRETIONARY DENIAL

After analyzing the *Becton* factors in view of the *Advanced Bionics* framework and the record before us, we determine that, on balance, the factors do not favor denying an *inter partes* review. Hence, we decline to exercise our discretion under § 325(d) to deny institution.

V. PATENTABILITY ANALYSIS

A. *Legal Principles: Obviousness*

A patent may not be obtained “if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103(a) (2006). An obviousness analysis involves underlying factual inquiries including (1) the scope and content of the prior art; (2) differences between the claimed invention and the prior art; (3) the level of ordinary skill in the art; and (4) where in evidence, objective indicia of nonobviousness, such as commercial success, long-felt but unsolved needs,

and failure of others.⁵ *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18, 35–36 (1966); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1047–48 (Fed. Cir. 2016) (en banc). When evaluating a combination of references, an obviousness analysis should address “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007).

We analyze the obviousness issues according to these principles.

B. Level of Ordinary Skill in the Art

Factors pertinent to determining the level of ordinary skill in the art include (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) prior-art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and (6) the educational level of workers active in the field. *Envtl. Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696–97 (Fed. Cir. 1983). Not all factors may exist in every case, and one or more of these or other factors may predominate in a particular case. *Id.* These factors are not exhaustive, but merely a guide to determining the level of ordinary skill in the art. *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007). Moreover, the prior art itself may reflect an appropriate skill level. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Petitioner asserts that a person of ordinary skill in the art at the time of the alleged invention would have had “a (1) Bachelor’s degree in electrical engineering, computer engineering, computer science, or a comparable field of study such as physics, and (2) approximately two to

⁵ The parties do not address objective indicia of nonobviousness. *See, e.g.*, Pet. 21–123; Prelim. Resp. 1, 38–65.

three years of practical experience with video encoding/decoding.” Pet. 10–11. Petitioner also asserts that “[a]dditional experience can substitute for the level of education, and vice-versa.” *Id.* at 11. Dr. Ramchandran’s testimony supports Petitioner’s assertions. *See* Ex. 1003 ¶ 41.

Patent Owner asserts that a person of ordinary skill in the art would have been “an electrical and/or computer engineer with one to two years of experience relating to video coding hardware and/or software.” Prelim. Resp. 27.

The parties seem to agree generally about the level of ordinary skill in the art. At this stage of the proceeding, neither party contends that any differences between their respective descriptions of an ordinarily skilled artisan would impact the patentability analysis. During the instituted trial, we encourage the parties to address whether there are any differences between their respective descriptions that would impact the patentability analysis. If so, they should explain how those differences impact the patentability analysis.

Based on the current record, our analysis would not change if we adopted Petitioner’s description of an ordinarily skilled artisan or Patent Owner’s description.

C. Claim Construction

We construe claim terms “using the same claim construction standard” that district courts use to construe claim terms in civil actions under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 42.100(b). Under that standard, claim terms “are given their ordinary and customary meaning, which is the meaning the term would have to a person of ordinary skill in the art at the time of the invention.” *Power Integrations, Inc. v. Fairchild Semiconductor*

Int'l, Inc., 904 F.3d 965, 971 (Fed. Cir. 2018) (citing *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc)). The meaning of claim terms may be determined by “look[ing] principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner does not propose an explicit construction for any claim term because, according to Petitioner, “no constructions are necessary to resolve any disputes identified in” the Petition. Pet. 11.

Patent Owner explains that the Preliminary Response “does not depend on claim construction.” Prelim. Resp. 27. Patent Owner “reserves the right to advance its own construction for any claim term should an IPR be instituted.” *Id.*

“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.” *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); see *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). Based on the current record, we determine that no claim term requires an explicit construction to decide whether Petitioner satisfies the “reasonable likelihood” standard for instituting trial.

D. Alleged Obviousness over TML6 and Fandrianto: Claims 1, 4–17, 19–26, 28, 29, 31, 33, 36–49, 51, 53–59, 61, 62, 64–78, 82, and 83

Petitioner contends that claims 1, 4–17, 19–26, 28, 29, 31, 33, 36–49, 51, 53–59, 61, 62, 64–78, 82, and 83 are unpatentable under § 103(a) because the claims would have been obvious over TML6 and Fandrianto.

See Pet. 1–2, 21–120. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 1, 38–65.

Below, we provide overviews of TML6 and Fandrianto. Then, we consider the obviousness issues. For the reasons explained below, Petitioner establishes sufficiently for purposes of institution that claims 1, 4–17, 19–26, 28, 29, 31, 33, 36–49, 51, 53–59, 61, 62, 64–78, 82, and 83 would have been obvious over TML6 and Fandrianto.

1. OVERVIEW OF TML6 (EXHIBIT 1005)

As discussed above, the ITU-Telecommunications Standardization Sector, Study Group 16, Video Coding Experts Group (VCEG), developed TML6 for “the purposes of evaluation and further development.” *See* Ex. 1001, 8:38–47; Ex. 1003 ¶ 44; Ex. 1008 ¶¶ 15, 21; *supra* Section II.C. TML6 includes an interpolation scheme that was “proposed for incorporation into ITU-T recommendation H.26L.” Ex. 1001, 8:41–48.

The TML6 source code “is a fully developed codec (i.e., encoder and decoder) and could be run on a processor to perform the encoding and decoding functions.” Ex. 1003 ¶ 44 (emphasis omitted); *see* Ex. 1008 ¶ 19. A single compressed file called “tml6pre.zip” contains the TML6 source-code files. Ex. 1003 ¶ 46; *see* Ex. 1008 ¶ 38.

As TML6 (Exhibit 1005) in this proceeding, Petitioner provides text versions of the following source-code files in “tml6pre.zip”:

File Name	Pages in TML6 (Exhibit 1005)
/tml6pre.zip/readme.txt	1–2
/tml6pre.zip/lencod/inc/image.h	3
/tml6pre.zip/lencod/src/block.c	4–34

File Name	Pages in TML6 (Exhibit 1005)
/tml6pre.zip/lencod/inc/global.h	35–47
/tml6pre.zip/lencod/src/image.c	48–68
/tml6pre.zip/lencod/src/lencod.c	69–100
/tml6pre.zip/lencod/src/macroblock.c	101–128
/tml6pre.zip/ldecod/inc/global.h	129–134
/tml6pre.zip/ldecod/inc/image.h	135–136
/tml6pre.zip/ldecod/src/image.c	137–154
/tml6pre.zip/ldecod/src/ldecod.c	155–163
/tml6pre.zip/ldecod/src/macroblock.c	164–183

Pet. 12–13 (emphases omitted).

2. OVERVIEW OF FANDRIANTO (EXHIBIT 1006)

Fandrianto is a U.S. patent titled “Programmable Architecture and Methods for Motion Estimation,” filed on February 19, 1992, and issued on January 14, 1997. Ex. 1006, codes (22), (45), (54). Fandrianto states that the invention “relates generally to motion estimation, and more specifically to a programmable architecture and methods for motion vector and/or prediction error determination.” *Id.* at 1:7–10.

Fandrianto explains that “as various standards for digital video compression exist and are proposed, a need has arisen for a flexible, high performance, low implementation cost programmable architecture for motion estimation.” Ex. 1006, 1:63–67. To address that need, Fandrianto discloses a programmable architecture for motion estimation as depicted in Fandrianto’s Figure 2 reproduced below:

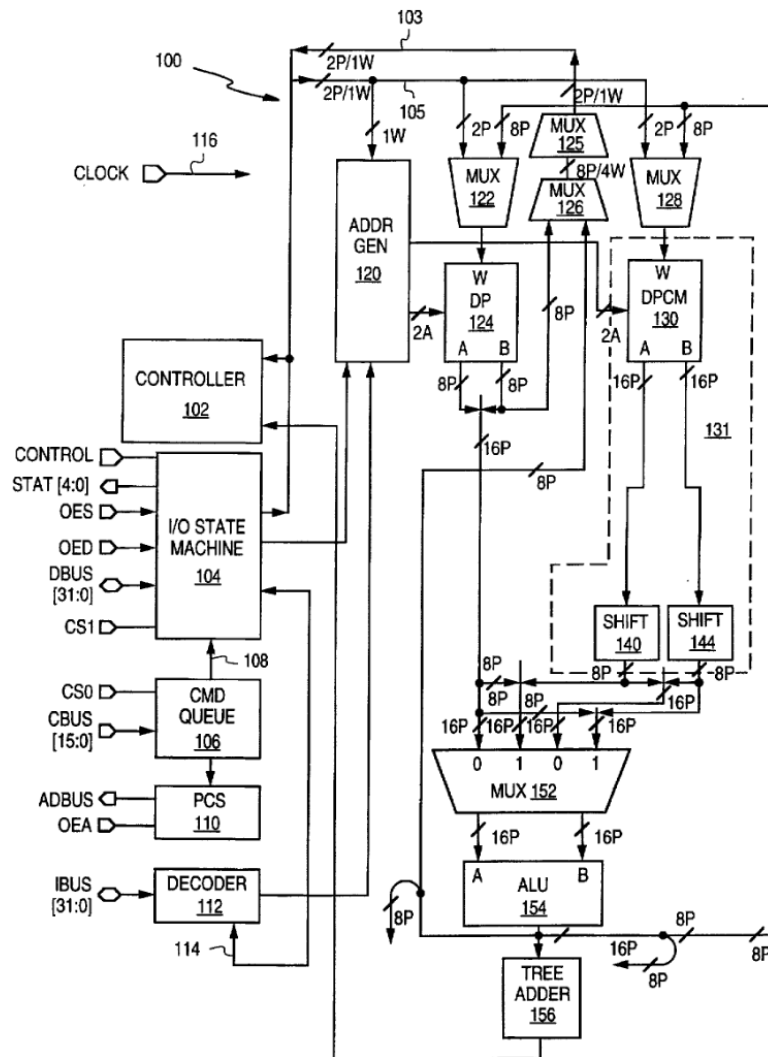


FIG. 2

Figure 2 illustrates a limited-memory motion-estimation architecture 100 including the following components:

- “an image block, best match block memory conveniently referred to as DP memory 124”;
- “a search memory conveniently referred to as DPCM memory 130”;
- “two funnel shifters 140 and 144”;
- “an arithmetic logic unit (‘ALU’) 154”; and
- “a tree adder 156.”

Ex. 1006, 2:48–49, 3:57–62, 3:66–4:4, 8:16, Fig. 2. “The video information stored in the DP memory 124 and the DPCM memory 130 are stored as blocks.” *Id.* at 4:7–8.

Fandrianto’s Figure 3B (reproduced below) depicts in more detail “the DP memory 124 and the DPCM memory 130”:

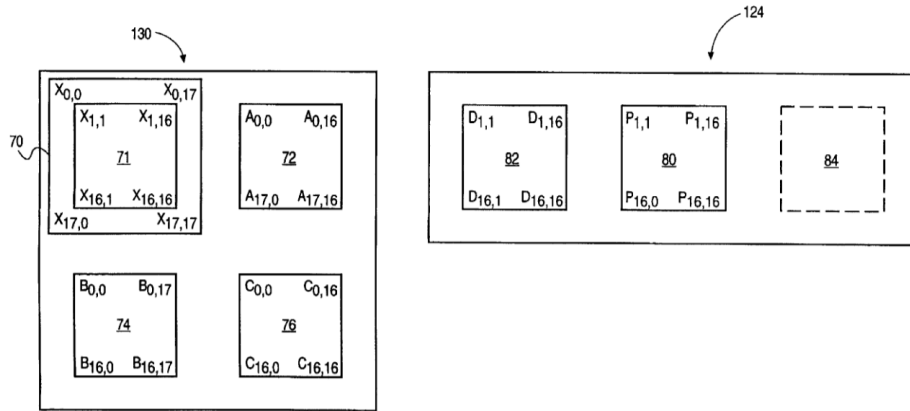


FIG. 3B

Figure 3B illustrates DP memory 124 including P block 80 for preframe or current video information, D block 82 for a best-match block or a prediction error, and I block 84 for scratchpad or other purposes. Ex. 1006, 4:10–12, 4:56–64, 5:33–37, 7:23–26, 7:37–44, 9:18–21, 12:9–15, Fig. 3B. Figure 3B also illustrates DPCM memory 130 including X block 70 with best-match search block 71, A block 72, B block 74, and C block 76. *Id.* at 5:37–41, 5:66–6:4, Fig. 3B.

X block 70 “was present during the motion vector search on an integral full pixel basis, and is merely relocated in the DPCM memory 130, to reduce external memory bandwidth.” Ex. 1006, 6:14–17. A block 72, B block 74, and C block 76 “are interpolated from the X block 70 and used in half pixel and, later, quarter pixel estimation.” *Id.* at 5:41–44. For

“improved prediction accuracy, half-pixel estimation and quarter-pixel estimation are performed after the integral pixel estimation.” *Id.* at 5:26–28.

Fandrianto’s Figure 5 (reproduced below) depicts full or unit pixels, half sub-pixels, and quarter sub-pixels:

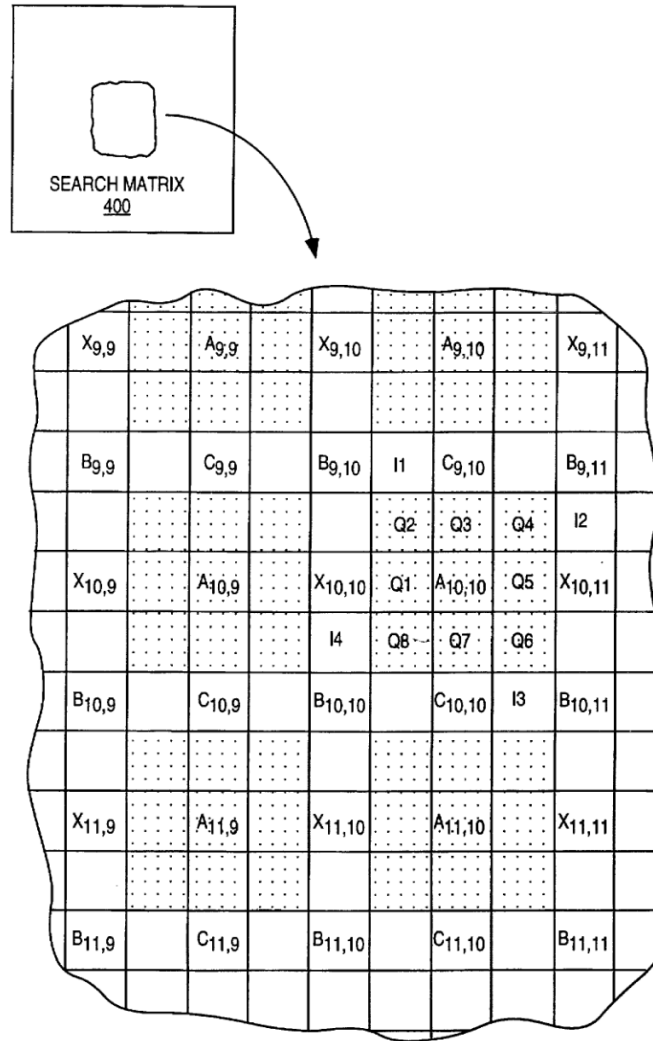


FIG. 5

Figure 5 illustrates interpolated search matrix 400 including four interleaved matrices corresponding to full or unit pixels $X_{r,c}$, half sub-pixels $A_{r,c}$, half sub-pixels $B_{r,c}$, and half sub-pixels $C_{r,c}$, where “r” denotes the row number and “c” denotes the column number. *See* Ex. 1006, 2:55–58, 5:50–55, Fig. 5.

Half sub-pixels $A_{r,c}$ “of the A block 72 are horizontally interpolated at half-pixel locations, from the X block 70.” Ex. 1006, 6:4–6; *see id.* at 6:19–34. Half sub-pixels $B_{r,c}$ “of the B block 74 are vertically interpolated at half-pixel locations, from the X block 70.” *Id.* at 6:6–8; *see id.* at 6:35–48. Half sub-pixels $C_{r,c}$ “are pixels interpolated at half-pixel locations, preferably vertically from the A matrix 72 or horizontally from the B matrix 74, but may also be interpolated diagonally from the X matrix 70.” *Id.* at 6:9–12; *see id.* at 6:49–7:2.

Fandrianto discloses motion-vector searching on a quarter-pixel basis and various techniques for interpolating quarter sub-pixel values. *See* Ex. 1006, 7:27–10:58. As an example, Fandrianto explains generally that when “interpolation is restricted to only horizontal and vertical interpolation, some of the quarter pixel estimation blocks are interpolated from one or more of the full and half pixel estimation search blocks (X block 70, A block 72, B block 74, and C block 76), while other quarter pixel estimation search blocks are interpolated from quarter pixel estimation search blocks.” *Id.* at 7:46–52. As another example, Fandrianto explains generally that “when diagonal interpolation is also used, all quarter pixel estimation search blocks are interpolated from the full and half pixel estimation search blocks.” *Id.* at 7:52–55.

For the limited-memory motion-estimation architecture shown in Figure 2, Fandrianto discloses an illustrative method for interpolating quarter sub-pixel values for Q1 through Q8 around the half sub-pixel $A_{10,10}$ in Figure 5. Ex. 1006, 8:16–10:50, Fig. 5. In that illustrative method, A block 72 holds “the current quarter pixel interpolated block, the pixels of which for convenience are referred to as $Q_{r,c}$.” *Id.* at 8:34–36. Fandrianto

provides specific equations for interpolating quarter sub-pixel values for $Q1_{r,c}$ through $Q8_{r,c}$ in that illustrative method. *Id.* at 8:37–10:50.

In particular, Fandrianto provides the following equations for interpolating quarter sub-pixel values for $Q1_{r,c}$ through $Q8_{r,c}$:

$$\begin{aligned}Q1_{r,c} &= (X_{r,c} + A_{r,c})/2 \\Q2_{r,c} &= (Q1_{r,c} + I1_{r,c})/2 = ((X_{r,c} + A_{r,c})/2 + (B_{r-1,c} + C_{r-1,c})/2)/2 \\Q3_{r,c} &= (C_{r-1,c} + A_{r,c})/2 \\Q4_{r,c} &= (Q3_{r,c} + I2_{r,c})/2 = ((C_{r-1,c} + A_{r,c})/2 + (B_{r-1,c+1} + X_{r,c+1})/2)/2 \\Q5_{r,c} &= (X_{r,c+1} + A_{r,c})/2 \\Q6_{r,c} &= (Q5_{r,c} + I3_{r,c})/2 = ((X_{r,c+1} + A_{r,c})/2 + (B_{r,c+1} + C_{r,c})/2)/2 \\Q7_{r,c} &= (C_{r,c} + A_{r,c})/2 \\Q8_{r,c} &= (Q7_{r,c} + I4_{r,c})/2 = ((C_{r,c} + A_{r,c})/2 + (B_{r,c} + X_{r,c})/2)/2\end{aligned}$$

Ex. 1006, 8:37–43 (equation 3), 8:58–9:3 (equations 4 and 5), 9:37–40 (equation 6), 9:45–57 (equations 7 and 8), 9:63–10:1 (equation 9), 10:6–18 (equations 10 and 11), 10:23–29 (equation 12), 10:34–46 (equations 13 and 14).

Although Fandrianto provides specific equations for interpolating quarter sub-pixel values for $Q1_{r,c}$ through $Q8_{r,c}$, e.g., with $Q2_{r,c}$ values based on $Q1_{r,c}$ values and $Q4_{r,c}$ values based on $Q3_{r,c}$ values, Fandrianto expressly states that “other techniques may be used if desired.” Ex. 1006, 7:36–37; *see id.* at 8:20–21.

3. WHETHER TML6 CONSTITUTES A SINGLE REFERENCE OR MULTIPLE REFERENCES

(a) Patent Owner’s Position

Patent Owner contends that TML6 is not “a single reference but rather a collection of several references,” i.e., eleven individual source-code files

prepared “over a period of several years” by multiple contributors to the VCEG. Prelim. Resp. 23–24, 39–40; *see id.* at 12 n.1. According to Patent Owner, each source-code file “constitutes a separate reference.” *Id.* at 40; *see id.* at 41. Patent Owner also contends that the Board should deny institution because Petitioner “fails to offer any motivation to combine” the individual source-code files. *Id.* at 39, 41.

Further, Patent Owner asserts that in *Kyocera* the Federal Circuit held that a collection of eleven technical specifications for the GSM standard “written by hundreds of different authors over a span of several years” did not constitute a single reference. Prelim. Resp. 40 (citing *Kyocera Wireless Corp. v. Int’l Trade Comm’n*, 545 F.3d 1340, 1351–52 (Fed. Cir. 2008)). Patent Owner also asserts that “the Federal Circuit held that each specification that comprised the GSM standard, each having their own title and separate page numbering, ‘stands as a separate document in its own right.’” *Id.* (quoting *Kyocera*, 545 F.3d at 1351).

(b) Petitioner’s Position

Petitioner contends that TML6 comprises source-code files that together constitute “a working video encoder and decoder” and were publicly accessible in a single compressed file on March 28, 2001. Pet. 12.

(c) Analysis

Based on the current record, we disagree with Patent Owner that TML6 is not “a single reference but rather a collection of several references.” *See* Prelim. Resp. 23–24, 39–40. Dr. Wenger testifies that TML6, like other test models, contains “a group of files that together make up a fully functional ‘source code’ of a working video encoder and decoder.” Ex. 1008 ¶ 19; *see* Ex. 1003 ¶ 44 (describing TML6 as “a fully developed

codec,” i.e., “encoder and decoder”). Patent Owner makes similar statements:

- (1) “TML6 is source code for a complete video coder implementation”; and
- (2) the “whole codec is designed to work together with the interpolation scheme that existed at the time, but only certain parts define the interpolation process itself.”

Prelim. Resp. 40 n.5, 42.

Moreover, as the ’273 patent explains and Dr. Wenger testifies, TML6’s purpose was testing, evaluation, and further development of the source code. *See* Ex. 1001, 8:41–47; Ex. 1008 ¶ 19. The ’273 patent describes TML6 as a single entity rather than referencing separate functions in separate files, e.g., the `onethpox()` function in the `image.c` file. *See, e.g.,* Ex. 1001, 8:38–47, 11:25–13:27, 28:36–41, 44:9–11, 46:31–41, 47:27–48:6, 49:24–50:63, Figs. 13a–13c. Also, the source-code files comprising TML6 were packaged together in a single compressed file called “tml6pre.zip.” Ex. 1003 ¶ 46; *see* Ex. 1008 ¶ 38. This suggests that those files were meant to be disseminated and used together.

The circumstances here differ materially from the circumstances in *Kyocera*. There, the Federal Circuit considered whether a “collection of eleven separate GSM specifications” anticipated the patent in suit. *See Kyocera*, 545 F.3d at 1351–52. The Federal Circuit noted that “the GSM standard includes hundreds of individual specifications drafted by approximately ten different subgroups, each with its own title and separate page numbering.” *Id.* at 1351. The Federal Circuit also noted that “the GSM standard is simply not a coherent whole document that can be assigned a single prior art date of creation.” *Id.* at 1352.

Here, in contrast to *Kyocera*, the single compressed file called “tml6pre.zip” has a single date of alleged public accessibility, i.e., March 28, 2001. Ex. 1008 ¶ 38; *see* Ex. 1003 ¶ 46; Ex. 1017, 1. Further, the individual source-code files in that compressed file act as a coherent whole because those source-code files together constitute “a working video encoder and decoder.” Ex. 1003 ¶ 46; Ex. 1008 ¶ 19; *see* Ex. 1003 ¶ 44 (describing TML6 as “a fully developed codec,” i.e., “encoder and decoder”); Prelim. Resp. 40 n.5. Hence, based on the current record, Petitioner establishes a reasonable likelihood that TML6 is a single prior-art reference.

4. INDEPENDENT CLAIM 1

(a) Preamble

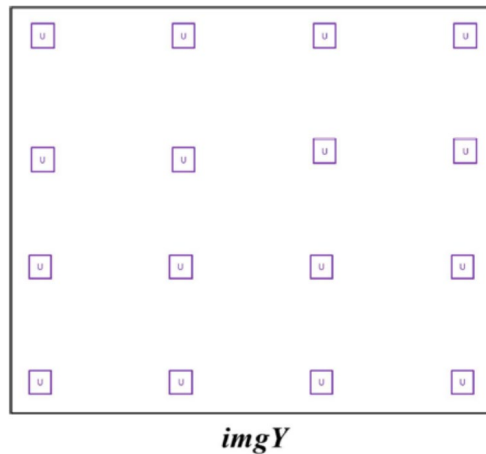
(i) Preamble 1[pre][a]

Claim 1’s preamble reads in part as follows: “[a] method for sub-pixel value interpolation to determine values for sub-pixels situated within a rectangular bounded region defined by four corner pixels with no intermediate pixels between the corners, the pixels and sub-pixels being configured for display in rows and columns.” Ex. 1001, 51:5–9 (preamble 1[pre][a]).

Petitioner contends that TML6 teaches preamble 1[pre][a] for several related reasons. *See* Pet. 29–34. First, Petitioner asserts that TML6 includes the `encode_one_frame()` function that encodes one frame of video data and invokes the following functions for interpolating sub-pixel values for a given video frame: `oneforthpix()` and `oneforthpix_2()`. *Id.* at 29 (emphases omitted).

Second, Petitioner asserts that TML6 defines the `imgY` data structure for storing “data values representing the brightness of unit pixels.” Pet.

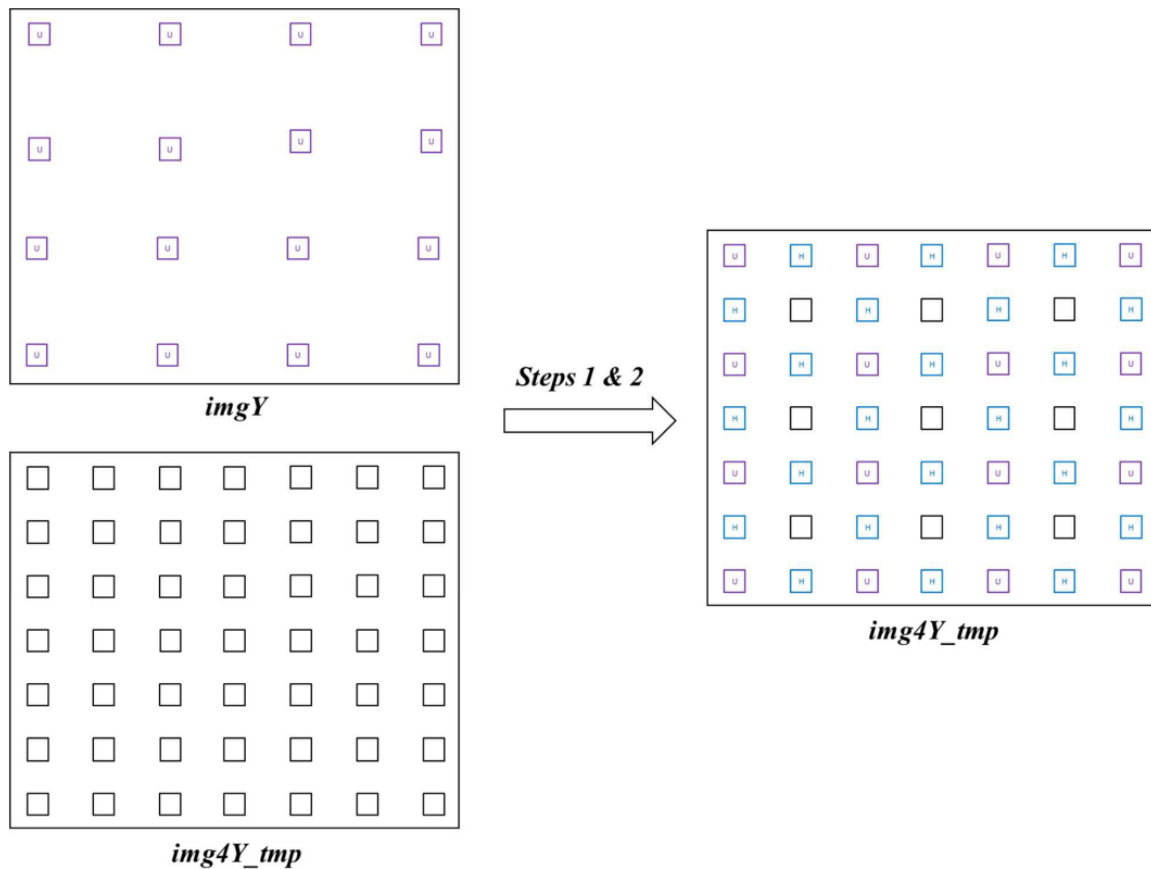
29–30. As support, Petitioner provides the following figure depicting the imgY data structure:



This figure shows the imgY data structure storing data values for 16 unit pixels labeled “U” and colored purple. *See id.* at 30.

Third, Petitioner asserts that the oneforthpix() function “performs three main steps to interpolate sub-pixel values based on the unit pixel values stored in imgY.” Pet. 30 (emphasis omitted).

Fourth, Petitioner asserts that in steps one and two the oneforthpix() function interpolates values for “some of the half sub-pixels” based on “the values of the unit pixels” and stores these interpolated half sub-pixel values in the img4Y_tmp data structure. Pet. 30–31. As support, Petitioner provides the following figure depicting the imgY and img4Y_tmp data structures:



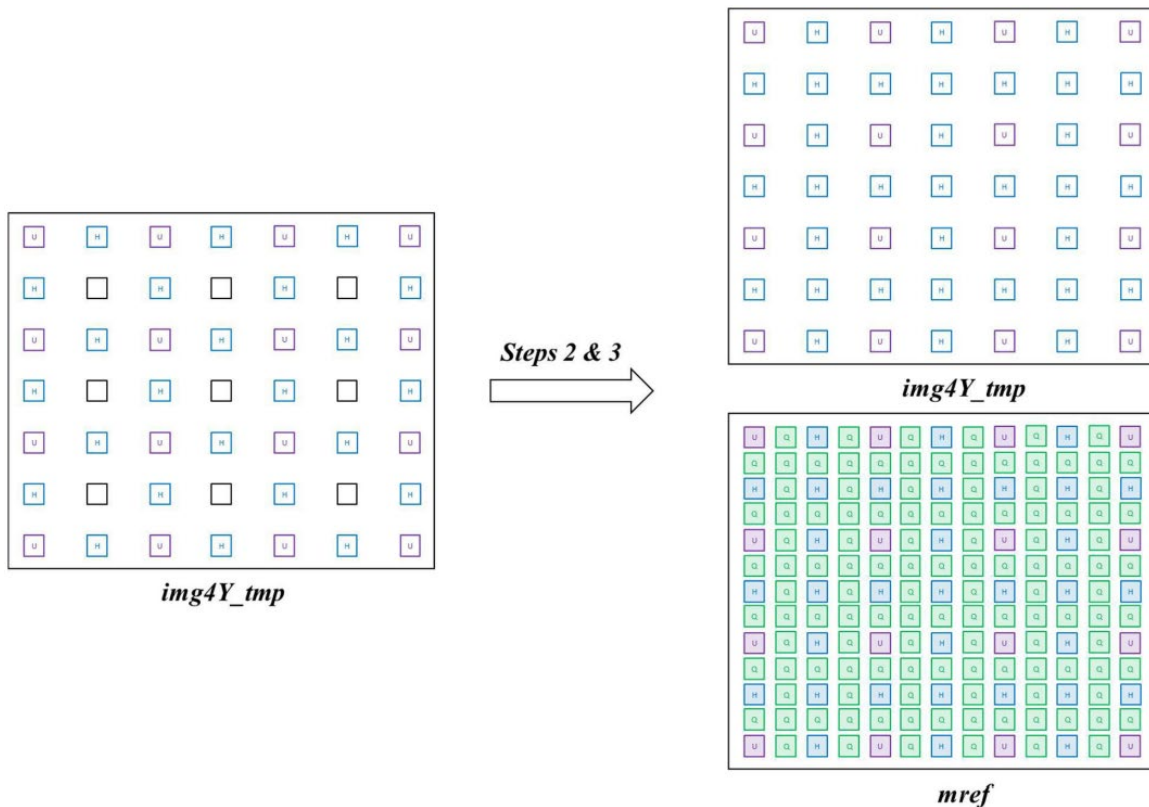
Above on the upper left, this figure shows the *imgY* data structure storing data values for 16 unit pixels labeled “U” and colored purple. *See id.* at 31. Above on the lower left, this figure shows the *img4Y_tmp* data structure initially storing no data values. *See id.* Above on the right, this figure shows the *img4Y_tmp* data structure storing data values for (a) 16 unit pixels labeled “U” and colored purple and (b) 24 half sub-pixels labeled “H,” colored blue, and located horizontally and vertically between the unit pixel values. *See id.* Above in the center, this figure includes an arrow pointing from left to right and the label “Steps 1 & 2.” *See id.*

Fifth, Petitioner asserts that in steps two and three the *onethrthpix()* function:

- (1) interpolates values for “additional half sub-pixels”;

- (2) stores these interpolated half sub-pixel values in the `img4Y_tmp` data structure;
- (3) uses the unit pixel values and the half sub-pixel values in the `img4Y_tmp` data structure to “interpolate values for quarter sub-pixels”; and
- (4) stores these interpolated quarter sub-pixel values in the `mref` data structure together with the half sub-pixel values and the unit pixel values.

Pet. 31–32. As support, Petitioner provides the following figure depicting the `img4Y_tmp` and `mref` data structures:



Above on the left, this figure shows the `img4Y_tmp` data structure storing data values for (a) 16 unit pixels labeled “U” and colored purple and (b) 24 half sub-pixels labeled “H,” colored blue, and located horizontally and vertically between the unit pixel values. *See id.* at 32. Above on the upper right, this figure shows the `img4Y_tmp` data structure storing data

values for (a) 16 unit pixels labeled “U” and colored purple and (b) 33 half sub-pixels labeled “H,” colored blue, and located horizontally, vertically, and diagonally between the unit pixel values. *See id.* Above on the lower right, this figure shows the mref data structure storing data values for (a) 16 unit pixels labeled “U” and colored purple, (b) 33 half sub-pixels labeled “H” and colored blue, and (c) 120 quarter sub-pixels labeled “Q,” colored green, and located horizontally, vertically, and diagonally between the unit pixel values and the half sub-pixel values. *See id.* Above in the center, this figure includes an arrow pointing from left to right and the label “Steps 2 & 3.” *See id.*

Sixth, Petitioner asserts that the img4Y_tmp and mref data structures include “half sub-pixels (blue) and/or quarter sub-pixels (green)” situated within “a rectangular bounded region defined by” four corner unit pixels (purple) “with no intermediate pixels between” the four corner unit pixels according to preamble 1[pre][a]. Pet. 32.

Seventh, Petitioner asserts that the unit pixels (purple), half sub-pixels (blue), and quarter sub-pixels (green) in the mref data structure are arranged “in rows and columns” and “configured for display” according to preamble 1[pre][a]. Pet. 32–33.

(ii) Preamble 1[pre][b]

Claim 1’s preamble reads in part as follows:

pixel and sub-pixel locations in the rows and columns being representable mathematically within the rectangular bounded region using the co-ordinate notation $K/2^N$, $L/2^N$, K and L being positive integers having respective values between zero and 2^N , N being a positive integer greater than one and representing a particular degree of sub-pixel value interpolation.

Ex. 1001, 51:9–15 (preamble 1[pre][b]).

Petitioner contends that TML6 teaches preamble 1[pre][b] because the oneforthpix() function:

- (1) interpolates “half sub-pixels (blue) based on the unit pixels U (purple)” in the imgY data structure and stores the pixel values and the interpolated sub-pixel values in the img4Y_tmp data structure; and
- (2) further interpolates “quarter sub-pixels (green) based on the unit pixels U (purple) and the previously interpolated half sub-pixels (blue)” and stores the pixel values and the interpolated sub-pixel values in the mref data structure.

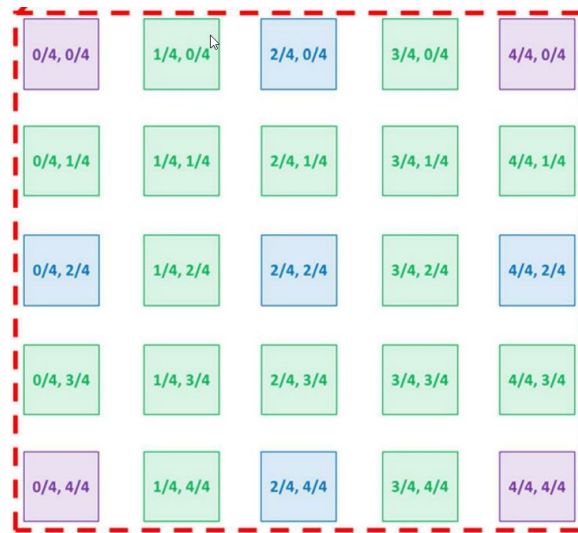
Pet. 35–37.

Further, Petitioner asserts that the locations of the pixels and the sub-pixels in the mref data structure are “representable mathematically” within a rectangular bounded region “using the coordinate notation $K/2^N$ for the horizontal co-ordinates and $L/2^N$ for the vertical co-ordinates” according to preamble 1[pre][b]. Pet. 37 (emphases omitted). Petitioner explains that when $N=2$ and K and L are “positive integers” between zero and 2^N , i.e., between zero and four:

- (1) the “horizontal co-ordinates include: $0/4$ ($K=0$), $1/4$ ($K=1$), $2/4$ ($K=2$), $3/4$ ($K=3$), and $4/4$ ($K=4$)”; and
- (2) the “vertical co-ordinates include: $0/4$ ($L=0$), $1/4$ ($L=1$), $2/4$ ($L=2$), $3/4$ ($L=3$), and $4/4$ ($L=4$).”

Id. at 37–38 (emphases omitted).

As support, Petitioner provides the following figure showing horizontal co-ordinates between $0/4$ and $4/4$ and vertical co-ordinates between $0/4$ and $4/4$:



This figure shows a dashed red line around a rectangular bounded region defined by four corner unit pixels in purple having the following horizontal co-ordinates (first position) and vertical co-ordinates (second position):

- (0/4, 0/4) for the upper left corner unit pixel;
- (4/4, 0/4) for the upper right corner unit pixel;
- (0/4, 4/4) for the lower left corner unit pixel; and
- (4/4, 4/4) for the lower right corner unit pixel.

See Pet. 37. This figure also shows half sub-pixels in blue and quarter sub-pixels in green including their respective horizontal co-ordinates (first position) and vertical co-ordinates (second position). *See id.*

(iii) Patent Owner's Position

At this stage of the proceeding, Patent Owner makes no arguments specific to claim 1's preamble. *See, e.g.,* Prelim. Resp. 1, 38–65.

Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

(iv) Analysis

Generally, a preamble does not limit a claim. *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1346 (Fed. Cir. 2002). We need not decide whether claim 1's preamble limits the claim because, based on the current record and for the reasons stated by Petitioner and supported by Dr. Ramchandran's testimony, Petitioner establishes sufficiently that TML6 teaches claim 1's preamble. *See* Pet. 29–39; Ex. 1003 ¶¶ 133–149.

(b) Limitation 1[a]

Claim 1 recites as follows:

interpolate a sub-pixel value for a sub-pixel having co-ordinates with odd values of K and L, according to a predetermined choice of either a weighted average of the value of a nearest-neighbouring pixel and the value of the sub-pixel situated at co-ordinates $\frac{1}{2}$, $\frac{1}{2}$, or a weighted average of the values of a pair of diagonally-opposed sub-pixels having co-ordinates with even values of K and L, including zero, situated within a quadrant of the rectangular bounded region, the quadrant being defined by the sub-pixel having co-ordinates $\frac{1}{2}$, $\frac{1}{2}$ and the nearest neighbouring pixel.

Ex. 1001, 51:17–27 (limitation 1[a]).

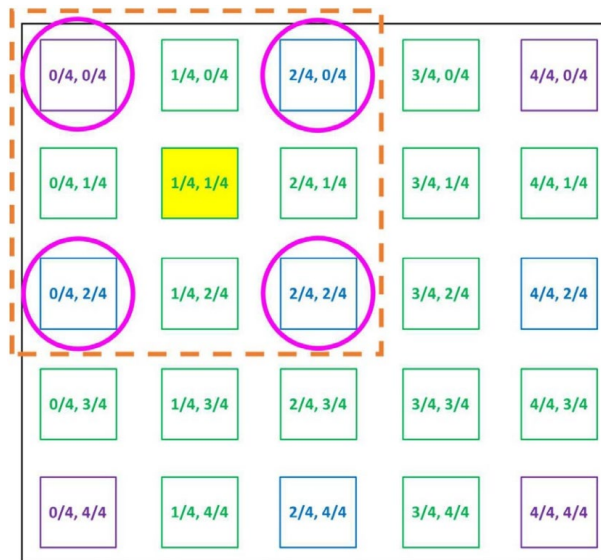
(i) Petitioner's Contentions

Petitioner contends that the combined disclosures in TML6 and Fandrianto teach limitation 1[a] for several related reasons. *See* Pet. 40–51. First, Petitioner asserts that the `onethpox()` function in TML6 interpolates the quarter sub-pixel at the co-ordinates (1/4, 1/4) using a weighted average of the four values for:

- the unit pixel at the co-ordinates (0/4, 0/4);
- the half sub-pixel at the co-ordinates (2/4, 0/4);
- the half sub-pixel at the co-ordinates (0/4, 2/4); and

- the half sub-pixel at the co-ordinates $(2/4, 2/4)$ corresponding to the co-ordinates $(1/2, 1/2)$.

Pet. 40. As support, Petitioner provides the following figure showing the unit pixel and the half sub-pixels used to interpolate the quarter sub-pixel at the co-ordinates $(1/4, 1/4)$:



This figure shows yellow highlighting over the quarter sub-pixel at the co-ordinates $(1/4, 1/4)$. *See id.* This figure also shows solid magenta circles around the unit pixel and the half sub-pixels used to interpolate the highlighted quarter sub-pixel at the co-ordinates $(1/4, 1/4)$. *See id.* This figure also shows a rectangular bounded region defined by four corner unit pixels in purple and a dashed orange square around a quadrant of the rectangular bounded region defined by the unit pixel at the co-ordinates $(0/4, 0/4)$ and the half sub-pixel at the co-ordinates $(2/4, 2/4)$ corresponding to the co-ordinates $(1/2, 1/2)$. *See id.*

Petitioner contends that the '273 patent confirms that "TML6 interpolates $(1/4, 1/4)$ sub-pixels using a weighted average of the

aforementioned unit pixel and three half sub-pixels.” Pet. 41 (citing Ex. 1001, 12:34–40, Fig. 13a; Ex. 1003 ¶ 153).

Second, Petitioner asserts that the `oneforthpix()` function in TML6 interpolates the quarter sub-pixel at the co-ordinates (1/4, 3/4) and the quarter sub-pixel at the co-ordinates (3/4, 1/4) “in the same manner” as the quarter sub-pixel at the co-ordinates (1/4, 1/4). Pet. 41–42.

Third, Petitioner asserts that Fandrianto teaches interpolating the quarter sub-pixel at the co-ordinates (1/4, 3/4) using a weighted average of either:

- (1) a pair of diagonally opposed half sub-pixels; or
- (2) the nearest-neighbouring pixel and the half sub-pixel at the co-ordinates (2/4, 2/4) corresponding to the co-ordinates (1/2, 1/2).

See Pet. 43–46.

To support its assertions about Fandrianto teaching interpolating the quarter sub-pixel at the co-ordinates (1/4, 3/4) using these weighted averages, Petitioner provides two annotated and highlighted excerpts from Fandrianto’s Figure 5 as reproduced below:

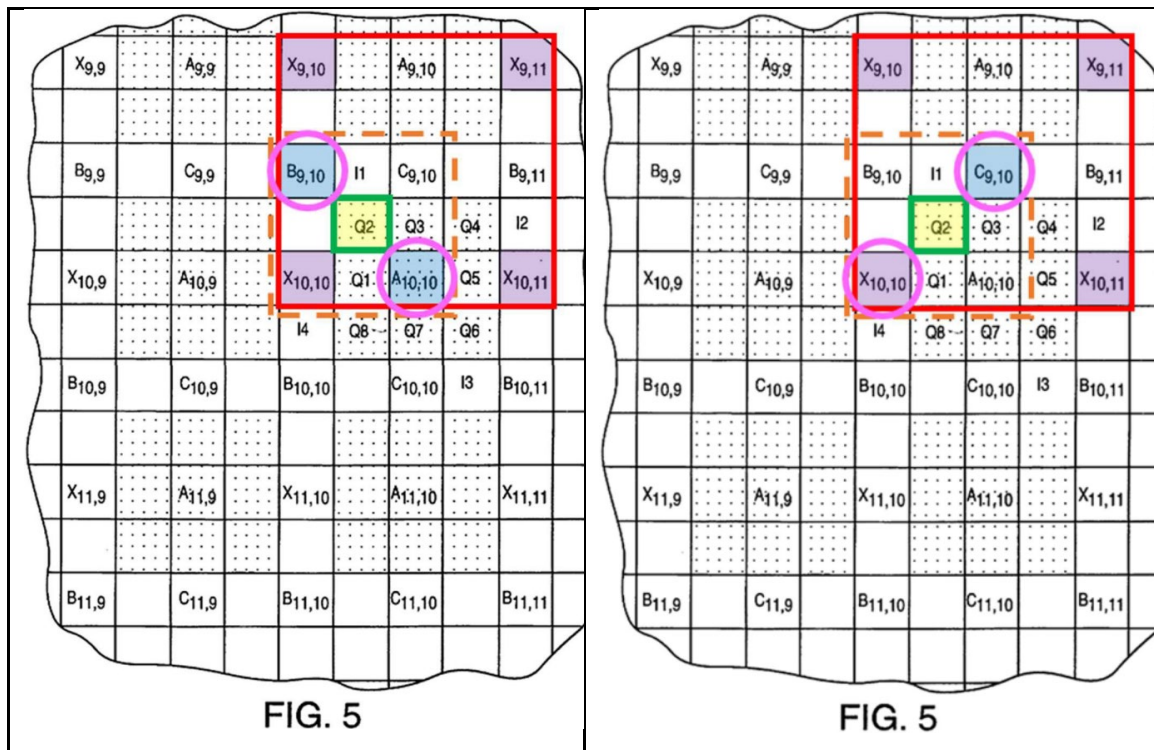


Figure 5 illustrates interpolated search matrix 400 including four interleaved matrices corresponding to full or unit pixels $X_{r,c}$, half sub-pixels $A_{r,c}$, half sub-pixels $B_{r,c}$, and half sub-pixels $C_{r,c}$, where “r” denotes the row number and “c” denotes the column number. *See* Ex. 1006, 2:55–58, 5:50–55, Fig. 5. Each of the above annotated and highlighted excerpts from Figure 5 includes:

- (1) purple highlighting over the unit pixels $X_{9,10}$, $X_{9,11}$, $X_{10,10}$, and $X_{10,11}$;
- (2) a solid red square around a rectangular bounded region defined by the unit pixels $X_{9,10}$, $X_{9,11}$, $X_{10,10}$, and $X_{10,11}$;
- (3) a dashed orange square around a quadrant of the rectangular bounded region defined by the unit pixel $X_{10,10}$ at the co-ordinates (0/4, 4/4) and the half sub-pixel $C_{9,10}$ at the co-ordinates (2/4, 2/4) corresponding to the co-ordinates (1/2, 1/2); and

- (4) a solid green square around the quarter sub-pixel Q2 at the co-ordinates (1/4, 3/4) and yellow highlighting over that quarter sub-pixel.

See Pet. 44–45.

Above on the left, the annotated and highlighted excerpt from Figure 5 also includes (1) a solid magenta circle around the half sub-pixel A_{10,10} at the co-ordinates (2/4, 4/4) and blue highlighting over that half sub-pixel and (2) a solid magenta circle around the half sub-pixel B_{9,10} at the co-ordinates (0/4, 2/4) and blue highlighting over that half sub-pixel. *See* Pet. 44. According to Petitioner, this excerpt depicts the quarter sub-pixel Q2 interpolated “using a weighted average of the pair of diagonally-opposed sub-pixels at co-ordinates (0/4, 2/4) (B_{9,10}) and (2/4, 4/4) (A_{10,10}) (both blue; circled).” *Id.* at 43.

Above on the right, the annotated and highlighted excerpt from Figure 5 also includes (1) a solid magenta circle around the half sub-pixel C_{9,10} at the co-ordinates (2/4, 2/4) corresponding to the co-ordinates (1/2, 1/2) and blue highlighting over that half sub-pixel and (2) a solid magenta circle around the unit pixel X_{10,10} at the co-ordinates (0/4, 4/4). *See* Pet. 45. According to Petitioner, this excerpt depicts the quarter sub-pixel Q2 interpolated “using a weighted average of the value of a nearest-neighbouring pixel—(0/4, 4/4) pixel X_{10,10} (purple; circled)—and the value of the sub-pixel C_{9,10} situated at coordinates (1/2, 1/2) (blue; circled).” *Id.* at 44–45.

Fourth, Petitioner asserts that an ordinarily skilled artisan would have been motivated to implement Fandrianto’s techniques for diagonally interpolating the quarter sub-pixel Q2 at the co-ordinates (1/4, 3/4) to interpolate the quarter sub-pixels at the co-ordinates (1/4, 1/4), (1/4, 3/4),

(3/4, 1/4), and/or (3/4, 3/4) in TML6. *See* Pet. 46–50. Petitioner asserts that Fandrianto “explicitly teaches a finite number of interpolation techniques for the (1/4, 1/4), (1/4, 3/4), (3/4, 1/4), and/or (3/4, 3/4) sub-pixels, including vertical interpolation and the two diagonal interpolations.” *Id.* at 50.

Petitioner also asserts that “it would have been obvious to try these finite options, including making a predetermined choice between either of the two diagonal interpolation options, to interpolate any of the (1/4, 1/4), (1/4, 3/4), (3/4, 1/4), and/or (3/4, 3/4) sub-pixels.” *Id.* at 50–51.

(ii) Patent Owner’s Contentions

Patent Owner disputes that the combined disclosures in TML6 and Fandrianto teach limitation 1[a]. *See* Prelim. Resp. 46–56, 60–61. In particular, Patent Owner contends that Fandrianto “does not disclose diagonal interpolating using two diagonally opposed pixel or sub-pixel values,” e.g., when interpolating the quarter sub-pixel Q2 at the co-ordinates (1/4, 3/4). *Id.* at 55; *see id.* at 48. Patent Owner contends that Fandrianto “discloses interpolation using quarter-pixel values where only one of the two sub-pixel values is located diagonally with respect to the quarter-quarter sub-pixel being interpolated.” *Id.* at 61 (emphasis omitted).

Additionally, Patent Owner contends that Fandrianto discloses interpolating the quarter sub-pixel Q2 value at the co-ordinates (1/4, 3/4) using the “vertically adjacent” quarter sub-pixel Q1 value at the co-ordinates (1/4, 4/4) and the “diagonally adjacent” half sub-pixel B_{9,10} value at the co-ordinates (0/4, 2/4). Prelim. Resp. 48–49, 55 (emphasis omitted).

To support its contentions, Patent Owner provides side-by-side annotated and highlighted excerpts from Fandrianto’s Figure 5 as reproduced below:

**Petitioner's Incorrect Interpretation
of Fandrianto**

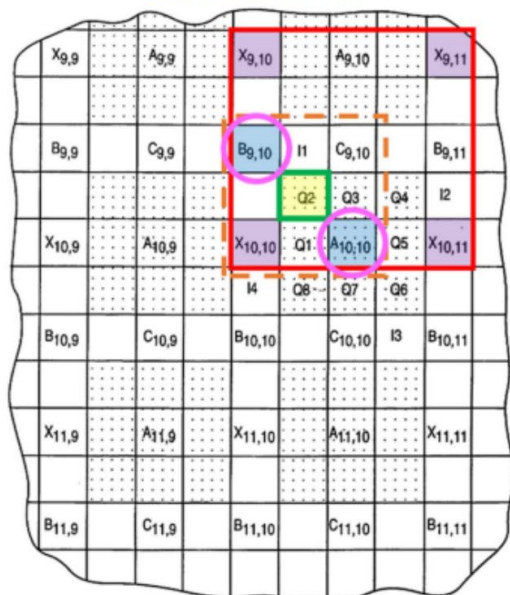


FIG. 5

Fandrianto's Interpolation of Q2

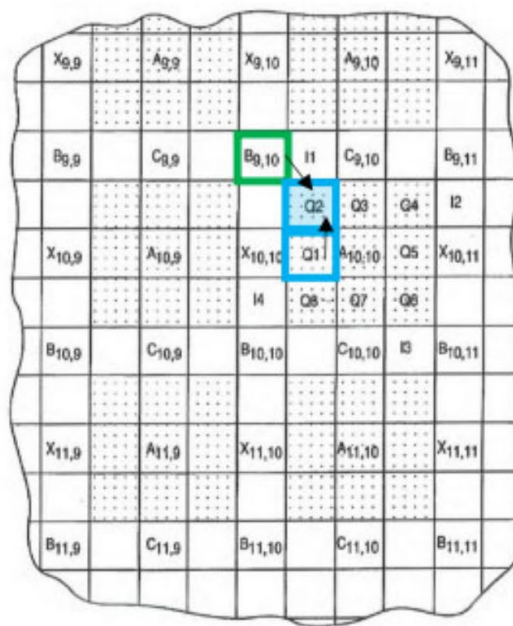


FIG. 5

Above on the left, the annotated and highlighted excerpt from Figure 5 includes (1) the annotation "Petitioner's Incorrect Interpretation of Fandrianto," (2) a solid green square around the quarter sub-pixel Q2 at the co-ordinates (1/4, 3/4) and yellow highlighting over that quarter sub-pixel, (3) a solid magenta circle around the half sub-pixel A_{10,10} at the co-ordinates (2/4, 4/4) and blue highlighting over that half sub-pixel, and (4) a solid magenta circle around the half sub-pixel B_{9,10} at the co-ordinates (0/4, 2/4) and blue highlighting over that half sub-pixel. *See* Prelim. Resp. 49, 55.

Above on the right, the annotated and highlighted excerpt from Figure 5 includes (1) the annotation "Fandrianto's Interpolation of Q2," (2) a solid blue square around the quarter sub-pixel Q2 at the co-ordinates (1/4, 3/4) and blue highlighting over that quarter sub-pixel, (3) a solid blue square around the quarter sub-pixel Q1 at the co-ordinates (1/4, 4/4), and (4) a solid

green square around the half sub-pixel $B_{9,10}$ at the co-ordinates $(0/4, 2/4)$.
See id.

Referring to the annotated and highlighted excerpt from Figure 5 above on the right, Patent Owner asserts that “the method of interpolating Q2 (highlighted in blue) with two adjacent sub-pixel values involves diagonally adjacent half-pixel $B_{9,10}$ (outlined in green) and vertically adjacent quarter-pixel Q1 (outlined in blue).” Prelim. Resp. 55 (emphasis omitted); *see id.* at 60–61. According to Patent Owner, “Q1 is vertically below Q2 and not diagonal to Q2.” *Id.* at 60.

Further, Patent Owner asserts that Petitioner misinterprets the following disclosure in Fandrianto about diagonal interpolation: “As a further example, Q2 pixels may be derived from a diagonal interpolation of the data in A block 72 and B block 74.” Prelim. Resp. 49 (quoting Ex. 1006, 10:56–58); *see id.* at 54. Patent Owner asserts that when interpolating quarter sub-pixel values, Fandrianto initially copies the $A_{r,c}$ values in A block 72 into D block 82 and then uses A block 72 to store $Q_{r,c}$ values for “the current quarter pixel interpolated block,” i.e., $Q_{1,r,c}$ through $Q_{8,r,c}$. *Id.* at 51–52 (quoting Ex. 1006, 8:34–36). Patent Owner also asserts that when Fandrianto interpolates the quarter sub-pixel Q2 value at the co-ordinates $(1/4, 3/4)$, A block 72 contains “the current quarter pixel interpolated block,” e.g., the quarter sub-pixel Q1 value at the co-ordinates $(1/4, 4/4)$, not the half sub-pixel $A_{10,10}$ value at the co-ordinates $(2/4, 4/4)$. *See id.* at 52–54, 56, 60.

Therefore, according to Patent Owner, Fandrianto’s disclosure that “the Q2 pixels may be derived from a diagonal interpolation of the data in the A block 72 and the B block 74” means that quarter sub-pixel Q1 values

stored in A block 72 are used with half sub-pixel B values stored in B block 74 to interpolate quarter sub-pixel Q2 values. *See* Prelim. Resp. 54–55 (emphasis omitted).

(iii) Analysis

Based on the current record, Petitioner establishes sufficiently that the combined disclosures in TML6 and Fandrianto teach limitation 1[a]. *See* Pet. 40–51; Ex. 1003 ¶¶ 150–163. As Petitioner asserts, the `oneforthpix()` function in TML6 interpolates the quarter sub-pixel at the co-ordinates (1/4, 1/4) using a weighted average of the four values for:

- the unit pixel at the co-ordinates (0/4, 0/4);
- the half sub-pixel at the co-ordinates (2/4, 0/4);
- the half sub-pixel at the co-ordinates (0/4, 2/4); and
- the half sub-pixel at the co-ordinates (2/4, 2/4) corresponding to the co-ordinates (1/2, 1/2).

See Ex. 1005, 58; Ex. 1003 ¶¶ 150–151; Pet. 40. As Petitioner also asserts, the `oneforthpix()` function in TML6 interpolates the quarter sub-pixel at the co-ordinates (1/4, 3/4) and the quarter sub-pixel at the co-ordinates (3/4, 1/4) “in the same manner” as the quarter sub-pixel at the co-ordinates (1/4, 1/4). *See* Ex. 1005, 58; Ex. 1003 ¶ 152; Pet. 41–42.

Fandrianto discloses various techniques for interpolating quarter sub-pixel values, e.g., “horizontal and vertical interpolation” and “diagonal interpolation.” *See* Ex. 1003 ¶¶ 117, 120, 122, 128, 158–161; Ex. 1006, 7:32–35, 7:46–55, 8:16–10:58. As an example, Fandrianto explains generally that when “interpolation is restricted to only horizontal and vertical interpolation, some of the quarter pixel estimation blocks are interpolated from one or more of the full and half pixel estimation search

blocks (X block 70, A block 72, B block 74, and C block 76), while other quarter pixel estimation search blocks are interpolated from quarter pixel estimation search blocks.” Ex. 1006, 7:46–52. As another example, Fandrianto explains generally that “when diagonal interpolation is also used, all quarter pixel estimation search blocks are interpolated from the full and half pixel estimation search blocks.” *Id.* at 7:52–55; *see* Ex. 1003 ¶ 117.

For the limited-memory motion-estimation architecture shown in Figure 2, Fandrianto discloses an illustrative method for interpolating quarter sub-pixel values for Q1 through Q8 around the half sub-pixel $A_{10,10}$ in Figure 5. Ex. 1006, 8:16–10:50, Fig. 5; *see* Ex. 1003 ¶¶ 113, 120, 155–156, 158. Among other things, Fandrianto provides specific equations for interpolating quarter sub-pixel values for $Q1_{r,c}$ through $Q8_{r,c}$ in that illustrative method. Ex. 1006, 8:37–10:50; *see* Ex. 1003 ¶¶ 117, 122, 160, 184, 193, 196, 202, 205.

Although Fandrianto provides specific equations for interpolating quarter sub-pixel values for $Q1_{r,c}$ through $Q8_{r,c}$, e.g., with $Q2_{r,c}$ values based on $Q1_{r,c}$ values and $Q4_{r,c}$ values based on $Q3_{r,c}$ values, Fandrianto expressly states that “other techniques may be used if desired.” Ex. 1006, 7:36–37; *see id.* at 8:20–21; Ex. 1003 ¶ 120.

Further, Fandrianto explains that “the order in which the quarter pixel estimation search blocks are generated and compared, and the selection of obsolete full and half pixel estimation search blocks to be overwritten are somewhat discretionary.” Ex. 1006, 8:16–20; *see* Ex. 1003 ¶¶ 155, 158. Fandrianto also explains that “a great many permutations of the order of derivation of pixels Q1–Q8 may be practiced, if desired.” Ex. 1006, 10:51–53; *see* Ex. 1003 ¶¶ 117, 122, 128, 155, 158, 161.

Then, Fandrianto discloses two exemplary “permutations” as follows:

For example, the Q2 pixels may be derived from a horizontal interpolation of the Q3 pixels with the results of a vertical interpolation of the data in the B block 74 and the X block 70. As a further example, the Q2 pixels may be derived from a diagonal interpolation of the data in the A block 72 and the B block 74.

Ex. 1006, 10:53–58.

When read in context, the disclosure about the Q2 pixels being “derived from a diagonal interpolation of the data in the A block 72 and the B block 74” does not mean that the A block 72 contains the $Q1_{r,c}$ values when interpolating the $Q2_{r,c}$ values, contrary to Patent Owner’s contentions. *See* Ex. 1006, 10:51–58; Prelim. Resp. 48–49, 52–56, 60–61. If the A block 72 contained the $Q1_{r,c}$ values when interpolating the $Q2_{r,c}$ values, that would constitute part of Fandrianto’s illustrative method for interpolating quarter sub-pixel values for Q1 through Q8 around the half sub-pixel $A_{10,10}$ in Figure 5, not a “permutation” of that illustrative method. *See* Ex. 1006, 8:37–9:32, 10:51–58.

Fandrianto’s general explanation that “when diagonal interpolation is also used, all quarter pixel estimation search blocks are interpolated from the full and half pixel estimation search blocks” provides additional context for the disclosure about the Q2 pixels being “derived from a diagonal interpolation of the data in the A block 72 and the B block 74.” *See* Ex. 1006, 7:52–55, 10:56–58. Based on the current record, Fandrianto’s general explanation indicates that the disclosure about the Q2 pixels being “derived from a diagonal interpolation of the data in the A block 72 and the B block 74” indicates that the $Q2_{r,c}$ values are “derived from a diagonal interpolation” of the $A_{r,c}$ values in the A block 72 and the $B_{r,c}$ values in the

B block 74. *See* Ex. 1003 ¶¶ 121, 159–160. This issue is better resolved at trial on a more developed record.

In any event, Fandrianto’s general explanation that “when diagonal interpolation is also used, all quarter pixel estimation search blocks are interpolated from the full and half pixel estimation search blocks” teaches that the value for quarter sub-pixel Q2 in Figure 5 may be obtained by interpolating the values for either (1) the half sub-pixel A_{10,10} and the half sub-pixel B_{9,10} or (2) the full pixel X_{10,10} and the half sub-pixel C_{9,10}. *See* Ex. 1003 ¶¶ 117, 160–161; Ex. 1006, 7:52–55.

Patent Owner’s argument rests on Fandrianto’s illustrative method for interpolating quarter sub-pixel values for Q1 through Q8 around the half sub-pixel A_{10,10} in Figure 5 and the specific order employed in that illustrative method, i.e., first obtain Q_{1,r,c} values, second obtain Q_{2,r,c} values, third obtain Q_{3,r,c} values, etc. *See, e.g.*, Prelim. Resp. 48–49, 52–56, 60–61. But Fandrianto expressly states that “other techniques may be used if desired.” Ex. 1006, 7:36–37; *see id.* at 8:20–21; Ex. 1003 ¶ 120. Further, Fandrianto explains that “the order in which the quarter pixel estimation search blocks are generated and compared, and the selection of obsolete full and half pixel estimation search blocks to be overwritten are somewhat discretionary.” Ex. 1006, 8:16–20; *see id.* at 7:32–35, 10:51–58; Ex. 1003 ¶¶ 155, 158.

Petitioner relies on one possible ordering out of several. *See* Pet. 43–46, 43 n.11. And a “prior art product that sometimes, but not always, embodies a claimed method nonetheless teaches that aspect of the invention.” *Hewlett-Packard Co. v. Mustek Sys., Inc.*, 340 F.3d 1314, 1326 (Fed. Cir. 2003).

Additionally, Patent Owner's contention that Fandrianto discloses interpolating the quarter sub-pixel Q2 value at the co-ordinates (1/4, 3/4) using the "vertically adjacent" quarter sub-pixel Q1 value at the co-ordinates (1/4, 4/4) and the "diagonally adjacent" half sub-pixel B_{9,10} value at the co-ordinates (0/4, 2/4) does not accurately reflect Fandrianto's description of the illustrative method for interpolating quarter sub-pixel values for Q1 through Q8 around the half sub-pixel A_{10,10} in Figure 5. *See* Prelim. Resp. 48–49, 55. Specifically, Fandrianto provides the following equations for interpolating quarter sub-pixel values for Q_{2,r,c}:

$$Q1_{r,c} = (X_{r,c} + A_{r,c})/2$$

$$Q2_{r,c} = (Q1_{r,c} + I1_{r,c})/2 = ((X_{r,c} + A_{r,c})/2 + (B_{r-1,c} + C_{r-1,c})/2)/2$$

Ex. 1006, 8:37–43 (equation 3), 8:58–9:3 (equations 4 and 5); *see* Ex. 1003 ¶¶ 117, 122, 160–161. Thus, the Q_{2,r,c} values are based on X_{r,c} values (e.g., X_{10,10}), A_{r,c} values (e.g., A_{10,10}), B_{r-1,c} values (e.g., B_{9,10}), and C_{r-1,c} values (e.g., C_{9,10}). *See* Ex. 1006, 8:37–43, 8:58–9:3.

(c) Limitation 1[b]

Claim 1 recites as follows:

interpolate sub-pixel values for sub-pixels having co-ordinates with K equal to an even value and L equal to zero and sub-pixels having co-ordinates with K equal to zero and L equal to an even value, used in the interpolation of the sub-pixels having co-ordinates with odd values of K and L, using weighted sums of the values of pixels located in rows and columns respectively.

Ex. 1001, 51:28–34 (limitation 1[b]).

Petitioner contends that TML6 teaches limitation 1[b] for two related reasons. *See* Pet. 51–58. First, Petitioner asserts that the `onethpox()` function in TML6 interpolates sub-pixel values for the half sub-pixel at the

co-ordinates $(2/4, 0/4)$ corresponding to the co-ordinates $(K/2^N, L/2^N)$ where $K=2$, $L=0$, and $N=2$ using a weighted sum of the values for the three unit pixels horizontally to the left of that half sub-pixel and the three unit pixels horizontally to the right of that half sub-pixel. *Id.* at 51–54, 58. According to Petitioner, the ONE_FOURTH_TAP data structure stores the weights for that weighted sum, and the mref data structure stores that weighted sum in a rounded form. *Id.* at 54.

Petitioner contends that the '273 patent confirms that TML6 interpolates sub-pixel values for the half sub-pixel at the co-ordinates $(2/4, 0/4)$ using a weighted sum of the values for the three unit pixels horizontally to the left of that half sub-pixel and the three unit pixels horizontally to the right of that half sub-pixel. Pet. 54–55 (citing Ex. 1001, 11:35–45, Fig. 13b; Ex. 1003 ¶ 166).

Second, Petitioner asserts that the oneforthpix() function in TML6 interpolates sub-pixel values for the half sub-pixel at the co-ordinates $(0/4, 2/4)$ corresponding to the co-ordinates $(K/2^N, L/2^N)$ where $K=0$, $L=2$, and $N=2$ using a weighted sum of the values for the three unit pixels vertically above that half sub-pixel and the three unit pixels vertically below that half sub-pixel. Pet. 51–52, 55–56, 58. According to Petitioner, the ONE_FOURTH_TAP data structure stores the weights for that weighted sum, and the mref data structure stores that weighted sum in a rounded form. *Id.* at 56.

Petitioner contends that the '273 patent confirms that TML6 interpolates sub-pixel values for the half sub-pixel at the co-ordinates $(0/4, 2/4)$ using a weighted sum of the values for the three unit pixels vertically above that half sub-pixel and the three unit pixels vertically below

that half sub-pixel. Pet. 57 (citing Ex. 1001, 11:46–63, Fig. 13c; Ex. 1003 ¶ 169).

At this stage of the proceeding, Patent Owner makes no arguments specific to limitation 1[b]. *See, e.g.*, Prelim. Resp. 1, 38–65.

Based on the current record and for the reasons stated by Petitioner and supported by Dr. Ramchandran’s testimony, Petitioner establishes sufficiently that TML6 teaches limitation 1[b]. *See* Pet. 51–58; Ex. 1003 ¶¶ 164–169.

(d) Limitation 1[c]

Claim 1 recites as follows:

interpolate sub-pixel values for sub-pixels having co-ordinates with even values of K and L, used in the interpolation of sub-pixel values for the sub-pixels having co-ordinates with odd values of K and L, using a predetermined choice of either a weighted sum of the values of sub-pixels having co-ordinates with K equal to an even value and L equal to zero and the values of sub-pixels having corresponding co-ordinates in immediately adjacent rectangular bounded regions, or a weighted sum of the values of sub-pixels having co-ordinates with K equal to zero and L equal to an even value and the values of sub-pixels having corresponding co-ordinates in immediately adjacent rectangular bounded regions.

Ex. 1001, 51:35–48 (limitation 1[c]).

Petitioner contends that the combined disclosures in TML6 and Fandrianto teach limitation 1[c] for several related reasons. *See* Pet. 58–65. First, Petitioner asserts that the `onethpox()` function in TML6 interpolates sub-pixel values for the half sub-pixel at the co-ordinates (2/4, 2/4) corresponding to the co-ordinates $(K/2^N, L/2^N)$ where $K=2$, $L=2$, and $N=2$ using a weighted sum of the values for the half sub-pixel at the co-ordinates (2/4, 0/4) and the half sub-pixel at the co-ordinates (2/4, 4/4) in the same

rectangular bounded region and in the two vertically adjacent rectangular bounded regions, i.e., a weighted sum of six values. *Id.* at 58–60.

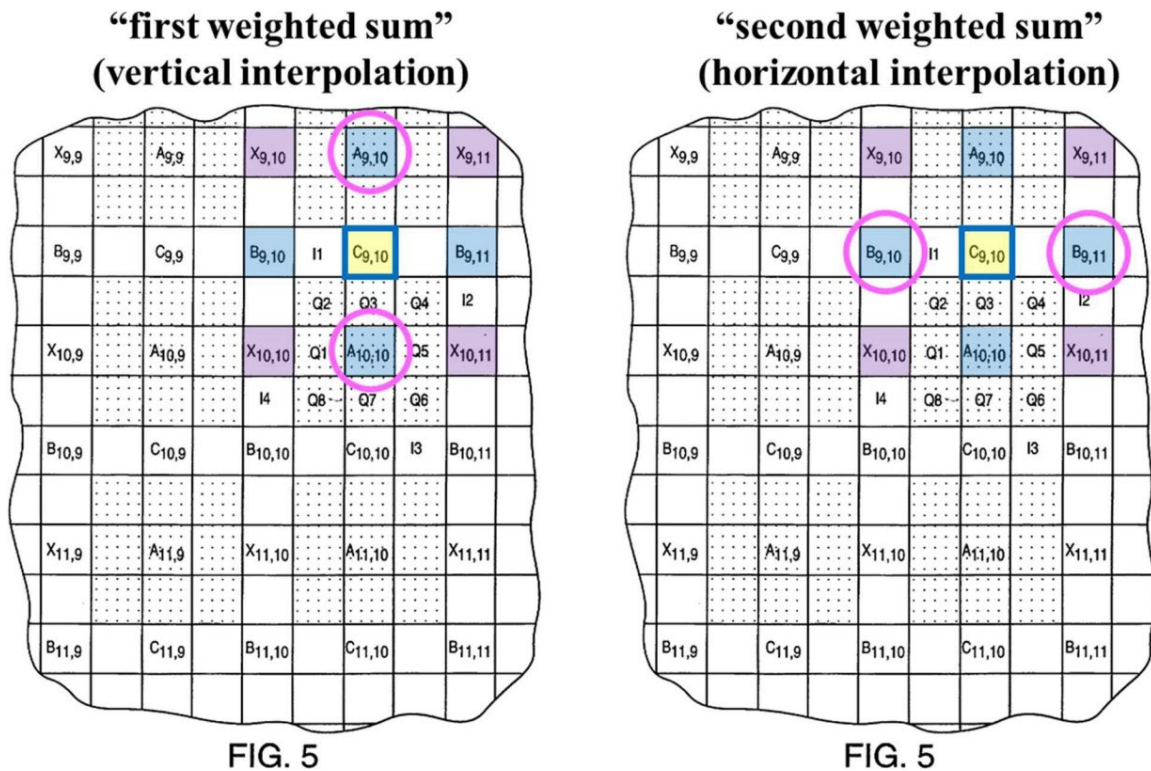
According to Petitioner, the mref data structure stores that weighted sum in a rounded form. *Id.* at 54.

Second, Petitioner asserts that Fandrianto discloses interpolating values for the half sub-pixel at the co-ordinates (2/4, 2/4) (e.g., half sub-pixel C_{9,10} in Figure 5) by either vertical interpolation or horizontal interpolation as follows:

- (1) averaging the values for the half sub-pixel at the co-ordinates (2/4, 0/4) (e.g., half sub-pixel A_{9,10} in Figure 5) and the half sub-pixel at the co-ordinates (2/4, 4/4) (e.g., half sub-pixel A_{10,10} in Figure 5), i.e., vertical interpolation; or
- (2) averaging the values for the half sub-pixel at the co-ordinates (0/4, 2/4) (e.g., half sub-pixel B_{9,10} in Figure 5) and the half sub-pixel at the co-ordinates (4/4, 2/4) (e.g., half sub-pixel B_{9,11} in Figure 5), i.e., horizontal interpolation.

Pet. 62.

To support its assertion, Petitioner provides side-by-side annotated and highlighted excerpts from Fandrianto's Figure 5 as reproduced below:



Above on the left, the annotated and highlighted excerpt from Figure 5 includes (1) the annotation “‘first weighted sum’ (vertical interpolation),” (2) a solid magenta circle around the half sub-pixel $A_{9,10}$ at the co-ordinates $(2/4, 0/4)$ and blue highlighting over that half sub-pixel, (3) a solid magenta circle around the half sub-pixel $A_{10,10}$ at the co-ordinates $(2/4, 4/4)$ and blue highlighting over that half sub-pixel, and (4) a solid blue square around the half sub-pixel $C_{9,10}$ at the co-ordinates $(2/4, 2/4)$ and yellow highlighting over that half sub-pixel. *See* Pet. 62. Above on the right, the annotated and highlighted excerpt from Figure 5 includes (1) the annotation “‘second weighted sum’ (horizontal interpolation),” (2) a solid magenta circle around the half sub-pixel $B_{9,10}$ at the co-ordinates $(0/4, 2/4)$ and blue highlighting over that half sub-pixel, (3) a solid magenta circle around the half sub-pixel $B_{9,11}$ at the co-ordinates $(4/4, 2/4)$ and blue highlighting over that half sub-pixel, and (4) a solid blue square around the half sub-pixel $C_{9,10}$ at the

co-ordinates (2/4, 2/4) and yellow highlighting over that half sub-pixel. *See id.*

Referencing the above side-by-side annotated and highlighted excerpts from Fandrianto's Figure 5, Petitioner asserts that:

Fandrianto interpolates the highlighted (2/4, 2/4) sub-pixel using either the "first weighted sum" of the values of sub-pixels having co-ordinates with K equal to an even value 2 and L equal to zero ("A block") or another weighted sum ("second weighted sum") of the values of sub-pixels having co-ordinates with K equal to zero and L equal to an even value ("B block"), with respective weights in each weighted sum equal to "1."

Pet. 62–63.

Third, Petitioner asserts that it would have been obvious based on Fandrianto's teachings to modify the oneforthpix() function in TML6 such that the oneforthpix() function interpolated sub-pixel values for the half sub-pixel at the co-ordinates (2/4, 2/4) using "a predetermined choice of either":

- (1) "the first weighted sum of TML6 (summing six sub-pixels having co-ordinates with K equal to an even value (2) and L equal to zero)"; or
- (2) "the second weighted sum of TML6 as modified by Fandrianto (also summing six sub-pixels, but horizontally like Fandrianto with sub-pixels having co-ordinates with K equal to zero and L equal to an even value (2))."

Pet. 63–64.

At this stage of the proceeding, Patent Owner makes no arguments specific to limitation 1[c]. *See, e.g.*, Prelim. Resp. 1, 38–65. As explained below, however, Patent Owner disputes that an ordinarily skilled artisan would have been motivated to combine Fandrianto's teachings with TML6's teachings. *See infra* Section V.D.4(e)(ii).

Based on the current record and for the reasons stated by Petitioner and supported by Dr. Ramchandran's testimony, Petitioner establishes sufficiently that the combined disclosures in TML6 and Fandrianto teach limitation 1[c]. *See* Pet. 58–65; Ex. 1003 ¶¶ 170–175. As explained below, based on the current record, Petitioner provides a sufficient reason with rational underpinning as to why an ordinarily skilled artisan would have been motivated to combine Fandrianto's teachings with TML6's teachings in the way Petitioner proposes. *See infra* Section V.D.4(e)(iii).

(e) Alleged Reasons to Combine the Teachings of the References

(i) Petitioner's Position

Petitioner identifies reasons that would have prompted an ordinarily skilled artisan to combine Fandrianto's teachings with TML6's teachings in the way Petitioner proposes, e.g., to improve “prediction accuracy” and increase speed. *See* Pet. 21–29, 50–51, 63–64. Further, Petitioner asserts that an ordinarily skilled artisan would have had “a reasonable expectation of success” in combining the teachings of the references. *Id.* at 26; *see id.* at 24, 28, 51, 64. Dr. Ramchandran's testimony supports Petitioner's position. *See* Ex. 1003 ¶¶ 119–132, 163, 174.

For instance, Dr. Ramchandran testifies that an ordinarily skilled artisan “would have been motivated to combine the teachings of TML6 (disclosing an encoder and decoder with $\frac{1}{2}$ and $\frac{1}{4}$ sub-pixel interpolation for motion prediction) and Fandrianto (disclosing a method of interpolating the $\frac{1}{4}$ sub-pixels residing at quarter unit horizontal and quarter unit vertical locations)” by “implementing Fandrianto's method for interpolating the $\frac{1}{4}$ sub-pixels residing at quarter unit horizontal and quarter unit vertical locations in the TML6 code.” Ex. 1003 ¶ 119; *see id.* ¶ 132.

Dr. Ramchandran explains that an ordinarily skilled artisan “would have been motivated to use Fandrianto’s $\frac{1}{4}$ sub-pixel interpolation technique in TML6 to take advantage of the optimized and versatile software and hardware architecture for such an interpolation that Fandrianto discloses.” *Id.* ¶ 120 (citing Ex. 1006, 2:4–7, 3:55–4:6, 5:26–32, 7:26–37, 7:52–55, Fig. 2); *see id.* ¶ 132. According to Dr. Ramchandran, combining Fandrianto’s teachings with TML6’s teachings would have improved “prediction accuracy.” *Id.* ¶ 119.

Dr. Ramchandran also testifies that “using Fandrianto’s method of interpolating the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations” with “the encoder and decoder of TML6 is a simple substitution of one known element (i.e., Fandrianto’s $\frac{1}{4}$ sub-pixel interpolation scheme) for another known element (i.e., TML6’s $\frac{1}{4}$ sub-pixel interpolation scheme) to obtain a predictable result (i.e., interpolation [of] $\frac{1}{4}$ sub-pixels).” Ex. 1003 ¶ 121 (emphases omitted). According to Dr. Ramchandran, that “simple substitution” would have produced “the predictable results of interpolating the value of sub-pixels residing at $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations,” including “freeing up memory” and “speeding the compression.” *Id.* ¶¶ 123, 132.

Dr. Ramchandran also testifies that “it would have been obvious to try Fandrianto’s method to interpolate the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations in TML6.” Ex. 1003 ¶ 124; *see id.* ¶¶ 126, 163, 174. Dr. Ramchandran explains that “interpolation is based on the well-known concept that values for sub-pixels at fractional locations are typically similar to values of the nearby pixels and sub-pixels (rather than

pixels and sub-pixels located far away from the sub-pixel that is being interpolated).” *Id.* ¶ 124.

Regarding the “obvious to try” rationale, Dr. Ramchandran testifies that an ordinarily skilled artisan “would have recognized that there are a finite number of pixels and sub-pixels” near a sub-pixel at the $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical location and “available to reasonably use in the interpolation to produce accurate interpolation results.” Ex. 1003 ¶ 125; *see id.* ¶¶ 124, 126, 163, 174. More particularly, Dr. Ramchandran explains that “there are only seven sub-pixels and one unit pixel immediately surrounding” a sub-pixel at the $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical location. *Id.* ¶ 125. Dr. Ramchandran testifies that an ordinarily skilled artisan would have “first look[ed] to these closest sub-pixels, as in TML6 and Fandrianto, to develop an interpolation scheme for the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations.” *Id.* (emphasis omitted).

Therefore, according to Dr. Ramchandran, it would have been “obvious to try” a “well-known one of these finite options—i.e., Fandrianto’s interpolation method for such sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations—for use in the encoder and/or decoder of TML6 as an alternative to the method used by TML6 to interpolate this sub-pixel.” Ex. 1003 ¶ 126 (emphasis omitted).

Dr. Ramchandran further testifies that an ordinarily skilled artisan “would have understood that the alternative methods of interpolating the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations is a design choice between finite options with well-understood tradeoffs—i.e., improved accuracy and computational efficiency.” Ex. 1003 ¶ 127 (emphasis omitted). Dr. Ramchandran explains that “TML6’s interpolation

method is arguably more accurate because it takes into account more of the pixels or sub-pixels immediately surrounding the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations being interpolated, but it is also more computationally complex because it relies on four values for the average rather than two.” *Id.* ¶ 128. Dr. Ramchandran also explains that “Fandrianto’s interpolation method may, in some instances, be less accurate because it does not use as many pixels or sub-pixels to interpolate the $\frac{1}{4}$ sub-pixel, but it also has the advantage of being less computationally intensive because it only relies on two values for the average rather than four.” *Id.*

As support, Dr. Ramchandran quotes Fandrianto’s disclosure that “[v]arious interpolation techniques may be used in the derivation of a given quarter pixel estimation block, depending on various factors such as the amount of memory available and the size of the memory ports and data buses.” Ex. 1003 ¶ 128 (quoting Ex. 1006, 7:32–35). As further support, Dr. Ramchandran quotes Fandrianto’s disclosure about using alternative techniques for interpolating quarter sub-pixel values as follows:

It will be appreciated that a great many permutations of the order of derivation of pixels [$\frac{1}{4}$ sub-pixels] Q1–Q8 may be practiced, if desired. For example, the Q2 pixels may be derived from a horizontal interpolation of the Q3 pixels with the results of a vertical interpolation of the data in the B block 74 and the X block 70. As a further example, the Q2 pixels may be derived from a diagonal interpolation of the data in the A block 72 and the B block 74.

Id. (alteration by Dr. Ramchandran) (quoting Ex. 1006, 10:51–58).

Therefore, according to Dr. Ramchandran, an ordinarily skilled artisan “would have been motivated to use the interpolation method of Fandrianto

for the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations as a design choice in balancing considerations of accuracy and computational efficiency.” Ex. 1003 ¶ 128.

(ii) Patent Owner’s Position

Patent Owner disputes that an ordinarily skilled artisan would have been motivated to combine Fandrianto’s teachings with TML6’s teachings. *See* Prelim. Resp. 41–46. Specifically, Patent Owner asserts that TML6 and Fandrianto both “relate to video” but “the similarities do not go far beyond that.” *Id.* at 42. Patent Owner explains that:

- (1) “TML6 is source code for a complete video coder implementation,” i.e., “a software implementation”;
- (2) the “the numerous different implementors [of TML6] would not typically consider any particular hardware configuration”;
- (3) Fandrianto (a) “relates to a specific implementation in which hardware resources, especially memory, are limited,” (b) is “not applicable across a range of different possible hardware implementations,” and (c) “would not be needed in situations where memory restrictions did not exist”; and
- (4) by the time the claimed invention was developed, “the hardware described in Fandrianto was obsolete.”

Prelim. Resp. 42 & n.6, 43 & n.7.

Patent Owner contends that Fandrianto’s disclosure about using “[v]arious interpolation techniques” to derive “a given quarter pixel estimation block” means that “Fandrianto’s architecture can be programmed to perform operations other than the ones described if the architecture’s memory will accommodate the operation.” Prelim. Resp. 43–44 (quoting Ex. 1006, 7:33–35). According to Patent Owner, that disclosure “provides

no express motivation to try alternative techniques.” *Id.* at 44. Patent Owner contends that an ordinarily skilled artisan would not have been motivated to “develop new video interpolation methods simply because Fandrianto’s architecture was programmable.” *Id.*

Further, Patent Owner asserts that “[p]erforming multiple (even if finite) distinct procedures to calculate a result for the same sub-pixel location is either wasteful (if the results are, by design, the same) or would require more steps in the interpolation process to determine the correct value, wasting storage or bandwidth capacity.” Prelim. Resp. 45. According to Patent Owner, an ordinarily skilled artisan would have been motivated to “avoid either calculating the same result more than once or creating an interpolation scheme where the same motion vector leads to different results depending on the calculation method, thus giving purpose to performing the various procedures.” *Id.*

Additionally, Patent Owner contends that the proposed TML6-Fandrianto combination would not involve a “simple substitution.” Prelim. Resp. 45. Patent Owner contends that (1) “Fandrianto manipulates the retrieved data using a funnel shifter that shifts the pixel group row by an integer number of pixel values ranging from 0 to 7” and (2) “any operation that mandates more than a single step of the ALU requires an intermediate block to be created, stored, and used as an input for a later step.” *Id.* at 45–46. Patent Owner contends that TML6:

is a software code with bit depths between 8 and 20 bits based on the stage of interpolation, requires multiplication, division, by numbers other than 2, interpolation with inputs from outside of a 2x2 block of pixels, and capacity to store both a 4N x 4M array of 8-bit pixels and a 2N x 2M array of 18-bit intermediate values for each N x M reference frame.

Id. at 46.

In Patent Owner’s view, “It is hard to imagine two supposedly similar disclosures that would be more challenging to combine or interchange.”

Prelim. Resp. 46.

(iii) Analysis

Based on the current record, Petitioner establishes sufficiently that an ordinarily skilled artisan would have had a reason to combine Fandrianto’s teachings with TML6’s teachings in the way Petitioner proposes, e.g., to improve “prediction accuracy” and increase speed. *See* Pet. 21–29, 50–51, 63–64; Ex. 1003 ¶¶ 119–128, 132, 163, 174. Further, based on the current record, Petitioner establishes sufficiently that an ordinarily skilled artisan would have had a reasonable expectation of success in combining the teachings of the references. *See* Pet. 24, 26, 28, 51, 64; Ex. 1003 ¶¶ 129–132, 163, 174.

As Dr. Ramchandran testifies, an ordinarily skilled artisan “would have been motivated to use the interpolation method of Fandrianto for the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations as a design choice in balancing considerations of accuracy and computational efficiency.” Ex. 1003 ¶ 128. An ordinarily skilled artisan “would have understood that the alternative methods of interpolating the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations is a design choice between finite options with well-understood tradeoffs—i.e., improved accuracy and computational efficiency.” *Id.* ¶ 127 (emphasis omitted).

Thus, the accuracy of TML6’s four-value interpolation may sometimes be worth the computational expense, but Fandrianto’s two-value interpolation may be needed in resource-limited applications when

computational efficiency is paramount. *See* Ex. 1003 ¶ 128. So, even if Fandrianto’s teachings apply to only resource-limited systems, Petitioner has sufficiently shown that a person of ordinary skill in the art seeking to modify TML6’s source code for at least that case would have looked to Fandrianto’s teachings. *See* Pet. 23; Ex. 1003 ¶¶ 127–128.

Further, as Dr. Ramchandran also testifies, “it would have been obvious to try Fandrianto’s method to interpolate the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations in TML6.” Ex. 1003 ¶ 124; *see id.* ¶¶ 126, 163, 174. An ordinarily skilled artisan “would have recognized that there are a finite number of pixels and sub-pixels” near a sub-pixel at the $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical location and “available to reasonably use in the interpolation to produce accurate interpolation results.” *Id.* ¶ 125. An ordinarily skilled artisan would have “first look[ed] to these closest sub-pixels, as in TML6 and Fandrianto, to develop an interpolation scheme for the sub-pixels” at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations.” *Id.* (emphasis omitted).

Patent Owner’s assertion that “[p]erforming multiple (even if finite) distinct procedures to calculate a result for the same sub-pixel location” mischaracterizes Petitioner’s position. *See* Pet. 25–29; Prelim. Resp. 45. For the sub-pixels at the “ $\frac{1}{4}$ unit horizontal and $\frac{1}{4}$ unit vertical locations,” Petitioner proposes using Fandrianto’s two-value interpolation as an alternative to TML6’s four-value interpolation in some situations, not using both procedures to calculate a result for the same sub-pixel location. *See* Pet. 25–29.

Regarding the “simple substitution” rationale, Patent Owner’s contentions concerning different bit depths in TML6 and Fandrianto raise

factual issues that are best resolved on a fully developed record. *See* Prelim. Resp. 45–46. Based on the current record, however, we see little reason to believe that incorporating Fandrianto’s interpolation scheme into TML6 in the way that Petitioner proposes would exceed the capabilities of an ordinarily skilled artisan, who is someone with “ordinary creativity” and “not an automaton.” *See KSR*, 550 U.S. at 421.

For the reasons discussed above, based on the current record, Petitioner provides a sufficient reason with rational underpinning as to why an ordinarily skilled artisan would have been motivated to combine Fandrianto’s teachings with TML6’s teachings in the way Petitioner proposes and would have had a reasonable expectation of success. *See* Pet. 21–29, 50–51, 63–64; Ex. 1003 ¶¶ 119–132, 163, 174.

(f) Preliminary Conclusion About Obviousness/Nonobviousness

As discussed above, Petitioner’s analysis sufficiently addresses how the combined disclosures in TML6 and Fandrianto teach claim 1’s subject matter. *See supra* Sections V.D.4(a)–(d). Additionally, Petitioner provides a sufficient reason with rational underpinning as to why an ordinarily skilled artisan would have been motivated to combine Fandrianto’s teachings with TML6’s teachings in the way Petitioner proposes and would have had a reasonable expectation of success. *See supra* Section V.D.4(e)(iii). Hence, Petitioner demonstrates a reasonable likelihood of proving that claim 1 is unpatentable under § 103(a) because the claim would have been obvious over TML6 and Fandrianto.

5. INDEPENDENT CLAIMS 31, 33, 64, 68, 71, 73, 75, 76,
82, AND 83 AND DEPENDENT CLAIMS 4–17, 19–26, 28, 29,
36–49, 51, 53–59, 61, 62, 65–67, 69, 70, 72, 74, 77, AND 78

For independent claims 31, 33, 64, 68, 71, 73, 75, 76, 82, and 83 and dependent claims 4–17, 19–26, 28, 29, 36–49, 51, 53–59, 61, 62, 65–67, 69, 70, 72, 74, 77, and 78, Petitioner provides an analysis supported by Dr. Ramchandran’s testimony about how the combined disclosures in TML6 and Fandrianto teach the claimed subject matter, including the preambles in the respective independent claims. *See* Pet. 65–120; Ex. 1003 ¶¶ 176–329.

For example, the preambles in independent claims 33, 64, 68, 71, 73, 75, 76, and 83 recite an “interpolator” or an apparatus comprising an “interpolator.” Ex. 1001, 56:8, 60:12, 61:40, 62:66, 63:46, 64:26, 65:4, 67:9. Petitioner identifies an “interpolator” in TML6, i.e., the `encode_one_frame()` function that encodes one frame of video data and invokes the following functions for interpolating sub-pixel values for a given video frame: `oneforthpix()` and `oneforthpix_2()`. Pet. 112 (citing Ex. 1003 ¶¶ 47–108, 134; Ex. 1005, 48–50 (lines 33–162), 57–60 (lines 538–719)). Further, Petitioner asserts that Fandrianto’s motion-estimation architecture 100 includes the functionality of an “interpolator.” *Id.* (citing Ex. 1003 ¶ 253; Ex. 1006, 3:55–4:6, 4:38–42, 4:56–64, 6:26–32, 6:61–65, 9:4–32, Fig. 2); *see id.* at 118.

For independent claims 31, 33, 64, 68, 71, 73, 75, 76, 82, and 83, Patent Owner makes essentially the same patentability arguments regarding TML6 and Fandrianto as for claim 1. *See* Prelim. Resp. 56–65. For dependent claims 4–17, 19–26, 28, 29, 36–49, 51, 53–59, 61, 62, 65–67, 69, 70, 72, 74, 77, and 78, Patent Owner urges patentability for the reasons stated for the respective independent claims. *See id.* at 62–64.

Based on the current record and for the reasons discussed above, we consider Patent Owner’s patentability arguments for claim 1 unavailing. *See supra* Sections V.D.4(b)(iii), V.D.4(e)(iii). Based on the current record and for (1) the reasons stated by Petitioner and supported by Dr. Ramchandran’s testimony and (2) the reasons discussed above for claim 1, Petitioner establishes sufficiently that the combined disclosures in TML6 and Fandrianto teach the subject matter in claims 4–17, 19–26, 28, 29, 31, 33, 36–49, 51, 53–59, 61, 62, 64–78, 82, and 83, including the preambles in the respective independent claims. *See* Pet. 65–120; Ex. 1003 ¶¶ 176–329; *supra* Sections V.D.4(a)–(d). Additionally, Petitioner provides a sufficient reason with rational underpinning as to why an ordinarily skilled artisan would have been motivated to combine Fandrianto’s teachings with TML6’s teachings in the way Petitioner proposes and would have had a reasonable expectation of success. *See supra* Section V.D.4(e)(iii). Hence, Petitioner demonstrates a reasonable likelihood of proving that these claims are unpatentable under § 103(a) because they would have been obvious over TML6 and Fandrianto.

E. Alleged Obviousness over TML6, Fandrianto, and an Ordinarily Skilled Artisan’s Knowledge: Claims 32, 52, and 79–81

Independent claim 32 recites a “method for eighth resolution sub-pixel value interpolation.” Ex. 1001, 55:34–56:7. Claim 52 depends directly from independent claim 33 and specifies that “N is set equal to 3,” and thus requires eighth resolution sub-pixel value interpolation. *Id.* at 58:59–60; *see id.* at 56:8–51 (claim 33). Independent claim 79 recites an “interpolator for eighth resolution sub-pixel value interpolation.” *Id.*

at 65:50–66:24. Claims 80 and 81 depend directly or indirectly from claim 79. *Id.* at 66:25–28.

Petitioner contends that claims 32, 52, and 79–81 are unpatentable under § 103(a) because the claims would have been obvious over TML6, Fandrianto, and an ordinarily skilled artisan’s knowledge. *See* Pet. 1–2, 120–23. Specifically, Petitioner asserts that “sub-pixel interpolation was a well-known technique for enhancing the resolution of digital images.” *Id.* at 120. Petitioner also asserts that an ordinarily skilled artisan would have:

- (1) known that “eighth resolution sub-pixel accuracy offered a desirable balance between improved image quality and manageable computational complexity”;
- (2) recognized that setting *N* equal to 3 instead of *N* equal to 2 as in TML6 “would achieve eighth pixel resolution in the TML6-Fandrianto system”; and
- (3) recognized that setting *N* equal to 3 instead of *N* equal to 2 as in TML6 was “the use of a known technique (higher-order interpolation) to improve similar devices (digital video systems) in the same way (increasing resolution and smoothness using sub-pixel interpolation).”

Id. at 120–21 (citing Ex. 1003 ¶¶ 330, 332–333, 337; Ex. 1023, 1, 14).

As support, Petitioner cites a July 2001 VCEG report that discusses “1/8 pixel accuracy prediction using 8-tap filters” to obtain “a higher complexity or higher coding efficiency profile.” Pet. 120 (citing Ex. 1023, 1, 14); *see* Ex. 1023, 14.

Further, Petitioner asserts that modifying the TML6-Fandrianto system to “achieve eighth pixel resolution would have been the application of a known technique (1/8 interpolation) to a known device (video encoder/

decoder) ready for improvement to yield predictable results (video coding system with improved video fidelity).” Pet. 121.

Patent Owner contends that Petitioner’s arguments fail for two reasons. *See* Prelim. Resp. 65. First, Patent Owner asserts that Petitioner’s arguments for independent claims 32 and 79 rest on Petitioner’s arguments for independent claims 1, 31, and 33 and the arguments for those independent claims fail for the reasons discussed for the challenge based on TML6 and Fandrianto. *Id.* Second, Patent Owner asserts that Petitioner’s arguments for dependent claims 52, 80, and 81 fail for the reasons discussed for the respective independent claims. *Id.*

Based on the current record and for the reasons discussed above, we consider Patent Owner’s patentability arguments for independent claims 1, 31, and 33 unavailing. *See supra* Sections V.D.4(b)(iii), V.D.4(e)(iii), V.D.5. Based on the current record and for (1) the reasons stated by Petitioner and supported by Dr. Ramchandran’s testimony and (2) the reasons discussed above for independent claims 1, 31, and 33, Petitioner establishes sufficiently that claims 32, 52, and 79–81 are unpatentable under § 103(a) because the claims would have been obvious over TML6, Fandrianto, and an ordinarily skilled artisan’s knowledge. *See* Pet. 120–23; Ex. 1003 ¶¶ 330–341; *supra* Section V.D.4(a)–(e), V.D.5.

VI. CONCLUSION

Based on the arguments and evidence presented by the parties, we determine that there is a reasonable likelihood Petitioner would prevail with respect to at least one claim challenged in the Petition. Hence, we institute an *inter partes* review of all challenged claims on all challenges included in the Petition. *See SAS Inst. Inc. v. Iancu*, 584 U.S. 357, 364–65 (2018)

(noting that the language of 35 U.S.C. § 314(b) “indicates a binary choice—either institute review or don’t”); *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (interpreting the statute as requiring “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”); 37 C.F.R. § 42.108(a). Additionally, we decline to exercise our discretion under § 314(a) and § 325(d) to deny institution.

At this preliminary stage, we have not made a final determination about the patentability of any challenged claim, the construction of any claim term, phrase, or limitation, or any other legal or factual issue.

VII. ORDER

Accordingly, it is

ORDERED that, according to 35 U.S.C. § 314(a), an *inter partes* review of claims 1, 4–17, 19–26, 28, 29, 31–33, 36–49, 51–59, 61, 62, and 64–83 in the ’273 patent is instituted on all challenges included in the Petition; and

FURTHER ORDERED that, according to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial that commences on the entry date of this decision.

IPR2024-01141
Patent 8,036,273 B2

For PETITIONER:

Jessica C. Kaiser
Robin L. Brewer
Jonathan R. Carter
PERKINS COIE LLP
kaiser-ptab@perkinscoie.com
brewer-ptab@perkinscoie.com
carter-ptab@perkinscoie.com
Amazon-NokiaIPR@perkinscoie.com

For PATENT OWNER:

Scott W. Hejny
Eric S. Hansen
McKOOL SMITH P.C.
shejny@mckoolsmith.com
ehansen@mckoolsmith.com