

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner

v.

INTERDIGITAL, INC.,
Patent Owner.

IPR2024-01441

U.S. Patent No. 9,674,556

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,674,556**

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1001	U.S. Patent No. 9,674,556 (“’556 Patent”)
1002	File History of the ’556 patent
1003	Declaration of Dr. Clifford Reader in Support of Petition
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1005	File History of U.S. Pat. App. No. 12/312,386, filed as PCT/US2007/022795 (“’386 Application”)
1006	U.S. Patent Appl. Publ. No. 2003/0219073 (“Lee”)
1007	U.S. Patent Appl. Publ. No. 2006/0110062 (“Chiang”)
1008	U.S. Patent Appl. Publ. No. 2003/0152146 (“Lin”)
1009	SMPTE Standard: VC-1 Compressed Video Bitstream Format and Decoding Process, SMPTE 421M-2006 (“VC1 Standard”)
1010	Onur G. Guleryuz, A Nonlinear Loop Filter for Quantization Noise Removal in Hybrid Video Compression, IEEE Int’l Conference on Image Processing (“Guleryuz”)
1011	U.S. Patent No. 8,194,757 to Schoner
1012	U.S. Patent No. 6,360,024 to Tan
1013	U.S. Patent No. 1,1796,030 to Kell
1014	Li X, Orchard M T, Spatially adaptive image denoising under overcomplete expansion, Proc. ICIP, Vol. 3, Sep. 2000
1015	ISO/IEC/JTC1/SC2/WG8 Moving Picture Expert Group, MPEG 89/254, Adaptive filter in the coding loop, Jan. 1990
1016	CCITT SGXV Working Party VX/1 Specialists Group on Coding for Visual Telephony, #356, Loop Filter Improvement, Sep. 19, 1988
1017	Declaration of J. Munford
1018	Bojnordi, Mahdi Nazm et al., A Fast Two Dimensional Deblocking Filter For H.264/AVC Video Coding, May 2006

Exhibit	Reference
1019	Printout of https://ieeexplore.ieee.org/abstract/document/1530059#citations , last visited Feb. 13, 2024
1020	Printout of https://ieeexplore.ieee.org/document/4054818 , last visited Feb. 13, 2024
1021	U.S. Patent Appl. Publ. No. 2007/0286290
1022	Warrington, Stephen, High Throughput Architecture for Variable Block Size Motion Estimation, Queen's University, Kingston, Ontario, Canada, Sep. 2006
1023	Excerpts from SMPTE Motion Imaging Journal, May/June 2006, www.smpte.org
1024	'556 Patent Infringement Contention Claim Chart, Exhibit 18 to InterDigital's First Suppl. Responses to Respondents' First Set of Interrogatories in ITC-337-TA-1373
1025	Commission Investigative Staff's <i>Markman</i> Brief, ITC-337-TA-1373
1026	U.S. Patent No. 7,388,999 to Samadani
1027	ISO/IEC/JTC1/SG2/WG8 Moving Picture Expert Group MPEG 89/248
1028	CLIFFORD READER, INTRAFRAME AND INTERFRAME ADAPTIVE TRANSFORM CODING
1029	CLIFF READER, MPEG4: CODING FOR CONTENT, INTERACTIVITY, AND UNIVERSAL ACCESSIBILITY, Jan. 1996
1030	CLIFF READER, MPEG PATENTS, MPEG VIDEO COMPRESSION STANDARD
1031	'556 Patent Infringement Contention Claim Chart, Exhibit 5 to InterDigital's Infringement Contentions in <i>InterDigital et al. v. Lenovo Group Ltd. et al.</i> , no. 5:23-cv-00493-FL (E.D.N.C.)
1032	Respondents' <i>Markman</i> Brief, ITC-337-TA-1373
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LISTING OF CHALLENGED CLAIMS

Reference	Claim Limitation
Claim 1	
1[pre]	A method comprising:
1[a1]	decoding an image region, wherein the decoding includes performing in-loop filtering to reduce at least a first and a second type of coding artifact using at least two filters in succession,
1[a2]	the at least two filters including a deblocking filter for performing a first pass to reduce blocking artifacts and an adaptive sparse de-noising filter for performing a second pass to reduce noise,
1[a3]	wherein the adaptive sparse de-noising filter is selectively enabled or disabled at a given level, the given level being at least a macroblock level, a slice level, a picture level or a sequence level.
Claim 2	
2	The method of claim 1, wherein at least one of the at least two filters is used to enforce at least one compression constraint.
Claim 3	
3	The method of claim 1, wherein at least one of the at least two filters is adaptively enabled or disabled depending upon at least data characteristics corresponding to the image region or data statistics corresponding to the image region.
Claim 4	
4	The method of claim 1, wherein a version of the image region that is displayed is different from at least one of an output signal corresponding to the image region after the at least two in-loop filters and an initial input signal corresponding to the image region before the at least two in-loop filters.

Reference	Claim Limitation
Claim 5	
5[pre]	An apparatus comprising at least a memory and one or more processors, the one or more processors being configured to:
5[a1]	decode an image region, the one or more processors including at least two filters for successively performing in-loop filtering to reduce at least a first and a second type of coding artifact,
5[a2]	the at least two filters including a deblocking filter for performing a first pass to reduce blocking artifacts and an adaptive sparse de-noising filter for performing a second pass to reduce noise,
5[a3]	wherein the adaptive sparse de-noising filter is selectively enabled or disabled at a given level, the given level being at least a macroblock level, a slice level, a picture level or a sequence level.
Claim 6	
6	The apparatus of claim 5, wherein at least one of the at least two filters is used to enforce at least one compression constraint.
Claim 7	
7	The apparatus of claim 5, wherein at least one of the at least two filters is adaptively enabled or disabled depending upon at least data characteristics corresponding to the image region or data statistics corresponding to the image region.
Claim 8	
8	The apparatus of claim 5, wherein a version of the image region that is displayed is different from at least one of an output signal corresponding to the image region after the at least two in-loop filters and an initial input signal corresponding to the image region before the at least two in-loop filters.

I. Introduction

Video compression is a complex task that requires breaking down the multitude of images that make up a video, finding and grouping patterns in and between images, and characterizing their differences, all while using a smaller amount of data to first encode, and then later reconstruct, the video images. Because most video compression results in data loss (to make the video smaller in size), filters are often used during video reconstruction to reduce or enhance certain features in the video images, such as smoothing over sharp changes in color that may arise from compression. Without such filters, a reconstructed video may appear to be of low quality (e.g., with blocky or grainy images).

While balancing compression and video quality may be difficult, the challenged claims here are so broad that they recite no more than what was already known: applying two particular filters when reconstructing a video, one after the other, with the ability to selectively turn one of the filters on and off. But the filters identified in the claims—and the purposes they serve—were all already known, as even the patent itself admits. And stacking two different filters together, each to serve its own particular purpose, and selectively turning them on or off when reconstructing a video had been done many times before. At most, the challenged claims took pieces of what was already well known and combined them in obvious ways.

For this reason, Intel Corporation (“Intel” or “Petitioner”) petitions for *inter partes* review (“IPR”) of U.S. Patent 9,674,556 (“’556 Patent”) claims 1-8 (“Challenged Claims”).

II. Grounds for Standing

Petitioner certifies the ’556 Patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR on the grounds herein.

III. Identification of Challenge

A. Prior Art

Petitioner respectfully requests review and cancellation under 35 U.S.C. §311 of the Challenged Claims in view of:

Prior Art
U.S. Patent Publication No. 2003/0219073 (“Lee”), filed on April 3, 2003, published on November 27, 2003; prior art under at least 35 U.S.C. §102(b). ¹ (EX1006)
Applicant Admitted Prior Art (“AAPA”)
U.S. Patent Publication No. 2006/0110062 (“Chiang”), filed on November 23, 2004, published on May 25, 2006; prior art under at least 35 U.S.C. §102(a) and/or (e). (EX1007)

¹ All references to 35 U.S.C. §§102, 103 are to the pre-AIA statutory framework.

U.S. Patent Publication No. 2003/0152146 (“Lin”), filed December 17, 2002, published on August 14, 2003; prior art under at least 35 U.S.C. § 102(b). (EX1008)

SMPTE Standard: VC-1 Compressed Video Bitstream Format and Decoding Process, SMPTE 421M-2006 (“VC1 Standard”), published on February 24, 2006; prior art under at least 35 U.S.C. § 102(a). (EX1009)²

Onur G. Guleryuz, *A Nonlinear Loop Filter for Quantization Noise Removal in Hybrid Video Compression*, IEEE Int’l Conference on Image Processing (“Guleryuz”); presented on September 14, 2005, published November 14, 2005; prior art under at least 35 U.S.C. § 102(a). (EX1010)³

² EX1017 is the declaration of June Munford explaining that the VC1 Standard (publicly accessible at least by February 24, 2006 or April 8, 2006) qualifies as a printed publication. Additional evidence of the VC1 Standard’s public availability includes at least EX1021-EX1023, which reference the VC1 Standard.

³ EX1017 explains that Guleryuz (publicly accessible at least by November 14, 2005) qualifies as a printed publication. Additional evidence of Guleryuz’s public availability includes at least EX1018-EX1020, which reference Guleryuz.

B. Grounds for Challenge

Ground		Claims	References
1A	§103	1-8	Lee
1B	§103	1-8	Lee, AAPA
2	§103	1-8	Chiang, Lin
3	§103	1-8	VC1 Standard, Guleryuz

IV. '556 Patent Overview

A. Specification

The '556 Patent describes “methods and apparatus for in-loop artifact filtering.” '556 Patent, Abstract. Video compression artifacts result from quantization and are present in various forms. *Id.*, 1:12-16. The '556 Patent describes the use of two or more in-loop filters to remove or reduce quantization artifacts. *Id.*, 10:17-29.

In the Background section, the '556 Patent describes prior art deblocking filters such as that implemented in the MPEG-4 AVC Standard. The Background admits that “[d]eblocking filtering in accordance with the MPEG-4 AVC Standard is well designed to reduce the blocky artifact but it does not try to correct other artifacts caused by quantization noise.” '556 Patent, 1:58-61. Notably, the specification later explains that “[t]he signal after [the MPEG-4] deblocking filter is

a better match to the independent and identically distributed (i.i.d.) noise presumption.” *Id.*, 14:28-30; EX1003, (“Reader”), ¶¶97-98.

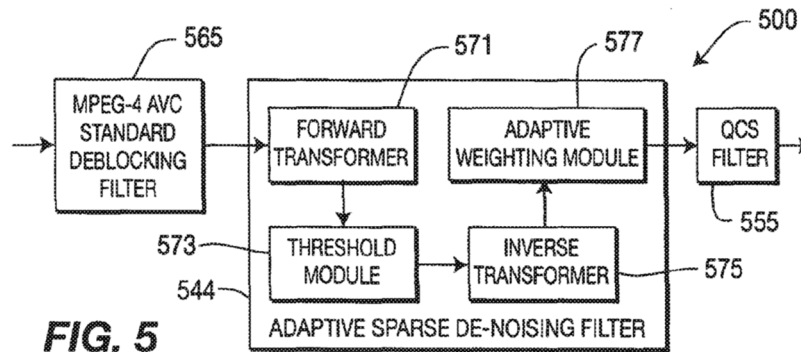
The Background next describes a type of prior art filter that overcomes the shortcomings of MPEG-4 deblocking. *Id.*, 2:4-47. This filter is described as “a denoising type nonlinear in-loop filter” that “adapts to non-stationary image statistics which exploits a sparse image model using an overcomplete set of linear transforms and hard-thresholding.” *Id.*, 2:6-10. The Background admits that this type of filter “can address all types of quantization noise” (*id.*, 2:13-14) but goes on to explain known problems with applying this filter on its own—i.e., not in conjunction with another filter (*id.*, 2:22-62). Reader, ¶98. Specifically, it explains that “sparsity based denoising tools” were “designed for additive, independent, and identically distributed (i.i.d.) noise removal, while quantization noise has significantly different properties, which can represent significant issues in terms of proper distortion reduction and visual de-artifacting.” *Id.*, 2:25-30. The Background indicates that “[a] possibility for a solution is spatio-frequency threshold adaptation, which may be able to correct the decision, but it is not trivial in its implementation.” *Id.*, 2:31-34. The Background goes on to claim that consequences of poorly designed sparsity based denoising tools include “over-smoothed reconstructed pictures, or a blocky artifact(s) may still be present despite the filtering procedure.” *Id.*, 2:34-37.

After discussing the known MPEG-4 deblocking filter and known adaptive sparse de-noising filter, the Background admits that “[i]t has been observed that the use of a single de-noising filter is not very efficient or effective in removing coding artifacts.” *Id.*, 2:48-50. And the Background explains that “a general purpose de-noising filter is usually based on a distortion model which does not exactly match the actual scenario to which it is applied. This model does not consider the local structure of blocky artifact.” *Id.*, 2:50-54. Consequently, the Background asserts that a special-purpose filter like the MPEG-4 deblocking filter “is not sufficient to correct the rest of the quantization noises. For example...noise/artifacts at pixels away from the boundaries, within textures, or to correct the distorted edges.” *Id.*, 2:54-62.

Having established (1) the properties of the known MPEG-4 deblocking filter, (2) the properties of known adaptive sparse de-noising filter, and (3) the known shortcomings of using a single de-noising filter, the ’556 Patent proposes “utilizing a succession of filters on coded pictures to reduce the amount of coding artifacts over video frames.” *Id.*, 10:8-10. “The filters are placed in the coding loop (in-loop), so the filtered frames are used as referenced frames for motion compensation of subsequent coded frames.” *Id.*, 10:10-13. In the ’556 Patent, the use of two or more in-loop filters requires “the first filter (or filtering pass) to remove or reduce a first type (or group of types) of quantization artifact and the second filter (or filtering

pass) to remove or reduce a second type (or group of types) of quantization artifact.”

Id., 10:29-33. Figure 5 shows the use of the two or more in-loop filters:



In Figure 5, the deblocking filter is applied in the first pass, “which targets removing blocking artifacts,” and the adaptive sparse de-noising filter is applied in the second pass to “further reduce quantization noise over video frames composed of locally uniform regions (smooth, high frequency, texture, and so forth).” *Id.*, 10:8-13. Notably, although the ’556 Patent provides descriptions of two filters, a deblocking filter and a sparse de-noising filter, it fails to provide details about how the proposed filters are different from the known MPEG-4 deblocking filter and the known adaptive sparse de-noising filter. Reader, ¶¶104-105.

The ’556 Patent further states that “[t]o further improve the result, we can enforce compression constraints including, but not limited to, quantization constraints, in order to help restore the image to the artifact-free form.” ’556 Patent, 10:23-26. The ’556 Patent specifically teaches a QCS filter, applied after the deblocking and “sparse de-noising” filters, for enforcing quantization constraints.

E.g., id., 11:6-16, Fig. 5, 15:24-58, Fig. 8. The '556 Patent does not, however, provide any examples of enforcing the broader category of compression constraints. Reader, ¶106; '556 Patent, 15:24-27. A POSITA would have understood that the broader category of compression constraints includes, e.g., pre-decided controls on filtering used by both the encoder and decoder to improve image quality. Reader, ¶106. These could include, e.g., the '556 Patent's QCS filter, as well as the flags controlling the '556 Patent's sparse filter. *Id.*, ¶106, 12:1-50, Tables 1, 2.

Finally, the '556 Patent explains that the adaptive sparse de-noising filter can be turned on/off at the macroblock, slice, picture, and/or sequence level. *Id.*, 11:50-53.

B. Prosecution History

The '556 Patent issued from U.S. Patent Application No. 14/981,345, which is a continuation of U. S. Patent Application No. 12/312,386, filed as PCT/US2007/022795 ("'386 Application") and issued as U.S. 9,277,243. The '556 Patent issued after minor amendments not relevant to the grounds in this Petition and a terminal disclaimer to U.S. 9,277,243. EX1002. The '386 Application was the subject of several rejections relevant to this Petition, the relevant portions of which are summarized below.

On February 22, 2012, all pending claims of the '386 Application were rejected as anticipated by U.S. Patent No. 6,665,346 to Lee ("Lee '346").⁴ EX1005, 171-175. Notably, as to pending dependent claims reciting a "sparse de-noising filter," the Examiner cited to portions of Lee '346 discussing Lee's deringing filter. EX1005, 172-173. Applicant amended the pending independent claims to include "wherein said [decoder renders / decoding step comprises rendering] a decision to selectively enable or disable each of the at least two filters at a given level, the given level being selected from among each of a macroblock level, a slice level, a picture level, and a sequence level." EX1005, 189-190. Applicant argued that Lee '346 discloses flags enabling/disabling its deblocking and deringing filters on the block level, but not the slice or sequence level. EX1005, 196. Applicant did not make any arguments regarding Lee '346's teachings of a "sparse de-noising filter."

The Office rejected the amended claims on January 2, 2014 as anticipated by U.S. Patent Publication No. 2003/0219073 ("Lee"). EX1005, 257-259. Notably, the Examiner argued that Lee discloses enabling or disabling its in-loop filtering at the macroblock level. EX1005, 257. The Examiner again mapped Lee's deringing filter to the recited "sparse de-nosing filter." EX1005, 258. In response, Applicant further

⁴ The Lee publication used in Grounds 1A and 1B of this Petition is a continuation of Lee '346.

amended the claims to incorporate the dependent claim limitations reciting a deblocking filter and a “sparse de-noising filter” into the pending independent claims. EX1005, 281-282. Applicant argued that:

The cited portions of Lee do not expressly or inherently disclose *a sparse de-noising filter for performing a second pass* to reduce noise.

While the cited portions of Lee may disclose deringing filtering, Lee does not disclose or suggest *a sparse de-noising filter for performing a second pass* to reduce noise.

EX1005, 287 (emphases in original).

The Examiner rejected these amended claims on July 15, 2014 as obvious over a combination of Lee and the AAPA. EX1005, 303-306. The Examiner accepted Applicant’s argument regarding Lee’s deringing filter but argued that “it would have been obvious...to use the teachings of the Applicant’s Admitted prior art to modify the apparatus of Lee by using a sparsity based de-noising filter in order to achieve a higher distortion reduction in terms of objective measures (e.g., mean squared error (MSE)) than other filters.” EX1005, 304 (citing to the Background section of the specification).

In response, Applicant filed a notice of appeal and an accompanying pre-appeal brief that argued, in relevant part, that the AAPA teaches away from the proposed combination with Lee. EX1005, 320-321. Specifically, Applicant argued

that the AAPA’s statement that “sparsity based de-noising techniques...present important visual artifacts that need to be addressed” “teaches away from the proposed combination.” EX1005, 320. Applicant also cited to the portion of the background section corresponding to 2:25-43 of the ’556 Patent, which generally discusses issues with implementing the AAPA adaptive sparse de-noising filter independently. EX1005, 321; Reader, ¶113. Applicant argued that “while the AAPA does mention sparsity-based denoising, it does so for the very purpose of pointing out why one skilled in the art would not consider using sparsity-based denoising as proposed by the combination asserted in the rejections.” EX1005, 321 (emphasis original).

After an Examiner interview on February 6, 2015 in which “Applicant’s representative agreed to amend the claims,” Applicant amended the relevant independent claims to recite an “*adaptive* sparse de-noising filter.” EX1005, 333, 342-344 (emphasis added). The Examiner issued a notice of allowance for the parent patent without any explanation for the allowance on May 22, 2015.⁵ EX1005, 363-

⁵ Applicant filed a request for continued examination after the May 22, 2015 notice of allowance and cancelled all but independent claim 16, which was slightly amended to correct an apparent typo and omit selectively enabling or disabling the

377. Notably, the Examiner did not respond to Applicant's argument that the AAPA teaches away from the Lee-AAPA combination. *Id.*

V. Level of Ordinary Skill

A POSITA during the relevant time period would have had at least a bachelor's degree in electrical engineering, computer science, computer development, and/or testing of relevant multimedia processing, such as video, and/or image processing or coding, and that advanced graduate studies with coursework and/or research focusing on topics of video encoding and decoding could substitute for working experience in the field. Reader, ¶93.

VI. Claim Construction

Claims should be construed "in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." 37 C.F.R. §42.100(b); *see also Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). Petitioner is unaware of any "prior claim construction determination" related to the '556 Patent. *See* 37 C.F.R. § 42.100(b).

adaptive sparse de-noising filter at "a macroblock level [or] a slice level." EX1005, 440. The Examiner allowed the amended claim 16 on September 14, 2015. EX1005, 492.

Petitioner believes the Challenged Claims need no construction to demonstrate they are unpatentable. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)) (explaining the Board “need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’”).

A. The Co-Pending ITC Investigation

In the co-pending ITC investigation, the construction of the term “sparse de-noising filter” is contested, including because PO has taken inconsistent positions as to its meaning between original prosecution of the parent application and in the ITC, apparently for the purpose of alleging infringement. Specifically, as discussed in Section IV.A, during the prosecution of the ’556 parent, PO argued that the term “sparse de-noising filter” does not encompass a “deringing” filter to secure the issuance of that patent. But in concurrent ITC proceedings (*infra*, IX.B), PO asserts that the ’556 Patent’s use of the term “sparse de-noising filter” is met by a filter that “perform[s] deringing.” EX1024, 7, 10. Given PO’s inconsistent positions, four possible constructions have been offered for “sparse de-noising filter” in the related ITC proceeding, as summarized in the table below:

Complainant (Patent Owner)’s Construction	Respondents’ Construction	Staff’s Construction
Plain and ordinary meaning (i.e., “a filter that reduces noise based on a sparse representation of the signal”)	“Sparse de-noising filter for performing a second pass to reduce noise, which is not a deringing filter” or alternatively “a filter which exploits a sparse image model using an over complete set of linear transforms and hard thresh-holding, which is not a deringing filter”	“A filter that reduces noise based on a sparse representation of the signal”

EX1025, 1032-1033.

Notably, while it appears that PO and the Staff propose the same construction, there is a dispute as to its application, as the Staff’s *Markman* brief shows:

Although the Staff agrees with Complainants’ construction, there is a dispute among the parties regarding whether the signal itself can be sparse (i.e., whether “a sparse representation of the signal”

encompasses a sparse signal). The Staff is of the view that “a sparse representation of the signal” in its proposed construction *does not* encompass a sparse signal (i.e., the representation of the signal is sparse, not the signal itself). The Staff understands that Complainants disagree and that the dispute is based on infringement arguments related to the functionality of the accused products.

EX1025, Staff Markman Br., n.10 (emphasis original). Thus, even assuming that a “sparse de-noising filter” is construed to mean “a filter that reduces noise based on a sparse representation of the signal,” there is a dispute whether the construction encompasses that the signal itself is sparse (as proposed by PO), or whether just the representation of the signal is sparse (consistent with the Respondents’ proposed constructions).

Accordingly, there are two questions pending in the ITC regarding the meaning of “sparse de-noising filter”: (1) whether the term excludes a “deringing filter,” and (2) whether additional construction is necessary, and if so, the correct construction. Petitioners propose that Respondents’ construction in the related ITC proceeding, which excludes a deringing filter, is correct based on PO's disclaimer of deringing filters to overcome a rejection based on Lee during prosecution of the '386 Application. Reader, ¶130. This was an express disclaimer, which carries forward to the '556 Patent. *See Cordis Corp. v. Bos. Sci. Corp.*, 658 F.3d 1347, 1356, n.5 (Fed.

Cir. 2011) (finding arguments to distinguish prior art served as a disclaimer, and “a disclaimer in the parent application carries forward into the construction of the same claim term in the child.”). A POSITA therefore would have understood that “sparse de-noising filter” in the ’556 Patent has a meaning narrower than its plain and ordinary one—namely one that excludes deringing filters. Reader, ¶131.

B. Construction for “sparse de-noising filter”

As shown in this Petition, the Challenged Claims are invalid regardless of which construction is applied (Reader, ¶130), and thus the Board need not explicitly construe any terms. But to the extent the Board determines that the term requires construction, Petitioners propose that Respondents’ alternative construction in the related ITC proceeding—i.e., “a filter which exploits a sparse image model using an over complete set of linear transforms and hard thresh-holding, which is not a deringing filter”—should be adopted.

In general, a “sparse de-noising filter” uses a “sparse” mathematical model. Reader, ¶131. This is consistent with Applicant’s arguments during prosecution of the ’386 Application and Respondents’ position taken in the related ITC proceeding because the deringing filter disclosed by Lee, while reducing thinly scattered or dispersed (i.e., “sparse”) noise in an image, does not utilize a sparse mathematical model to do so. *Id.* It is also consistent with ITC Respondents’ alternative construction and the disclosure of the ’556 Patent, in which the “sparse de-noising

filter” conducts filtering by determining an “over complete set of linear transforms and hard-thresholding” for a given level of image information (’556 Patent, 2:9-10, 13:24-34) because this operation results in a mathematically sparse image model. Reader, ¶131.

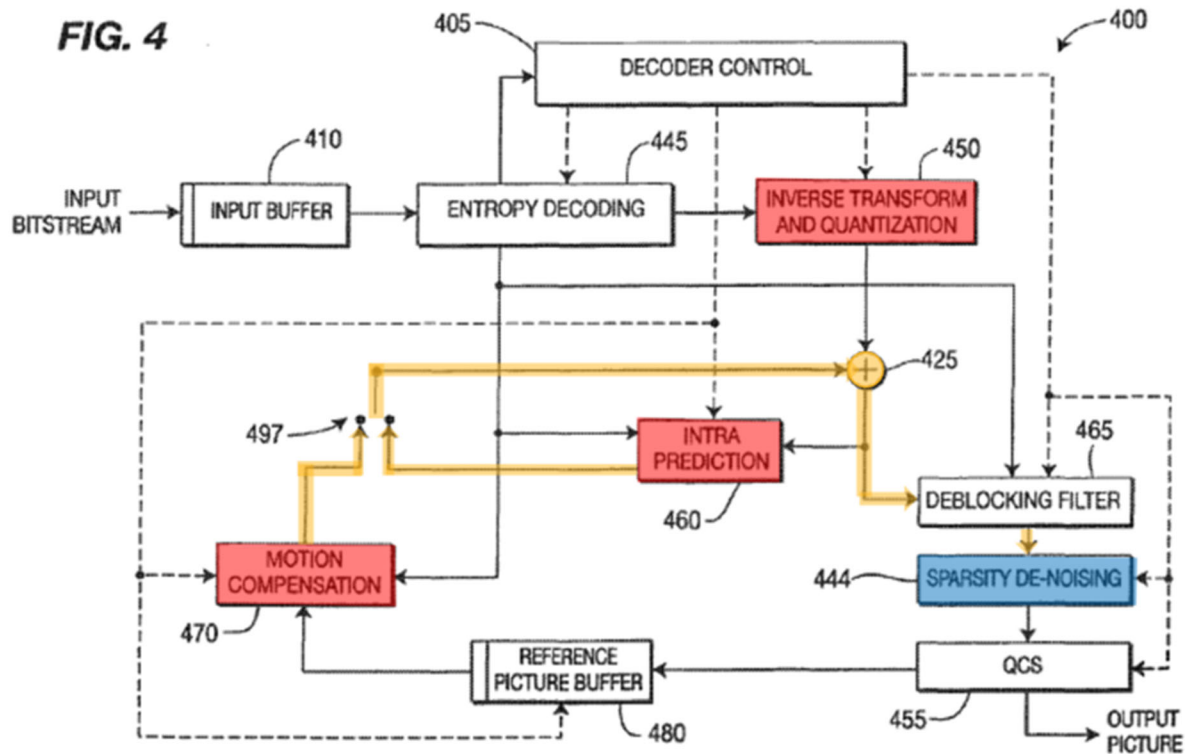
This construction is also consistent with the plain English understanding of the phrase “sparse de-noising filter.” The word “sparse” is an adjective describing the noun “filter,” meaning that the filter is “sparse,” as opposed to the data on which the filter operates being sparse. *Id.*

Furthermore, the ITC Staff’s proposed construction, while appearing identical to PO’s construction, is actually consistent with Respondents’ alternative construction. *Id.* Both constructions contemplate a filter that operates on data that is not sparse, with the filter transforming and filtering the signal using a sparse mathematical model. *Id.* Aside from the exclusion of deringing filters by Respondents’ construction, the biggest substantive difference between the two is that the Staff’s construction is broader because it does not limit how sparsity is achieved by the recited filter, while Respondents’ alternative construction uses the ’556 Patent’s own description of the filter to do so. *Id.*; ’556 Patent, 2:4-10. Regardless, both of Respondents’ constructions and the Staff’s construction reject PO’s position that the recited “sparse denoising filter” broadly encompasses a filter that reduces noise based on a sparse signal. Reader, ¶131.

PO's proposed ITC construction and interpretation of said construction—that the filter “reduces noise based on a sparse representation of the signal” and a “sparse representation of the signal” encompasses a sparse signal (EX1025, n.10; EX1024, 7, 9) is unsupported by the evidence and therefore incorrect. Reader, ¶¶132-135.

First, the term “sparse representation” appears only once in the specification to describe a prior-art filter with inadequate threshold values (which are used to trigger when the filter is applied) that results in a signal with “sparse representation at the filtering stage.” ’556 Patent, 2:37-41. This describes the noise-based attributes of a *signal*, which is separate and unrelated to the claimed “sparse de-noising *filter*” used to reduce the noise within an image. Reader, ¶133.

Second, PO's ITC construction is inconsistent with the ’556 Patent's Figure 4 (annotated below), which depicts a decoder applying the alleged invention of the ’556. ’556 Patent, 9:8-12.



This particular arrangement of components—having the “sparsity de-noising” filter (blue) receive a signal that has already been de-quantized (by the “inverse transform and quantization,” 450) (red) and combined (425) (orange) with other compensators (470) (red) and predictors (460) (red)—would have conveyed to a POSITA that the series of filters (e.g. the deblocking, de-noising, and QCS filters) would not receive “a sparse representation of a signal” at all. Reader, ¶¶134-135. Rather, signal transformation and quantization are performed to create a sparse representation of a signal (e.g., for transmission), and inverse transformation and quantization reverses these processes, as the name suggests, resulting in a dense (i.e., not sparse) signal. Reader, ¶135; ’556 Patent, Fig. 5.

VII. Detailed Grounds Explanation

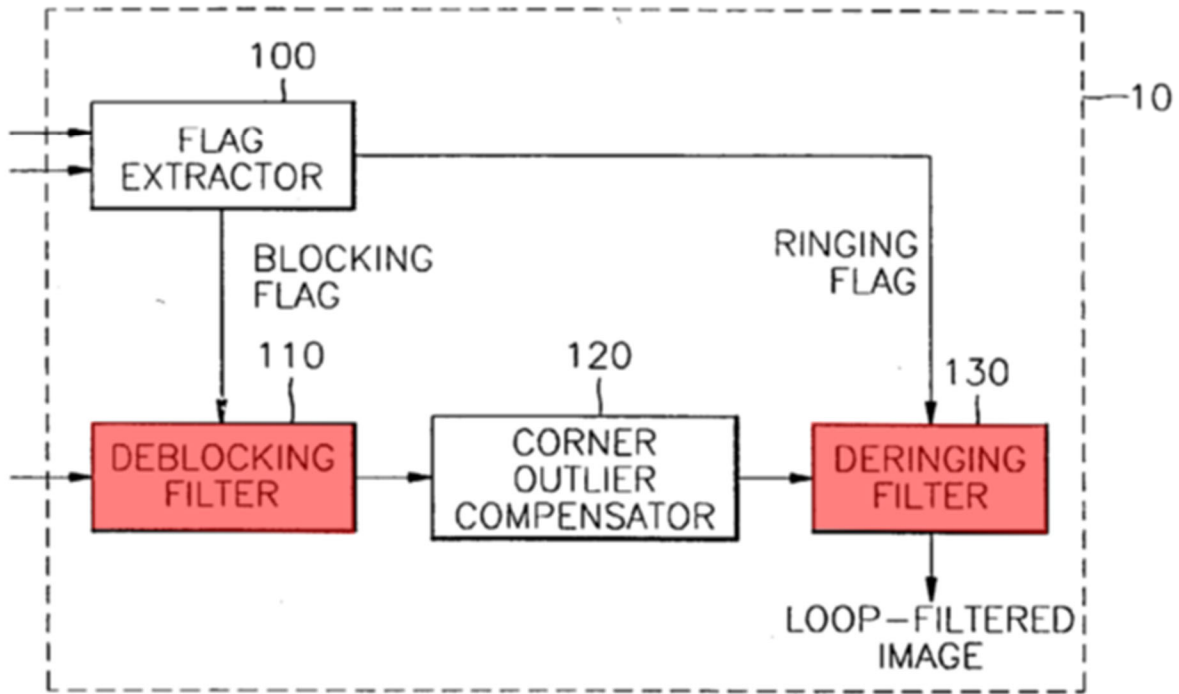
A. Ground 1A: Obviousness Based on Lee

To the extent that PO's current position with the ITC is applied—i.e., that a “sparse denoising filter” is a “filter that reduces noise based on a sparse representation of the signal,” which encompasses a “sparse signal”—Lee discloses or suggests the limitations of claims 1-8 of the '556 Patent. Reader, ¶137.

1. Lee

Lee is directed to a loop-filtering method including a deblocking filter followed by a deringing filter. Lee, Abstract, [0044]. Lee's Figure 1 (annotated) is reproduced below:

FIG. 1



In Figure 1, “an apparatus 10 for loop-filtering image data for reducing quantization effect occurring when the image data is block-base coded and decoded, which is used in connection with a general encoder and decoder, comprises a flag extractor 100, a deblocking filter 110, a corner outlier compensator 120 and a deringing filter 130.” Lee, ¶44. Lee discloses the use of flags on a block level, with deringing filtering enabled or disabled based on a deringing flag. *See id.*, ¶¶10-12, 24, 118; Reader, ¶¶115-116.

2. Claim 1

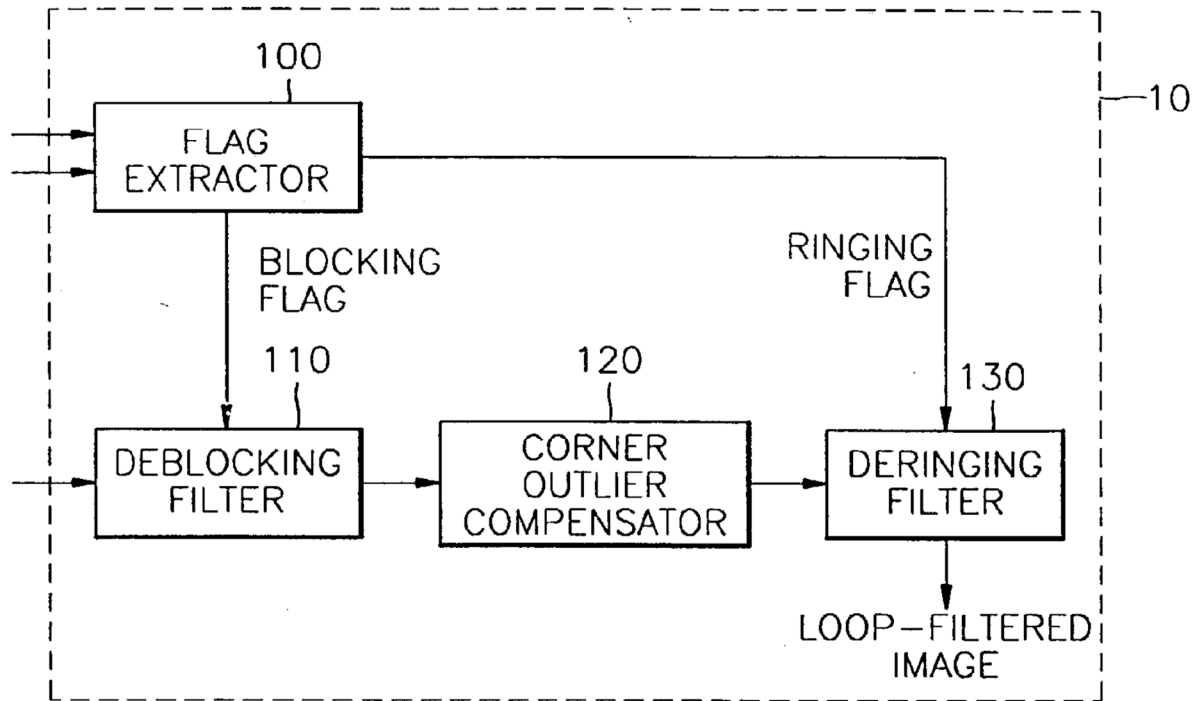
a. 1[pre]

To the extent that the preamble is limiting, Lee discloses or suggests a method. Reader, ¶139. Lee discloses “[a] loop-filtering method for reducing quantization effect generated when an image data is encoded or decoded.” Lee, Abstract.

b. 1[a1]

Lee discloses or suggests this limitation. Reader, ¶¶140-145. Lee discloses “loop-filtering image data for reducing quantization effect occurring when [] image data is block-base coded and decoded, which is used with a general encoder and decoder.” Lee, ¶44. This is accomplished using the apparatus depicted in Lee’s Figure 1:

FIG. 1



Lee explains that “[t]he basic idea of the loop-filtering method...is to adaptively filter using spatial frequency and temporal information to reduce the quantization effect.” Lee, ¶50. Thus, Lee teaches “decoding an image region, wherein the decoding includes performing in-loop filtering.” Reader, ¶142.

Lee further teaches that its loop-filtering reduces at least two types of coding artifacts – blocking and ringing artifacts – using at least two filters in succession – a deblocking filter and a deringing filter. Specifically, Lee teaches using its deblocking filter 110 to reduce a first type of coding artifact – blocking artifacts. Lee, ¶¶70-72;

Reader, ¶143. The deblocking filter 110 checks for a blocking flag extracted by flag extractor 100 to determine whether to perform deblocking. Lee, ¶47.

Next, corner “outlier compensator 120 detects the corner outlier of the data passed through the deblocking filter 110 and compensates for the detected corner outliers.” Lee, ¶48. Lee explains that “[c]orner outlier compensation is only performed for INTRA frame.” *Id.*, ¶100. Thus, the corner outlier compensator is not applied when decoding an inter frame. Reader, ¶144.

Next, Lee teaches using its deringing filter 130 to reduce a second type of coding artifact – ringing artifacts. Lee, ¶¶70-71, 104; Reader, ¶145. “The deringing filter 130 checks the ringing flag extracted by the flag extractor 100...to deringing-filter the corner outlier compensated data.” Lee, ¶49. In the case of decoding an inter frame, the ringing flag check and deringing filtering (if indicated by the flag) is done immediately after the deblocking filtering because the intervening corner outlier compensator is not applied. Reader, ¶145, Lee, ¶104.

Accordingly, Lee teaches using its deblocking and deringing filters in succession because deringing is performed after deblocking and corner compensation, or immediately after deblocking when decoding inter frames. Reader, ¶145.

c. 1[a2]

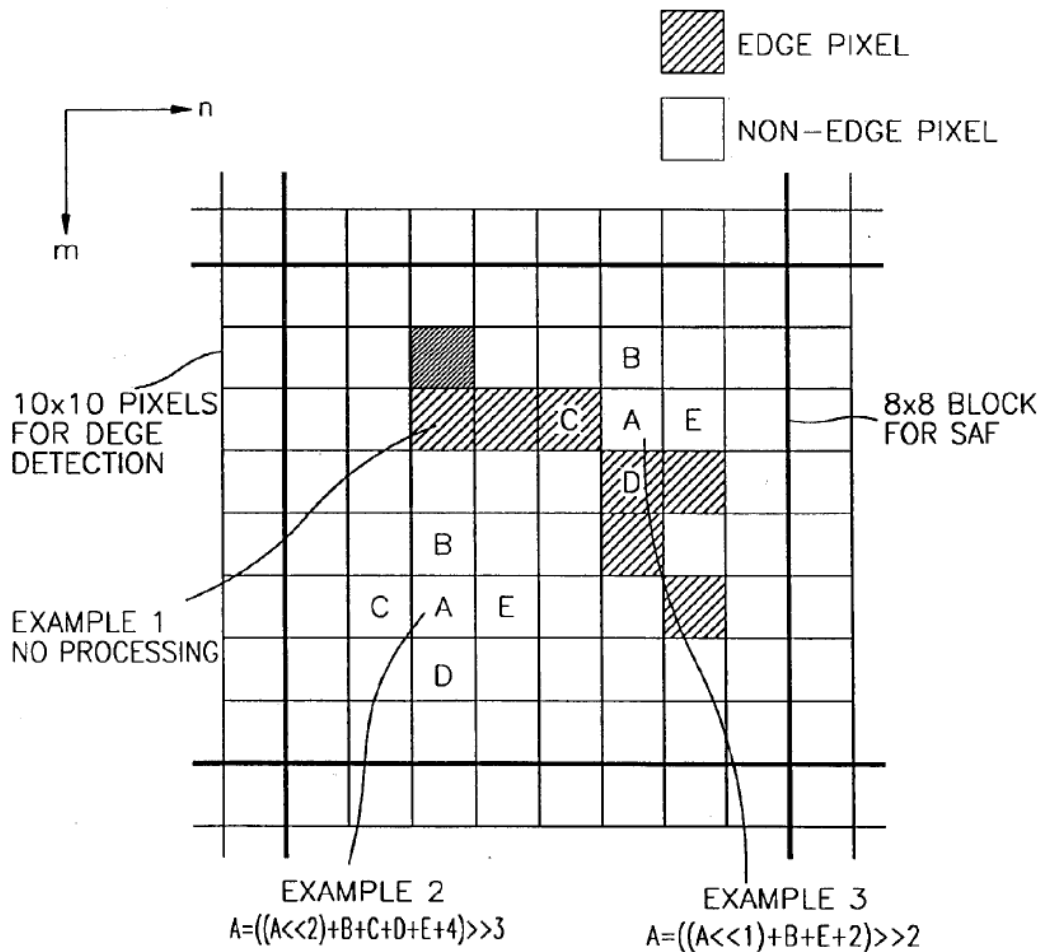
Lee discloses or suggests this limitation. Reader, ¶¶146-150. As explained in Section VII.A.2.b, Lee teaches using a deblocking filter 110 to reduce blocking artifacts. Lee, ¶¶70-72, Reader, ¶147. Further, Lee teaches that the deblocking filter is applied before its corner outlier compensator 120 and deringing filter 130. Lee, ¶¶47-49, Fig. 1; Reader, ¶147. Thus, deblocking filter 110 performs a first pass of filtering. Reader, ¶147.

As explained in Section VII.A.2.b, Lee further teaches using a deringing filter 130 after the first pass of deblocking filter 110. Lee, ¶¶70-71, 104; Reader, ¶147. To the extent that prosecution history disclaimer does not apply to “sparse de-noising filter” to exclude a deringing filter, under PO’s proposed ITC construction and understanding of the term, Lee’s deringing filter would be a “sparse de-noising filter.” Reader, ¶147. Specifically, PO’s interpretation of the term broadly encompasses a filter which “adapts to the sparse nature of underlying video signals by ‘preventing excessive blurring when the filter is applied across an edge,’” precisely the behavior found in Lee’s deringing filter. Reader, ¶148 (citing EX1024, 1031).

Lee’s deringing filter is an “adaptive sparse de-noising filter” under PO’s interpretation because it 1) creates an “edge map” of an image (“a sparse representation of a signal”) and 2) performs filtering “based on” said edge map.

Reader, ¶148. To create an edge map, Lee's deringing filter detects image edges by comparing the differences between neighboring pixels to a threshold value, which Lee refers to as the "quantization factor" or QP. Lee, ¶24. If the difference between two neighboring pixels is large (i.e., greater than the threshold value), Lee determines that pixel to be close to an image edge and sets the edge map value at that location to 1. *Id.* If the difference is small, Lee determines the pixel is not at an edge, and sets the edge map value to 0. *Id.*, ¶¶24, 111-113, Fig. 7B. The resulting edge map is made up of entirely ones and zeros that represent the location of the edges in the original image. Reader, ¶148. As Lee's Figure 7B demonstrates, this representation is "sparse" because a minority of pixels (just the edge pixels) have a value of one and the majority of pixels have a zero-value. Reader, ¶148.

FIG. 7B



Lee then filters “based on” the edge map. Lee, ¶¶24, 113; Reader, ¶149. Lee’s deringing filter analyzes 4-connected filter windows to determine if the filter windows contain an edge pixel. Lee, ¶113, Fig. 7A. If the center pixel of the filter window is an edge pixel, no filtering is performed. *Id.* If a non-center pixel is an edge pixel, Lee performs weighted filtering to exclude edge pixels. *Id.* And if no edge pixel is included, low-pass filtering is performed. *Id.* Lee’s deringing filter

therefore performs filtering “based on” the edge map (“sparse representation of a signal”) it creates. Reader, ¶149.

Lee’s deringing filter is also therefore “adaptive” because it changes the filtering performed based on its edge map. Lee, ¶¶24, 50 (“The basic idea of the loop-filtering method on the image data according to the invention is to adaptively filter using spatial frequency and temporal information to reduce the quantization effect.”), 111-113; Reader, ¶149.

And as explained in Section VII.A.2.b, Lee’s deringing filter is applied after the deblocking filter. Lee, ¶100; Reader, ¶150. Accordingly, a POSITA would have understood the application of Lee’s adaptive deringing filter to be “performing a second pass to reduce noise.” Reader, ¶150.

d. 1[a3]

Lee discloses or suggests this limitation. Reader, ¶¶151-152. Lee teaches “extracting a flag indicating whether the image data requires loop filtering.” Lee, ¶¶10, 57. Lee further teaches that this flag “comprises...a ringing flag indicating whether the reduction of ringing noise near image edges is required.” *Id.*, ¶12. Specifically, “the deringing filtering for reducing the ringing noise in the filtering step is performed if the ringing flag indicates a need for the deringing filtering, and is not performed if the ringing flag indicates no need for the deringing filter.” *Id.*, ¶24. Finally, Lee teaches that its ringing flag, and thus the adaptive deringing filter

is applied at the macroblock level. Lee, ¶¶63, 55 (“The blocking and ringing flags are extracted from the DCT domain of each 8x8 block in the intra-macroblock (MB). *Also, the flags of the inter-MB* are calculated from a residual signal and flags of a reference video object plane (VOP)”) (emphasis added); Reader, ¶152.

3. Claim 2

Lee discloses or suggests this limitation. Reader, ¶¶153-157. Lee discloses at least two types of compression constraints enforced by Lee’s deblocking filter.

First, Lee discloses “extracting a flag indicating whether the image data requires loop-filtering using the distribution of inverse quantized coefficients (IQCs) of an inverse quantized image data and a motion vector indicating the difference between the previous frame and the current frame.” Lee, ¶10. Lee further discloses that this flag comprises, *inter alia*, “a blocking flag indicating whether reduction of blocking artifacts near block boundaries is required.” *Id.*, ¶12, *see also, id.*, ¶¶31, 45. A POSITA would have understood that indication of the deblocking flag from the inverse quantized coefficients is used by Lee’s deblocking filter to enforce a compression constraint because both the encoder and decoder are constrained ahead of time to use syntax and tools available to ensure that which is encoded can later be decoded. Reader, ¶155.

Second, Lee discloses several possible rules for performing its deblocking filtering based on extracted blocking flags and ringing flags (to control the deringing

filter). *E.g.*, Lee, ¶¶20-22, 76, 88. For example, Lee discloses a circumstance where, a first filtering along a block boundary is performed and then, considering two adjacent blocks I and J, if the ringing flags for both indicate no need for deringing filtering and the horizontal blocking flags indicate a need for reducing blocking artifacts, “comparing the difference between two adjacent pixels around the block boundary with the H.263 quantization factor QP” and performing a second filtering if certain flags remain and “if the difference between two pixels is less than the QP.” Lee, ¶20, *see also, id.*, ¶¶21-22. In other words, Lee discloses its deblocking filter filtering once, reassessing by comparing pixel value differences along adjacent block boundaries to a predetermined value, and filtering again as needed. Reader, ¶156. The blocking filter thus enforces a quantization constraint by comparison of the quantization along block boundaries to the H.263 quantization factor and filtering until the image is sufficiently improved. *Id.*, ¶156.

Accordingly, Lee discloses at least two different manners in which its deblocking filter enforces at least two different rules that are encompassed within the term “compression constraint.” *Id.*, ¶157.

4. Claim 3

Lee discloses or suggests this limitation. Reader, ¶¶158-161. Specifically, Lee teaches “the deringing filtering for reducing the ringing noise...is performed if the

ringing flag indicates a need for the deringing filtering, and is not performed if the ringing flag indicates no need for the deringing filtering.” Lee, ¶24.

Lee further teaches that the value of its ringing flag depends on various image characteristics. For example, Lee teaches that deringing filtering is performed when “the block I is an intra block, when the block I is not an intra block and has an 8×8 prediction mode, and when the block I is not an intra block and has no 8×8 prediction mode and the RF 1 of the block 1 indicates no need for the deringing filtering,” and “is not performed when the RF1 of the block I indicates no need for the deringing filtering.” Lee, ¶27.

Even more specifically, Lee teaches the circumstances under which its deringing filter is applied when decoding an inter macroblock. Lee, ¶¶63, 66-69. Lee teaches that “the RF [ringing flag] of the reference block A_c 0 is set to 1 if the IQC of the residual signals in the 8×8 block of the inter-frame is non-zero.” Lee, ¶66. Additionally, Lee also teaches setting RF to 1 if four motion vectors are transferred from one macroblock. *Id.* In another embodiment, Lee teaches setting the ringing flag based on the IQC (inverse quantized coefficients) of macroblock of interest. *Id.*, ¶69. In any case, the ringing flag RF being set to 1 adaptively enables the deringing filter based on the data characteristics or data statistics of the macroblock, i.e., “image region,” of interest. Reader, ¶161.

5. Claim 4

Lee discloses or suggests this limitation. Reader, ¶¶162-163. Specifically, Lee discloses that “the version of the image region that is displayed is different from...an initial input signal corresponding to the image region before the at least two in-loop filters.”

Lee explains that its deblocking and deringing filters “reduce[] the quantization effect” “such as blocking artifacts...and ringing noise.” Lee, Abstract, ¶118. A POSITA would have understood that the reduction of the blocking and ringing artifacts by Lee’s deblocking and deringing filters results in a “version of the image region that is displayed [being] different from...an initial input signal corresponding to the image region before the at least two in-loop filters.” Reader, ¶163; Lee, ¶¶6-7 (discussing effect of deblocking and deringing filters on images after decoding).

6. Claim 5

a. 5[pre]

To the extent that the preamble is limiting, Lee discloses or suggests this limitation. Reader, ¶¶164-165. Lee discloses that its teachings “may be embodied in a general purpose digital computer that is running a program from a computer usable medium, including but not limited to storage media such as magnetic storage media (e.g., ROMs, floppy disks, hard disks, etc.), optically readable media (e.g., CD-

ROMs, DVDs, etc.) and carrier waves (e.g., transmissions over the Internet).” Lee, 116. A POSITA would have understood that a general purpose digital computer comprises one or more processors and that the examples of “computer useable medium” recited by Lee comprise “a memory.” Reader, ¶165.

b. 5[a1]

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.2.b. Reader, ¶167.

c. 5[a2]

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.2.c. Reader, ¶169.

d. 5[a3]

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.2.d. Reader, ¶171.

7. Claim 6

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.3. Reader, ¶173.

8. Claim 7

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.3. Reader, ¶175.

9. Claim 8

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.5. Reader, ¶177.

B. Ground 1B: Obviousness Based on Lee and AAPA

The Challenged Claims are invalid as obvious over a combination of Lee and the applicant admitted prior art (AAPA) regardless of which of the four proposed constructions of “sparse de-noising filter” is applied. Reader, ¶178.

1. AAPA

a. Adaptive sparse de-noising filter

The '556 Patent admits that adaptive sparse de-noising filters are prior art. Reader, ¶¶117-119. Specifically, the '556 Patent admits that:

In order to overcome the limitations of the MPEG-4 AVC Standard deblocking filter, an approach has been recently proposed involving a de-noising type nonlinear in-loop filter. In this proposed approach, a nonlinear de-noising filter adapts to non-stationary image statistics which exploits a sparse image model using an over complete set of linear transforms and hard-thresholding. The nonlinear de-noising filter automatically becomes high-pass, or low-pass, or band-pass, and so forth, depending on the region the filter is operating on.

'556 Patent, 2:4-13. A POSITA would have understood that the '556 Patent discloses a prior art “adaptive sparse de-noising filter” because it: (1) “adapts to non-stationary image statistics,” i.e., based on the region being analyzed; (2) uses a mathematically sparse filter design; and (3) is intended to reduce or eliminate noise. Reader, ¶¶117-118. The '556 Patent further goes on to explain that “the [sparsity based] de-noising tool was designed for additive, independent and identically distributed (i.i.d.) noise removal.” '556 Patent, 2:25-27; Reader, ¶118.

While the '556 Patent does acknowledge that the known adaptive sparse de-noising filter, when applied on its own, has known drawbacks such as being “not trivial in its implementation” and “present[ing] important visual artifacts that need to be addressed,” it nonetheless admits that known adaptive sparse de-noising filters “present a higher distortion reduction in terms of objective measures (e.g., mean square error (MSE)) than other techniques.” '556 Patent, 2:31-47.

b. MPEG-4 AVC Standard deblocking filter

The '556 Patent admits that “adaptive deblocking filters have been studied in the past and some well-known deblocking filtering methods have been proposed and adopted in various standards.” '556 Patent, 1:23-25; Reader, ¶120. The specification then focuses on prior art in-loop deblocking filtering in accordance with the MPEG-4 AVC Standard. *E.g.*, '556 Patent, 1:33-2:21, 2:63-4:54, Figs. 1-3. The specification explains that “[d]eblocking filtering in accordance with the MPEG-4 AVC Standard

is well designed to reduce the blocky artifact, but it does not try to correct other artifacts caused by quantization noise.” *Id.*, 1:58-61. The specification further notes that “quantization noise in video compression, and particularly with respect to the MPEG-4 AVC Standard, is usually not independent and identically distributed (i.i.d.).” *Id.*, 14:22-24. However, “[t]he signal after [MPEG-4 AVC Standard] deblocking filter is a better match to the independent and identically distributed (i.i.d.) noise presumption.” *Id.*, 14:28-30.

2. Claim 1

a. 1[pre]-1[a1]

Lee discloses or suggests these claim elements for the same reasons as explained in Sections VII.A.2.a-VII.A.2.b. Reader, ¶¶181-184.

b. 1[a2]

Lee in combination with the AAPA teaches this limitation under any of the proposed constructions of “sparse de-noising filter.” *Id.*, ¶¶185-191.

As explained in Section VII.A.2.c, Lee discloses a deblocking filter 110 performing a first pass of filtering to reduce blocking artifacts. *Id.*, ¶187. A POSITA would have recognized that after application of Lee’s deblocking filter, the remaining noise would more closely match independent and identically distributed (i.i.d.) noise because blocking artifacts, which are not i.i.d., would be removed or reduced. *Id.*, ¶187.

A POSITA would have then been motivated to use the AAPA's adaptive sparse denoising filter, as described in Section VII.B.1.a, to perform a second pass of filtering to reduce noise because the AAPA adaptive sparse denoising filter offers the advantage of "higher distortion reduction...than other techniques." '556 Patent, 2:43-44; Reader, ¶188. A POSITA would have understood the AAPA adaptive sparse denoising filter to teach a "sparse de-noising filter" under all four proposed constructions. The AAPA "exploits a sparse image model using an over complete set of linear transforms and hard-thresholding," '556 Patent, 2:8-10, and is thus encompassed by each of PO's, Staff's, and Respondents' proposed constructions. Additionally, the AAPA "was designed for additive, independent and identically distributed (i.i.d.) noise removal," and thus is not a deringing filter. '556 Patent, 2:25-27, Reader, ¶188.

A POSITA would have understood that the main drawback of using the AAPA adaptive sparse denoising filter on its own—namely that it was designed for additive i.i.d. noise such that it "may get confused by true edges or false blocky edges," and attempting to solve the confusion with "spatio-frequential threshold adaptation...is not trivial in its implementation," and "might result into over-smoothed reconstructed pictures or blocky artifact(s)"—would be mitigated or entirely avoided by applying Lee's deblocking filter in the first pass. Reader, ¶189; '556 Patent, 2:25-37. Lee's deblocking filter would remove or greatly reduce blocky artifacts, and the

resulting image, while still having other types of quantization effects not addressed by Lee's deblocking filter, would lack at least the "false blocky edges" that are identified as troublesome for the AAPA adaptive sparse denoising filter. Reader, ¶189. Thus, a POSITA would have been motivated to use the AAPA adaptive sparse denoising filter after Lee's deblocking filter because the two would have worked synergistically with each other. *Id.* Such a combination would have been no more than combining prior art elements (Lee's decoding method using a deblocking filter and second filter, and the AAPA adaptive sparse denoising filter) according to known methods (using a second filter after Lee's deblocking filter) to yield predictable results (improved artifact removal and easier implementation of the AAPA adaptive sparse denoising filter after removal of blocky artifacts). *Id.* It further would have been no more than applying a known technique (the AAPA adaptive sparse denoising filter) to a known device ready for improvement (Lee's decoder comprising a deblocking filter and at least one other filter) to yield predictable results (overall higher distortion reduction and easier implementation of the AAPA adaptive sparse denoising filter). *Id.*

A POSITA would have further understood that the AAPA adaptive sparse denoising filter could have been used instead of Lee's deringing filter or in addition to Lee's deringing filter. *Id.*, ¶190. To the extent that the AAPA adaptive sparse denoising filter was used in addition to Lee's deringing filter, a POSITA would have

recognized that it could have been used at any time after Lee's deblocking filter in order to reap the synergy with the Lee's deblocking filter discussed above. *Id.* The relative order of the AAPA adaptive sparse denoising filter and Lee's deringing filter in such a scenario would have been a design choice that a POSITA would have made based on the demands of the system they were implementing. *Id.*

To the extent a POSITA decided to use the AAPA adaptive sparse denoising filter instead of Lee's deringing filter, doing so would have been no more than a simple substitution of one known element for another to obtain predictable results (overall higher distortion reduction and easier implementation of the AAPA filter). Reader, ¶191. To the extent a POSITA chose to use the AAPA adaptive sparse denoising filter in addition to Lee's deringing filter, it would have been no more than use of a known technique (the AAPA adaptive sparse denoising filter) to improve similar devices (Lee's decoder using multiple filters) in the same way (achieving higher overall distortion reduction). *Id.* In either implementation, a POSITA would have been able to individually tune and optimize filters to reduce artifacts. *Id.*

c. 1[a3]

Lee in combination with the AAPA discloses this limitation under any of the four proposed constructions of "sparse de-noising filter." Reader, ¶¶192-194.

As explained in Section VII.A.2.d, Lee discloses selectively enabling or disabling its deblocking and deringing filters at a macroblock level. When

combining Lee’s filtering method with the AAPA adaptive sparse denoising filter, as discussed in Section VII.B.2.b, a POSITA would have found it obvious to include a flag for the AAPA adaptive sparse denoising filter because it would allow for the conservation of computing resources by enabling the AAPA adaptive sparse denoising filter only when it is advantageous to apply it. *Id.*, ¶194. Doing so would have amounted to nothing more than applying a known technique (use of a flag to selectively enable or disable a filter at the macroblock level) to a known method ready for improvement (the AAPA adaptive sparse denoising filter) to yield predictable results (more efficient application of computing resources by deploying the AAPA adaptive sparse denoising filter only when it is advantageous to do so). *Id.*

3. Claim 2

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.3.*Id.*, ¶196.

4. Claim 3

Lee in combination with the AAPA teaches this limitation under any of the four proposed constructions of “sparse de-noising filter.” *Id.*, ¶¶197-199.

Regardless of the implementation details a POSITA would have applied when using a flag to selectively enable or disable the AAPA adaptive sparse denoising filter, as discussed in Sections VII.B.2.b and VII.B.2.c, the combination of Lee and

the AAPA teaches this limitation because Lee's deblocking filter is also controlled by a "blocking flag indicating whether a need for reducing blocking artifacts near block boundaries exists." Lee, ¶31. For example, Lee teaches how to propagate blocking flag information for inter macroblocks through the use of motion vectors and a reference frame. Lee, ¶¶63-65; Reader, ¶199. For example, Lee teaches that its deblocking filtering is not performed when each of the differences between two adjacent blocks and their previous counterparts are not greater than a predetermined value. Lee, ¶76; Reader, ¶199. A POSITA would have understood this control of the deblocking filtering to be dependent upon data characteristics corresponding to the image region because application of the deblocking filter depends on the differences between blocks in an image region between frames. Reader, ¶199.

5. Claim 4

Lee in combination with the AAPA teaches this limitation under any of the four proposed constructions of "sparse de-noising filter." *Id.*, ¶¶200-202.

A POSITA would have understood that the reduction of the blocking artifacts by Lee's deblocking filter and quantization noise by the AAPA adaptive sparse denoising filter results in a "version of the image region that is displayed [being] different from...an initial input signal corresponding to the image region before the at least two in-loop filters." *Id.*, ¶202.

6. Claim 5

a. 5[pre]

Lee in combination with the AAPA teaches this limitation under any of the four proposed constructions of “sparse de-noising filter.” *Id.*, ¶¶203-205. Lee discloses that its teachings “may be embodied in a general purpose digital computer that is running a program from a computer usable medium, including but not limited to storage media such as magnetic storage media (e.g., ROM's, floppy disks, hard disks, etc.), optically readable media (e.g., CD-ROMs, DVDs, etc.) and carrier waves (e.g., transmissions over the Internet).” Lee, 116. A POSITA would have understood that a general purpose digital computer comprises one or more processors and that the examples of “computer usable medium” recited by Lee comprise “a memory.” *Id.*, ¶205.

b. 5[a1]-5[a3]

Lee in combination with the AAPA teaches these limitations for the same reasons as discussed in Sections VII.B.2.a-VII.B.2.c. *Id.*, ¶¶206-211.

7. Claim 6

Lee discloses or suggests this limitation for the same reasons as explained in Section VII.A.3. *Id.*, ¶213.

8. Claim 7

Lee in combination with the AAPA teaches these limitations for the same reasons as discussed in Section VII.B.3. *Id.*, ¶215.

9. Claim 8

Lee in combination with the AAPA teaches these limitations for the same reasons as discussed in Section VII.B.5. *Id.*, ¶217.

C. Ground 2: Obviousness Over Chiang and Lin

Chiang combined with Lin renders obvious claims 1-8 of the '556 Patent to the extent that “sparse de-noising filter” is construed as proposed by PO in the related ITC proceeding. *Id.*, ¶218.

1. Chiang (US 2006/0110062 A1)

Chiang teaches “an edge adaptive filtering system [and method] for reducing artifacts” in a decoded image. Chiang, ¶5. Chiang’s image decoder implements an edge adaptive filter in conjunction with a deblocking filter. *Id.*, ¶34. Chiang’s edge adaptive filter “processes image information to remove ringing artifacts. *Id.*, ¶41. Chiang’s de-blocking filter reduces blocking artifacts. *Id.*, ¶29. Chiang describes that each of the de-blocking filter and the edge adaptive filter can be implemented in-loop. *Id.*, ¶¶34, 40.

In Chiang, the adaptive edge filter adaptively filters image information in a block by using the filter weights identified from a visual weight map generator. *Id.*,

¶56. The visual weight map generator identifies filter weights based on input from a texture analyzer, an edge analyzer, a quality analyzer, and a monotone detector, each of which analyze portions of the image being decoded. *Id.*, ¶55; Reader, ¶122. In some circumstances, Chiang recognizes that it is appropriate to set filter weights to 0, meaning that no adaptive edge filtering occurs. Chiang, ¶81.

2. Lin (US 2003/0152146 A1)

Lin provides techniques and tools for processing reference frames in a motion estimation/compensation loop or motion compensation loop. Lin, Abstract. Lin teaches its decoder using one or more in-loop filters, and that in-loop filtering can be enabled or disabled on “a per-frame, per-sequence, or other basis.” Lin, ¶¶123, 131.

3. Claim 1

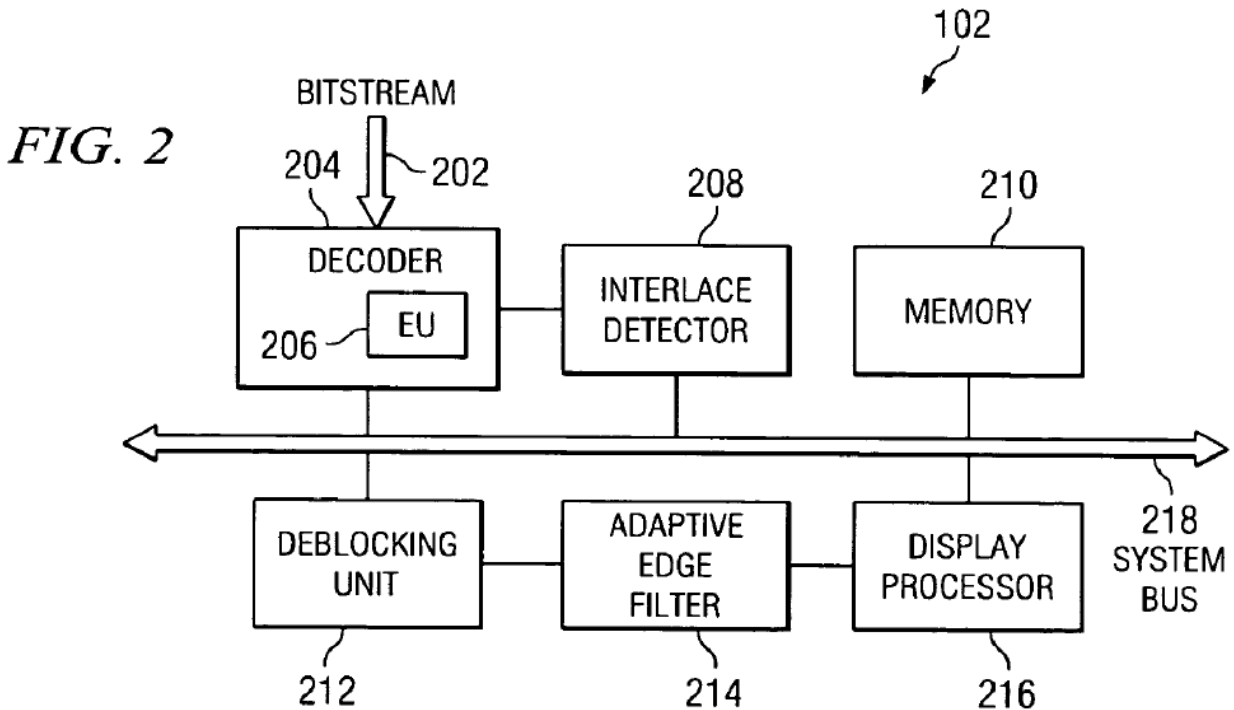
a. 1[pre]

To the extent that the preamble is limiting, Chiang in combination with Lin renders obvious a method. Reader, ¶¶220-221. For example, Chiang is directed to “an edge adaptive filtering system for reducing artifacts and method.” Chiang, ¶1.

b. 1[a1]

Chiang in combination with Lin renders obvious this limitation. Reader, ¶¶222-226.

Chiang discloses “decoding an image region.” Reader, ¶222. For example, Chiang discloses “image decoder 102 [that] decodes [] received information representing an image.” Chiang, ¶29. Chiang describes its decoding method with reference to an example image decoder, depicted in Figure 2:



Chiang discloses using two types of filters “in conjunction” to remove two types of artifacts from decoded images: an “edge adaptive filtering system that reduces or removes ringing artifacts” and a “de-blocking filtering system that reduces or removes blocking artifacts.” Chiang, ¶34; Reader, ¶224.

Chiang further teaches that its adaptive edge filtering system and its de-blocking filtering system may be implemented as in-loop filters or after the decoding loop. Reader, ¶225; Chiang ¶¶ 34 (“The edge adaptive filtering system may be used

at any suitable point.... For example [it] could operate after motion compensation during image decoding....”), 40 (“the decoder 204 may implement in-loop filtering to reduce or eliminate blocking artifacts”). Although much of Chiang’s subsequent explanation regarding application of its filters focuses on an embodiment in which the filters are applied outside of the decoding loop, a POSITA would have understood that those teachings equally apply to an in-loop implementation. Reader, ¶225.

Finally, Chiang teaches that its de-blocking filter and adaptive edge filter are used “in succession.” Reader, ¶226. Specifically, Chiang teaches an implementation in which “[t]he output of the de-blocking unit 212 is provided to an adaptive edge filter 214.” Chiang, ¶41. As noted above, while this particular arrangement involves the de-blocking unit 212 and adaptive edge filter 214 being applied outside of the decoding loop, a POSITA would have understood that Chiang teaches applying the same order of filters in-loop. Reader, ¶226.

c. 1[a2]

Chiang in combination with Lin renders obvious this limitation. Reader, ¶¶227-229.

As explained in Section VII.C.3.b, Chiang’s deblocking filter “reduces or removes blocking artifacts.” Chiang, ¶34. Chiang further teaches that its deblocking filter may be applied before its adaptive edge filter, i.e., in a “first pass.” Chiang,

¶41; Reader, ¶228. In this arrangement, a POSITA would have further understood that Chiang's adaptive edge filter performs a "second pass" because it filters the image information after it has already been filtered by Chiang's de-blocking filter. Reader, ¶228.

Finally, a POSITA would have understood that, to the extent that prosecution history disclaimer does not apply to "sparse de-noising filter" to exclude a deringing filter, Chiang's adaptive edge filter is an adaptive "sparse de-noising filter" under PO's proposed ITC construction and understanding of the term. Reader, ¶229. Specifically, PO's interpretation of the term broadly encompasses a filter which "adapts to the sparse nature of underlying video signals by 'preventing excessive blurring when the filter is applied across an edge'"; precisely the behavior found in Chiang's adaptive edge filter, which "perform[s] edge adaptive filtering to reduce or remove ringing artifacts near edges and in flat regions of decoded images." Chiang, ¶¶41, 31 ("For each pixel, the edge adaptive filtering system uses the [distance between a pixel of interest and an edge] to identify a filter weight for that pixel"), 81-82 (describing "an inverse relationship between filter weights and relative edge magnitudes"); Reader, ¶229 (citing PO's infringement contentions). Applying the same reasoning, Chiang's adaptive edge filter must also be a "sparse de-noising filter," and thus teaches this limitation. *Id.*

d. 1[a3]

Chiang in combination with Lin renders obvious this limitation. Reader, ¶¶230-237.

Chiang discloses that the filter weights of its adaptive edge filter are provided by a visual weight map generator. Chiang, ¶56 (“adaptive filter 314 also receives the filter weights from the visual weight map generator 312.”). For each macroblock, the visual weight map generator itself uses visual weight curves output by an edge analyzer, a quality analyzer, a texture analyzer, and a monotone detector to associate filter weights with a given image block. Chiang, ¶¶49-50, 52, 55, Fig. 3; Reader, ¶231. Each of these visual weight curves must therefore be individually calculated before filter weights can be provided to the adaptive filter. *See*, Chiang ¶¶51-55; Reader, ¶231. However, Chiang discloses circumstances where filter weights are ultimately set to zero, such that no filtering occurs. Chiang, ¶¶75, 81, 88. Accordingly, in circumstances where Chiang sets the filter weights to 0 for a given macroblock, Chiang selectively disables its adaptive edge filter (i.e., “adaptive sparse de-noising filter”) at the macroblock level. Reader, ¶231.

Chiang also discloses circumstances in which filter weights would predictably be set at or close to zero. Reader, ¶232. For example, monotone or near monotone regions may be excluded from filtering to “prevent inherent grainy details from being smoothed out.” Chiang, ¶75. As another example, Chiang notes that images

that are coarsely quantized may have “high ringing noise due to greater loss of high frequency coefficients” while finely quantized image data may have “little ringing noise and better video quality.” Chiang, ¶70.

Based on these disclosures, a POSITA would have understood that under certain circumstances, Chiang’s adaptive edge filter may perform multiple calculations to ultimately determine that no filtering should occur. Reader, ¶233. A POSITA would have thus recognized that the Chiang’s decoder’s processing resources may be conserved, and decoding sped up, if the calculations to set filter weights are omitted in circumstances when no filtering is required. *Id.*

In the same field of invention, Lin discloses a method for decoding that uses in-loop filters. E.g., Lin, ¶¶2, 118. Lin explains that various features of loop filtering can be combined. Lin, ¶118. For example, Lin discloses that one feature is “adaptively enabling and disabling loop filtering in a...decoder on a per-frame, per-sequence, or other basis.” Lin, ¶126. Lin further teaches “[e]nabling or disabling loop filtering in a video decoder according to flags received from a video encoder.” Lin, ¶127. A POSITA would have recognized that receiving flags from an encoder to enable or disable loop filtering would conserve processing resources by a decoder without degrading image quality in circumstances where the decoder would have otherwise had to perform calculations to determine that no filtering (i.e., setting a filter weight of zero) should occur. Reader, ¶234. A POSITA would have further

understood that Lin teaches using such flags “on a per-frame, per-sequence, or other basis.” *Id.*

A POSITA would have been motivated to combine Chiang’s decoding method with Lin’s teachings of receiving a flag from the encoder to enable or disable loop filtering on a per-frame, per-sequence, or other basis in order to conserve processing resources at the decoder. Reader, ¶¶235-236. A POSITA would have understood that disabling in-loop filtering as taught by Lin in circumstances when Chiang’s filter weights would have been set to zero, such as for decoding monotone or near monotone regions, would have conserved processing resources without degrading image quality. Reader, ¶235. Similarly, in circumstances where an image is very finely quantized, a POSITA would have recognized that disabling in-loop filtering as taught by Lin could conserve resources while still providing acceptable image quality because finely quantized images already have “little ringing noise and better video quality.” Chiang, ¶70; *Id.*

A POSITA would have had a reasonable expectation of success in using Lin’s flags to enable or disable loop filtering because Chiang already teaches use of a flag to indicate certain image characteristics, such whether the image is interlaced or progressive to the decoder, Chiang ¶¶58, 60, 62. Chiang further teaches that its decoder comprises an “extraction unit 206 [that] extracts various encoding parameters from the bitstream [received from an encoder].” Chiang, ¶37. A POSITA

would have thus recognized that Chiang already teaches the use of a flag to control filtering and a way to extract flags from an encoded bitstream. Applying Lin's teaching of receiving a flag from the encoder to enable or disable filtering on a per-frame, per-sequence, or other basis with Chiang's decoding method in order to conserve resources by the decoder would have thus been no more than applying known technique (receiving flags from the encoder) to a known method ready for improvement (Chiang's decoding method) to yield predictable results. Reader, ¶236.

Accordingly, Chiang, and/or the combination of Chiang and Lin, renders obvious enabling or disabling in-loop filtering, and thus Chiang's in-loop adaptive edge filter ("adaptive sparse de-noising filter") at a given level, the given level being at least a sequence level. Reader, ¶237.

4. Claim 2

Chiang in combination with Lin renders obvious this limitation. Reader, ¶¶238-242. Each of Chiang and Lin teach this limitation, and a POSITA would have been motivated to combine those references' teachings as discussed with respect to claim 1. Reader, ¶239.

First, Chiang discloses its adaptive edge filter adjusting its filtering depending on whether the image being decoded is an interlaced or progressive image "so that interlaced details of the image are protected and filtering is improved or optimized." Chiang, ¶¶31, 37-38. Chiang also discloses its adaptive edge filter enforcing multiple

other compression constraints. Chiang explains that encoding parameters that “may include quan_scale_code, quan_scale_type, non_linear_quan_scale, quan_matrix, macroblock_type, and picture_coding_type parameters” are extracted from the MPEG-2 bitstream. *Id.*, ¶68. A quality analyzer then uses these parameters to output a visual weigh curve value, ct_q . *Id.*, ¶71. Chiang then discloses that “edge adaptive filter 214 can be customized with quantization step size to select suitable visual weight curve values for balancing between filtering ringing noise and smoothing details.” *Id.*, ¶70, *see also, id.*, ¶¶71-74. In all cases, Chiang’s adaptive edge filter changes its filtering based on the qualities of the compressed image being filtered, i.e., enforces a compression constraint. Reader, ¶240. Lin discloses using a flag to enable or disable loop filtering, and a POSITA would have been motivated to incorporate this teaching from Lin with Chiang as discussed in Section VII.C.3.d. A POSITA would have understood that enabling or disabling loop filtering via a flag, as taught by Lin, would result in both of Chiang’s deblocking and adaptive edge filters enforcing a compression constraint because both the encoder and decoder are constrained ahead of time to use syntax and tools available to ensure that which is encoded can later be decoded. Reader, ¶241.

5. Claim 3

Chiang in combination with Lin renders obvious this limitation. *Id.*, ¶¶243-244.

As explained in Section VII.C.3.d, the combination of Chiang and Lin renders obvious enabling or disabling in-loop filtering by using a flag from the encoder in circumstances where filter weights would have been set to zero or where images are finely quantized and thus are already relatively high quality. *Id.*, ¶244. A POSITA would have thus understood that both (i.e., “at least one”) of Chiang’s in-loop filters are adaptively enabled or disabled depending on data characteristics corresponding to the image region (e.g., whether the image region is monotone or nearly monotone, Chiang, ¶75, or finely quantized, Chiang, 70). Reader, ¶244.

6. Claim 4

Chiang in combination with Lin renders obvious this limitation. Reader, ¶¶245-246.

Specifically, Chiang explains that its deblocking filter “at least partially reduce[s] blocking artifacts in the image” and its adaptive edge filter “partially reduce[s] ringing artifacts in the image. Chiang, ¶29. A POSITA would have understood that the reduction of the blocking and ringing artifacts by Chiang’s deblocking and adaptive edge filters results in a “version of the image region that is displayed [being] different from...an initial input signal corresponding to the image region before the at least two in-loop filters.” Reader, ¶246

7. Claim 5

a. 5[pre]

To the extent that the preamble is limiting, Chiang in combination with Lin renders obvious this limitation. Reader, ¶¶247-248. Chiang discloses an apparatus comprising an image decoder. Chiang, ¶27, Fig. 1. Chiang further discloses that the image decoder comprises a display processor 216 and a memory 210. Chiang, ¶¶42-43, Fig. 2. Further, a POSITA would have understood that in addition to the processor and memory explicitly identified in Figure 2, the other elements of the decoding apparatus disclosed by Chiang would have also been implemented via one or more processors and memories. Reader, ¶248.

b. 5[a1]-5[a3]

Chiang in combination with Lin renders obvious this limitation for the same reasons as discussed in Sections VII.C.3.b-VII.C.3.d. Reader, ¶¶249-254.

8. Claim 6

Chiang in combination with Lin renders obvious this limitation for the same reasons as discussed in Section VII.C.4. Reader, ¶256.

9. Claim 7

Chiang in combination with Lin renders obvious this limitation for the same reasons as discussed in Section VII.C.4. Reader, ¶258.

10. Claim 8

Chiang in combination with Lin renders obvious this limitation for the same reasons as discussed in Section VII.C.6. Reader, ¶260.

D. Ground 3: Obviousness Over the VC1 Standard and Guleryuz

The VC1 Standard combined with Guleryuz renders obvious claims 1-8 of the '556 Patent under any of the four proposed constructions in the related ITC proceeding. Reader, ¶261.

1. VC-1 Compressed Video Bitstream Format and Decoding Process (“VC1 Standard”)

The VC1 Standard is an SMPTE (the Society of Motion Picture and Television Engineers) standard based on WMV9 (Windows Media Video 9) developed by Microsoft. The VC1 Standard contains coding tools for interlaced video sequences as well as progressive encoding.

The VC1 Standard describes the decoding process for decoding progressive pictures and interlace pictures. VC1, 120, 253. Two filtering operations, i.e., overlap smoothing and in-loop deblocking, are included in a decoding process. E.g., VC1, 4, 5, Figs. 3, 4. Relevant here, the in-loop deblocking filtering is performed to smooth out the discontinuities at block boundaries. VC1, 178. In addition, two filtering operations, i.e., deblocking filtering and deringing filtering, are included in the post-processing. VC1, 452.

Syntax elements are included in a bitstream to be decoded that selectively enable or disable the filtering operations. VC1, 463. These syntax elements include a LOOPFILTER flag to control the in-loop deblocking filtering, VC1, 462, an OVERLAP flag to control overlap smoothing, VC1, 463, and a POSTPROC flag to control the two post-processing filtering operations, VC1, 452.

2. A Nonlinear Loop Filter for Quantization Noise Removal in Hybrid Video Compression (“Guleryuz”)

Guleryuz discusses the use of loop filters for video compression. Guleryuz, 1. Guleryuz discloses a “high-performance, nonlinear, loop filter that reduces quantization noise over video frames composed of locally uniform regions (smooth, high frequency, texture, etc.) separated by singularities.” *Id.*, Abstract. Guleryuz explains that its filter “is not limited to block based transform coders and provides a robust solution for intra as well as differentially encoded frames.” *Id.* Guleryuz’s filter reduces quantization noise. *Id.*, 1-2. Such noise includes both blocking artifacts and artifacts around sharp edges. *Id.*, 3-4.

3. Claim 1

a. 1[pre]

To the extent that the preamble is limiting, the VC1 Standard in combination with Guleryuz renders obvious a method. Reader, ¶¶264-265. For example, the VC1 Standard discloses a decoding process. E.g., VC1, 4-5; Figs. 3-4.

b. 1[a1]

The VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶266-271. For example, the VC1 Standard discloses a decoding process that includes an in-loop deblock filtering process. VC1, 178-188 and 322-328; *see generally*, VC1, Section 8 and Section 10. A POSITA would have understood that the in-loop deblock filtering process reduces a first type of coding artifact – blocking artifacts. Reader, ¶267; VC1, 198 (“the intent of the loop filtering is to smooth out the discontinuities at block boundaries”).

In the same field as the VC1 Standard, Guleryuz discloses a “high-performance, nonlinear, loop filter that reduces quantization noise over video frames composed of locally uniform regions (smooth, high frequency, texture, etc.) separated by singularities.” Guleryuz, Abstract. Guleryuz explains that its filter “is not limited to block based transform coders and provides a robust solution for intra as well as differentially encoded frames.” *Id.* Guleryuz’s filter reduces quantization noise. Guleryuz, 1-2. Such noise includes both blocking artifacts and artifacts around sharp edges. Guleryuz, 3-4; Reader, ¶268. A POSITA would have understood that Guleryuz’s filter therefore reduces at least a second type of coding artifact (e.g., artifacts around sharp edges). Reader, ¶268.

A POSITA looking to apply the teachings of the VC1 Standard would have recognized that in-loop deblocking filters such as the one taught by the VC1

Standard have shortcomings in that they do not address other types of coding artifacts very well. Reader, ¶269. Indeed, the stated purpose of the VC1 in-loop deblocking filter is to “smooth out discontinuities at block boundaries” – it is silent regarding other coding artifacts. VC1, 198. A POSITA would have further recognized that using an additional in-loop filter to remove coding artifacts after application of a deblocking filter was a common technique to improve the quality of decoded images.⁶ Reader, ¶269. Indeed, the VC1 Standard already teaches the use of multiple in-loop filters, each addressing different coding artifacts, because it employs both an overlap smoothing filter and a deblocking filter in the decoding loop. E.g., VC1 at Figs. 3, 4. Accordingly, a POSITA would have been motivated to combine the teachings of the VC1 Standard and Guleryuz by applying Guleryuz’s in-loop denoising filter after the VC1 Standard in-loop deblock filter. Reader, ¶269. Doing so would have amounted to no more than combining prior art elements (the VC1 Standard in-loop deblock filter and Guleryuz’s in-loop denoising filter)

⁶ While the VC1 Standard contemplates a post-processing deringing filter to remove ringing artifacts, a POSITA would have recognized the benefit of using a second in-loop filter after VC1’s in-loop deblock filter in order to improve the decoding process by providing higher quality reference frames during the decoding loop. Reader, ¶269.

according to known methods (implementing an in-loop denoising filter after an in-loop deblocking filter as taught in numerous prior art references including Lee and Chiang) to yield predictable results (improved decoded image quality over use of just VC1's in-loop deblock filter). *Id.* Likewise, it would have been no more than use of a known technique (applying an in-loop denoising filter after an in-loop deblocking filter, as taught by numerous prior art references such as Lee and Chiang) to a known method ready for improvement (the VC1 Standard applying an in-loop deblock filter) to yield predictable results (improved decoded image quality). *Id.*

In combining the VC1 Standard's in-loop deblock filter and Guleryuz's in-loop denoising filter, a POSITA would have been motivated to apply Guleryuz's in-loop denoising filter *after* the VC1 Standard in-loop deblock filter. Reader, ¶270. Guleryuz notes the fact that quantization noise is not i.i.d. noise presents an obstacle to applying its denoising filter. Guleryuz, 2. A POSITA would have further understood that after removal or reduction of blocking artifacts, the remaining quantization noise is a much closer match to i.i.d. noise. Reader, ¶270. Accordingly, a POSITA would have been motivated to apply Guleryuz's in-loop denoising filter after the VC1 Standard in-loop deblock filter because doing so would have made implementing Guleryuz's filter easier. *Id.* However, even if a POSITA would not have made the connection that applying the deblock filter would have eased implementation of Guleryuz's denoising filter, doing so would have been obvious to

try because it is one of two options (deblock filter first or denoising filter first). *Id.* It also would have been obvious to try because other prior art such as Lee and Chiang teach applying a deblocking filter first. *Id.*

Accordingly, the combination of the VC1 Standard and Guleryuz teaches decoding an image region wherein the decoding includes performing in-loop filtering to reduce at least a first (block artifact) and a second (quantization noise) type of coding artifact using at least two filters (VC1 in-loop deblock filter and Guleryuz's in-loop denoising filter) in succession. Reader, ¶271.

c. 1[a2]

The VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶272-275.

As explained in Section VII.D.3.b, a POSITA would have been motivated to combine the teachings of the VC1 Standard and Guleryuz such that the VC1 Standard's in-loop deblock filter is applied first to reducing blocking artifacts. Reader, ¶273. As such, Guleryuz's in-loop denoising filter would have been applied in a "second pass." *Id.* And as explained in Section VII.D.3.b, Guleryuz's in-loop denoising filter reduces quantization noise. Guleryuz, 1; Reader, ¶273.

A POSITA would have recognized that Guleryuz's in-loop denoising filter is a "sparse denoising filter" under any of the four proposed constructions in the related ITC proceedings. Reader, ¶274. Guleryuz's filter "exploits a sparse image model

using a possibly overcomplete set of linear transforms.” Guleryuz, 1. Guleryuz further teaches that its filter uses “a hard-threshholding nonlinearity using a threshold to preprocess [elements in a set $S_i(j)$ of sample values]” in its expectation calculation. Guleryuz, 2-3. A POSITA would have thus recognized that Guleryuz’s filter is a “sparse denoising filter” as used in the ’556 Patent and proposed in the Respondents’ alternative construction. Reader, ¶274. Further, Guleryuz’s filter is also consistent with the Staff’s construction because Guleryuz’s transforms would have resulted in a “sparse representation of the signal” which is then denoised per Guleryuz’s denoising rule. *Id.* And because PO’s construction broadly encompasses both sparse signals and sparse representations of signals, Guleryuz’s filter is also consistent with PO’s construction. *Id.* Finally, Guleryuz’s in-loop denoising filter is a “sparse denoising filter” under Respondents’ primary construction that excludes deringing filters because Guleryuz’s filter reduces all quantization noise, not just ringing artifacts. *Id.*

Finally, Guleryuz’s filter is adaptive. Reader, ¶275. Specifically, Guleryuz explains that “[c]onsideration is given to compression parameters/modes to ensure overfiltering is kept to a minimum and a refinement step is proposed that improves the expectation calculation.” Guleryuz, 2. Guleryuz further teaches its filter calculating multiple denoised estimates of a signal and averaging them “to form an overall estimate” used to set filter weights. Guleryuz, 2-3; Reader, ¶275. A POSITA

would have thus recognized that Guleryuz's sparse denoising filter is adaptive because filter weights are changed (i.e., "adapted") based on changes in the signal. Reader, ¶275.

d. 1[a3]

The VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶276-281.

The VC1 Standard teaches use of a loop filter flag that is "a Boolean that shall indicate whether loop filtering is enabled for a sequence." VC1, 482-483. The VC1 Standard teaches that if "LOOPFILTER == 0, then loop filtering shall not be enabled. If LOOPFILTER == 1, then loop filtering shall be enabled." *Id.*

In the combination discussed in Section VII.D.3.b, where Guleryuz's adaptive sparse de-noising in-loop filter is used after the VC1 Standard's deblock filter, a POSITA would have recognized that the VC1 Standard's loop filter flag would selectively enable or disable Guleryuz's adaptive sparse de-noising filter at the sequence level because Guleryuz's filter is applied in-loop (after the VC1 Standard deblock filter). Reader, ¶278 (explaining that the VC1 Standard loop filter flag would have applied to both the in-loop deblock filter taught by the VC1 and Guleryuz's adaptive sparse de-noising filter because the two filters would both be in the same "loop filter" function block).

To the extent that PO argues that the VC1 Standard's LOOPFILTER flag would not have selectively enabled or disabled Guleryuz's adaptive sparse denoising filter in the combination as proposed above, PO would be incorrect because, as Dr. Reader explains, a POSITA would have implemented Guleryuz's adaptive sparse denoising filter in the same function block as VC1's in-loop deblocking filter, such that the LOOPFILTER flag would selectively enable or disable both filters together. Reader, ¶279. A POSITA would have found it obvious to use a single flag to control two filters and would have been motivated to do so because the VC1 Standard itself teaches that a single flag, the POSTPROC flag, can control two separate filters. VC1 at 472; Reader, ¶279.

Alternatively, and as a design choice that would offer finer control over in-loop filtering at the expense of slightly reduced compression due to having to code an additional filter flag, a POSITA would have been motivated to implement Guleryuz's adaptive sparse de-noising filter with its own flag that selectively enables or disables the filter. Reader, ¶280. The VC1 Standard itself teaches use of flags to selectively enable or disable various filters in the decoding processes. In addition to the LOOPFILTER flag, the VC1 Standard also teaches an OVERLAP flag to selectively enable or disable a filtering operation referred to as overlap smoothing, VC1, 195, and POSTPROC field to selectively enable or disable post-processing filtering of pictures, VC1, 472. Thus, a POSITA would have found it obvious to

include a separate flag to individually control Guleryuz's adaptive sparse de-noising filter as applied after VC1's in-loop deblocking filter. Reader, ¶280. Doing so would have been no more than combining prior art elements (the VC1 Standard's decoding process and Guleryuz's adaptive sparse de-noising filter) according to known methods (VC1's use of flags to enable or disable filters used in the decoding process) to yield predictable results (selectively enabling or disabling Guleryuz's adaptive sparse de-nosing filter). *Id.* It also would have merely amounted to use of a known technique (VC1's use of flags to enable or disable filters in the decoding process) to improve similar methods in the same way (also using a flag to enable or disable Guleryuz's adaptive sparse de-noising filter when it is applied in VC1's decoding process). *Id.*

Accordingly, the combination of the VC1 Standard and Guleryuz teaches at least two possible configurations that a POSITA would have been motivated to implement in which Guleryuz's adaptive sparse denoising filter is selectively enabled or disabled at the sequence level. Reader, ¶281.

4. Claim 2

The VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶282-285.

Guleryuz teaches that its adaptive sparse denoising filter includes a “mask function” used to reduce overfiltering in circumstances where differentially coded

SKIP macroblocks have been previously filtered. Guleryuz, 3. Specifically, Guleryuz teaches that the mask function “determines the pixels which should not undergo filtering.” Guleryuz, 3. “In short, if the mask for a pixel is set to 1, the final filtered value is copied from the output of the *combine* function, otherwise the final filtered value is set to the value provided by *y*.” *Id.* “For intra frames the mask function is 1 on all pixels.” *Id.* The value of the mask for a pixel is determined based on “the compression modes around each macroblock boundary.” *Id.* Guleryuz further provides rules for determining the mask value for six different macroblock types. *Id.*, section 3.5. A POSITA would have understood that Guleryuz’s adaptive sparse denoising filter enforces a compression constraint because it values the strength of filtering (or entirely disables filtering) based on compression characteristics of the macroblock being filtered (either, what type of macroblock it is coded as). Reader, ¶¶284-285.

5. Claim 3

The VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶286-288.

Guleryuz teaches that its adaptive sparse denoising filter includes a “mask function” used to reduce overfiltering in circumstances where differentially coded SKIP macroblocks have been previously filtered. Guleryuz, 3. Specifically, Guleryuz teaches that the mask function “determines the pixels which should not

undergo filtering.” Guleryuz, 3. “In short, if the mask for a pixel is set to 1, the final filtered value is copied from the output of the *combine* function, otherwise the final filtered value is set to the value provided by *y*.” *Id.* A POSITA would have thus understood that the Guleryuz teaches adaptively disabling (via a mask value of 1) or enabling (via a mask value other than 1) its adaptive sparse denoising filter. Reader, ¶287.

The value of the mask for a pixel is determined based on “the compression modes around each macroblock boundary.” Guleryuz, 3. A POSITA would have understood that Guleryuz thus adaptively determines the mask value depending on “data characteristics corresponding to the image region,” i.e., the compression modes around each macroblock. Reader, ¶288. Accordingly, the combination of the VC1 Standard and Guleryuz teaches adaptively enabling or disabling the adaptive sparse denoising filter as taught by Guleryuz “depending on data characteristics corresponding to the image region.” *Id.*

6. Claim 4

The VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶289-290.

The VC1 Standard teaches that its in-loop deblock filter “smooth[es] out the discontinuities at block boundaries.” VC1 at 198. Similarly, Guleryuz teaches that its adaptive sparse denoising filter produces “filter effects [that] are especially

pronounced around sharp edges...texture and edge information is preserved while artifacts are suppressed.” Guleryuz, 3. Based on each of these teachings, a POSITA would have recognized that, because each of the VC1 Standard deblock filter and Guleryuz’s adaptive sparse denoising filter modifies an input image to produce a filtered output image, the version of the image that is displayed after the in-loop filtering performed by the combination of the VC1 Standard and Guleryuz discussed in Section VII.D.3.b would be different from the initial input signal corresponding to the image before the two in-loop filters are applied. Reader, ¶290.

7. Claim 5

a. 5[pre]

To the extent that the preamble is limiting, the VC1 Standard in combination with Guleryuz renders obvious this limitation. Reader, ¶¶291-292. Specifically, a POSITA would have understood that both the VC1 Standard and the adaptive sparse denoising filter taught by Guleryuz are intended to be implemented by a decoder, and that decoders are apparatuses comprising at least a processor and memory. Reader, ¶292. Indeed, the VC1 Standard acknowledges that “processing speed and memory” are taken into consideration by the standard. VC1, 449; Reader, ¶292.

b. 5[a1]-5[a3]

The VC1 Standard in combination with Guleryuz renders obvious this limitation for the same reasons as discussed in Sections VII.D.3.b-VII.D.3.d. Reader, ¶¶293-298.

8. Claim 6

The VC1 Standard in combination with Guleryuz renders obvious this limitation for the same reasons as discussed in Section VII.D.4. Reader, ¶300.

9. Claim 7

The VC1 Standard in combination with Guleryuz renders obvious this limitation for the same reasons as discussed in Section VII.D.4. Reader, ¶302.

10. Claim 8

The VC1 Standard in combination with Guleryuz renders obvious this limitation for the same reasons as discussed in Section VII.D.6. Reader, ¶304.

VIII. Discretionary Factors Favor Institution

A. *Fintiv*

Petitioner expects that PO will not raise *Fintiv* here, but even if it does, the Board should not deny institution on that basis.

There are two concurrent proceedings involving the '556 Patent, one before the district court, and one before the ITC. *Fintiv*, however, does not apply to ITC proceedings. K. Vidal, Memorandum, U.S. PAT. AND TRADEMARK OFFICE, 2–3 (June 21, 2022).

As for the district court proceedings, the relevant *Fintiv* factors weigh heavily against a discretionary denial. Those proceedings were initiated in September 2023, *InterDigital, Inc. et al v. Lenovo Group Limited, et al*, 5-23-cv-00493, ECF No. 1 (EDNC Sept. 1, 2023). The court has entered a schedule that proceeds only through claim construction, no Markman order has been issued, and no trial has been scheduled. ECF No. 120 (June 12, 2024). The June 2024 statistics for median-time-to-trial for the court put trial in mid-April, 2026, after the expected FWD deadline (March 2026). Further, it is unclear whether any overlap yet exists between this Petition and issues that might be raised in the district court. For these reasons, discretionary denial under *Fintiv* is unwarranted.

B. Section 325(d)

The Board should likewise not exercise its discretion under §325(d) to deny institution. *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8, 17–18 (Dec. 15, 2017) (precedential); *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469 Paper 6, 9–11 (Feb. 13, 2020) (precedential).

Considering the first part of the *Advanced Bionics* framework—including *Becton, Dickinson* factors (a), (b), and (d)—two of the references presented in this petition were previously before the Examiner: Lee, Guleryuz, and the AAPA. The Examiner applied Lee and the AAPA in rejections of the parent application, but

Guleryuz was cited only in an IDS but never applied by the Examiner. *See GMG Prods. LLC v. Traeger Pellet Grills LLC*, PGR2019-00024, Paper 17, 27 (July 17, 2019) (listing on an IDS alone “does not favor denying institution” because “the Examiner did not provide any detailed assessment of [the prior art, and], instead, only indicat[ed] the references had been considered”). The remaining references in Grounds 2 and 3 (Chiang, Lin, and VC-1) have never been before the Office with respect to the ’556 patent. Accordingly, considering the entirety of the Grounds in this Petition, the same or substantially the same art or arguments were not previously presented to or considered by the Office; there is no need to go to *Advanced Bionics* part two.

Nevertheless, should the PTAB disagree, Petitioner addresses part two of the *Advanced Bionics* framework. Regarding Ground 1A, the Examiner did not consider PO’s proposed construction of “sparse denoising filter” during prosecution. If the Board adopts that construction here, the Examiner erred in allowing the Challenged Claims over Lee for the reasons discussed in Ground 1A above, including how Lee teaches a “sparse denoising filter” under PO’s construction. *See supra* §VII.A.2.c; *see also* Reader, ¶¶137, 147-150. In addition, as discussed in Section IV.A, the Examiner allowed the parent application after Applicant amended the pending claims to recite an “adaptive sparse denoising filter.” But the Examiner characterized Lee’s deringing filter as adaptive. EX1005, 304 (“Lee discloses an adaptive

deringing filter (de-noising filter) (paragraph [0049]”). And to the extent the Examiner found Lee’s deringing filter is not adaptive, that was error as explained above. *See supra* §VII.A.2.c; *see also* Reader, ¶149.⁷

Regarding Ground 1B, the Examiner erred in allowing the claims of the parent application and subsequently the Challenged Claims over Lee in view of AAPA because the Lee-AAPA combination renders obvious all of the Challenged Claims regardless of the adopted construction of “adaptive sparse denoising filter.” *See supra* §VII.B; *see also* Reader, ¶¶178, 188-191. As explained in this petition, neither Applicant’s argument that the AAPA taught away from use of a sparse denoising filter nor Applicant’s amendment to add “adaptive” to the claim term should have overcome the Examiner’s rejection based on the Lee-AAPA combination. *See supra* §VII.B; *see also* Reader, ¶¶113, 178, 188-191. Furthermore, the Examiner correctly found that Lee’s deringing filter is adaptive, and the AAPA likewise teaches that the known denoising filter is “adaptive.” EX1001, 2:7:13 (“a nonlinear de-noising filter

⁷ To the extent that the Board adopts any of the other proposed constructions in the ITC (Respondent’s or the ITC Staff’s), Petitioner concedes that the Challenged Claims are not unpatentable as obvious over Lee alone. However, the Challenged Claims are still unpatentable as obvious over other Grounds in the Petition, and so the Board should still not deny institution under Section 325(d).

adapts to non-stationary image statistics which exploits a sparse image model.... The nonlinear de-noising filter automatically becomes high-pass, or low-pass, or band-pass, and so forth, depending on the region the filter is operating on.”). The Examiner’s later allowance after the claims were amended to recite an “*adaptive* sparse de-noising filter” was thus an error. *See supra* §IV.B; *see also* Reader, ¶118.

Regarding Ground 3, as noted above, Guleryuz was cited in an IDS during prosecution of the parent application. However, the Examiner did not apply Guleryuz in a rejection or consider it in combination with the VC-1 standard.

For at least these reasons, the Board should not discretionarily deny institution under Section 325(d).

IX. Mandatory Notices

A. Real Party in Interest

In addition to itself, Petitioner identifies Lenovo Group Limited and Lenovo (United States) Inc. as real parties in interest.

B. Related Matters

To the best of Petitioner’s knowledge, the ’556 patent has been involved in the following matters:

- *InterDigital, Inc. et al v. Lenovo Group Limited, et al*, 5-23-cv-00493 (EDNC);

- Electronic Devices Including Smartphones, Computers, Tablet Computers, and Components Thereof; Inv. No. 337-TA-1373 (ITC).

C. Notice of Counsel and Service Information

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D. Service Information

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X. Conclusion

Inter Partes Review of the challenged claims is respectfully requested.

Respectfully submitted,

/ Jessica Kaiser /

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Date: September 17, 2024

CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(d)

Pursuant to 37 C.F.R. §42.24(a), Petitioner hereby certifies that portions of the above-captioned Petition for *Inter Partes* Review of U.S. Patent 9,674,556, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,984. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that true copies of the Petition for *Inter Partes* Review of U.S. Patent No. 9,674,556 and supporting materials (Exhibits and Power of Attorney) were served via overnight delivery on the Patent Owner at the correspondence address of record as listed on PAIR:

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