

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,

Petitioner

v.

TELEFONAKTIEBOLAGET LM ERICSSON,

Patent Owner.

IPR2024-01008

U.S. PATENT NO. 9,641,841

PATENT OWNER'S PRELIMINARY RESPONSE

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Exhibit No.	Description
Ex-2001	Declaration of Dr. Iain Richardson
Ex-2002	<i>Curriculum Vitae</i> of Dr. Iain Richardson
Ex-2003	ITU Webpage showing ITU-T Rec. H.261, first published in 1988, https://www.itu.int/rec/T-REC-H.261-198811-S/en
Ex-2004	PDF Print of FiltScript2.m
Ex-2005	PDF Print of TestFilt2.m
Ex-2006	PDF Print of FiltBlocksAltThr_2a.txt
Ex-2007	PDF Print of FiltBlocksAltThr_2b.txt
Ex-2008	PDF Print of FiltBlocksThr1Thr2_2a.txt
Ex-2009	PDF Print of FiltBlocksThr1Thr2_2a.txt
Ex-2010	PDF Print of FiltStatsAltThr_2a.txt
Ex-2011	PDF Print of FiltStatsAltThr_2b.txt
Ex-2012	PDF Print of FiltStatsThr1Thr2_2a.txt
Ex-2013	PDF Print of FiltStatsThr1Thr2_2b.txt
Ex-2014	PDF Print of TestUint8.c
Ex-2015	Sullivan et al., <i>HEVC: Algorithms and Architectures</i> (2014)

TABLE OF CLAIMS

Reference	Claim Limitation
Claim 1	
1[pre]	A method for filtering control applicable to a block of multiple pixels in a video frame, each pixel having a respective pixel value, said method comprising:
1[a]	calculating a first filter decision value for said block, by only using pixels p_{2i}, p_{1i}, and p_{0i}, based on: $ p_{2i}-2p_{1i}+p_{0i} $ wherein p_{0i} denotes a pixel value of a pixel closest to, in a first line of pixels in said block, a block boundary to a neighboring block of multiple pixels in said video frame, p_{1i} denotes a pixel value of a pixel next closest to, in said first line of pixels, said block boundary and p_{2i} denotes a pixel value of a pixel second next closest to, in said first line of pixels, said block boundary;
1[b]	calculating a second filter decision value for said neighboring block, by only using pixels q_{2i}, q_{1i}, and q_{0i}, based on: $ q_{2i}-2q_{1i}+q_{0i} $ wherein q_{0i} denotes a pixel value of a pixel in said neighboring block closest to, in a corresponding first line of pixels in said neighboring block, said block boundary, q_{1i} denotes a pixel value of a pixel of said neighboring block next closest to, in said corresponding first line of pixels, said block boundary and q_{2i} denotes a pixel value of a pixel in said neighboring block second next closest to, in said corresponding first line of pixels, said block boundary;
1[c]	determining how many pixels in said first line of pixels in said block to filter relative to said block boundary based on a comparison of said first filter decision value to a first threshold value; and
1[d]	determining how many pixels in said corresponding first line of pixels in said neighboring block to filter relative to said block boundary based on a comparison of said second filter decision value to a second threshold value.

Reference	Claim Limitation
Claim 2	
2[a]	The method according to claim 1, wherein calculating said first filter decision value comprises calculating said first filter decision value as: $ p_{20}-2p_{10}+p_{00} + p_{23}-2p_{13}+p_{03} $ wherein p00 denotes said pixel value of said pixel closest to, in said first line of pixels, said block boundary, p10 denotes said pixel value of said pixel next closest to, in said first line of pixels, said block boundary, p20 denotes said pixel value of said pixel second next closest to, in said first line of pixels, said block boundary, p03 denotes a pixel value of a pixel closest to, in a second line of pixels in said block, said block boundary, p13 denotes a pixel value of a pixel next closest to, in said second line of pixels, said block boundary and p23 denotes a pixel value of a pixel second next closest to, in said second line of pixels, said block boundary; and
2[b]	calculating said second filter decision value comprises calculating said second filter decision value as: $ q_{20}-2q_{10}+q_{00} + q_{23}-2q_{13}+q_{03} $ wherein q00 denotes said pixel value of said pixel in said neighboring block closest to, in said corresponding first line of pixels, said block boundary, q10 denotes said pixel value of said pixel of said neighboring block next closest to, in said corresponding first line of pixels, said block boundary, q20 denotes said pixel value of said pixel in said neighboring block second next closest to, in said corresponding first line of pixels, said block boundary, q03 denotes a pixel value of a pixel in said neighboring block closest to, in a corresponding second line of pixels in said neighboring block, said block boundary, q13 denotes a pixel value of a pixel of said neighboring block next closest to, in said corresponding second line of pixels, said block boundary and q23 denotes a pixel value of a pixel in said neighboring block second next closest to, in said corresponding second line of pixels, said block boundary.
Claim 3	

Reference	Claim Limitation
3[a]	The method according to claim 1, wherein determining how many pixels in said first line of pixels in said block to filter comprises:
3[b]	comparing said first filter decision value to a first threshold value;
3[c]	determining to filter two pixels in said first line of pixels in said block relative to said block boundary if said first filter decision value is below said first threshold value; and
3[d]	determining to filter one pixel in said first line of pixels in said block relative to said block boundary if said first filter decision value is equal to or exceeds said first threshold value; and
3[e]	determining how many pixels in said corresponding first line of pixels in said neighboring block to filter comprises:
3[f]	comparing said second filter decision value to a second threshold value;
3[g]	determining to filter two pixels in said corresponding first line of pixels in said neighboring block relative to said block boundary if said second filter decision value is below said second threshold value; and
3[h]	determining to filter one pixel in said corresponding first line of pixels in said neighboring block relative to said block boundary if said second filter decision value is equal to or exceeds said second threshold value.
Claim 5	
5[pre]	A filtering control device comprising:
5[a]	a first decision value calculator configured to calculate a first filter decision value for a block of multiple pixels in a video frame, by only using pixels p_{2i}, p_{1i}, and p_{0i}, based on: $ p_{2i}-2p_{1i}+p_{0i} $ wherein p_{0i} denotes a pixel value of a pixel closest to, in a first line of pixels in said block, a block boundary to a neighboring block of multiple pixels in said video frame, p_{1i} denotes a pixel value of a pixel next closest to, in said first line of pixels, said block boundary and p_{2i} denotes a pixel value of a pixel second next closest to, in said first line of pixels, said block boundary;
5[b]	second decision value calculator configured to calculate a second filter decision value for a neighboring block, by only using pixels q_{2i} , q_{1i} , and q_{0i} , based on:

Reference	Claim Limitation
	$ q_{2i}-2q_{1i}+q_{0i} $ wherein q_{0i} denotes a pixel value of a pixel in said neighboring block closest to, in a corresponding first line of pixels in said neighboring block, said block boundary, q_{1i} denotes a pixel value of a pixel of said neighboring block next closest to, in said corresponding first line of pixels, said block boundary and q_{2i} denotes a pixel value of a pixel in said neighboring block second next closest to, in said corresponding first line of pixels, said block boundary;
5[c]	a first pixel determiner configured to determine how many pixels in a first line of pixels in said block to filter relative to said block boundary based on said first filter decision value calculated by said first decision value calculator; and
5[d]	a second pixel determiner configured to determine how many pixels in a corresponding first line of pixels in said neighboring block to filter relative to said block boundary based on said second filter decision value calculated by said second decision value calculator, wherein
5[e]	further comprising a first comparator configured to compare said first filter decision value calculated by said first decision value calculator to a first threshold value; and
5[f]	a second comparator configured to compare said second filter decision value calculated by said second decision value calculator to a second threshold value.
Claim 6	
6[a]	The device according to claim 5, wherein said first decision value calculator is configured to calculate said first filter decision value as: $ p_{20}-2p_{10}+p_{00} + p_{23}-2p_{13}+p_{03} $ wherein p_{00} denotes said pixel value of said pixel closest to, in said first line of pixels, said block boundary, p_{10} denotes said pixel value of said pixel next closest to, in said first line of pixels, said block boundary, p_{20} denotes said pixel value of said pixel second next closest to, in said first line of pixels, said block boundary, p_{03} denotes a pixel value of a pixel closest to, in a second line of pixels in said block, said block boundary, p_{13} denotes a pixel value of a

Reference	Claim Limitation
	pixel next closest to, in said second line of pixels, said block boundary and p23 denotes a pixel value of a pixel second next closest to, in said second line of pixels, said block boundary; and
6[b]	said second decision value calculator is configured to calculate said second filter decision value as: $ q_{20}-2q_{10}+q_{00} + q_{23}-2q_{13}+q_{03} $ wherein q00 denotes said pixel value of said pixel in said neighboring block closest to, in said corresponding first line of pixels, said block boundary, q10 denotes said pixel value of said pixel of said neighboring block next closest to, in said corresponding first line of pixels, said block boundary, q20 denotes said pixel value of said pixel in said neighboring block second next closest to, in said corresponding first line of pixels, said block boundary, q03 denotes a pixel value of a pixel in said neighboring block closest to, in a corresponding second line of pixels in said neighboring block, said block boundary, q13 denotes a pixel value of a pixel of said neighboring block next closest to, in said corresponding second line of pixels, said block boundary and q23 denotes a pixel value of a pixel in said neighboring block second next closest to, in said corresponding second line of pixels, said block boundary.
Claim 7	
7[a]	The device according to claim 5, further comprising: said first pixel determiner is configured to i) determine to filter two pixels in said first line of pixels in said block relative to said block boundary if said first filter decision value is below said first threshold value as determined by said first comparator and
7[b]	ii) determine to filter one pixel in said first line of pixels in said block relative to said block boundary if said first filter decision value is equal to or exceeds said first threshold value as determined by said first comparator; and
7[c]	said second pixel determiner is configured to i) determine to filter two pixels in said corresponding first line of pixels in said neighboring block relative to said block boundary if said second filter decision value is below said second threshold value as determined by said second comparator and

Reference	Claim Limitation
7[d]	ii) determine to filter one pixel in said corresponding first line of pixels in said neighboring block relative to said block boundary if said second filter decision value is equal to or exceeds said second threshold value as determined by said second comparator.
Claim 9	
9[a]	The device according to claim 5, further comprising a threshold determiner configured to i) determine said first threshold value based on a quantization parameter associated with said block, and
9[b]	ii) determine said second threshold value based on a quantization parameter associated with said neighboring block.
Claim 10	
10[a]	The device according to claim 5, further comprising: a first offset calculator configured to calculate a first offset Δ based on $9 \times ((q0j - p0j) - 3 \times (q1j - p1j)) / 16$ wherein $p0j$ denotes a pixel value of a pixel closest to, in said first line of pixels, said block boundary, $p1j$ denotes a pixel value of a pixel next closest to, in said first line of pixels, said block boundary, $q0j$ denotes a pixel value of a pixel in said neighboring block closest to, in said corresponding first line of pixels, said block boundary and $q1j$ denotes a pixel value of a pixel of said neighboring block next closest to, in said corresponding first line of pixels, said block boundary;
10[b]	a first pixel modifier configured to modify said pixel value of said pixel closest to said block boundary in said first line of pixels by adding said first offset calculated by said first offset calculator to said pixel value of said pixel closest to said block boundary in said first line of pixels;
10[c]	a second pixel modifier configured to modify said pixel value of said pixel in said neighboring block closest to said block boundary in said corresponding first line of pixels by subtracting said first offset calculated by said first offset calculator from said pixel value of said pixel in said neighboring block closest to said block boundary in said corresponding first line of pixels;
10[d]	a second offset calculator configured to calculate, if said first filter decision value is below said first threshold value as determined by said first comparator, a second offset based on

Reference	Claim Limitation
	$(p_{0j} + p_{2j} - 2p_{1j} + 2\Delta)/4$ wherein p_{2j} denotes a pixel value of a pixel second next closest to, m said first line of pixels, said block boundary;
10[e]	third pixel modifier configured to modify, if said first filter decision value is below said first threshold as determined by said first comparator, said pixel value of said pixel next closest to said block boundary in said first line of pixels by adding said second offset calculated by said second offset calculator to said pixel value of said pixel next closest to said block boundary in said first line of pixels;
10[f]	a third offset calculator configured to calculate, if said second filter decision value is below said second threshold value as determined by said second comparator, a third offset based on $(q_{0j} + q_{2j} - 2q_{1j} - 2\Delta)/4$ wherein q_{2j} denotes a pixel value of a pixel in said neighboring block second next closest to, in said corresponding first line of pixels, said block boundary; and
10[g]	a fourth pixel modifier configured to modify, if said second filter decision value is below said second threshold as determined by said second comparator, said pixel value of said pixel in said neighboring block next closest to said block boundary in said corresponding first line of pixels by adding said third offset calculated by said third offset calculator to said pixel value of said pixel in said neighboring block next closest to said block boundary in said corresponding first line of pixels.
Claim 11	
11[a]	The device according to claim 5, further comprising a third comparator configured to compare a sum of said first filter decision value and said second filter decision value to a threshold value, wherein
11[b]	said first pixel determiner is configured to determine, if said sum of said first filter decision value and said second filter decision value is below said threshold value as determined by said third comparator, how many pixels in said first line of pixels in said block to filter

Reference	Claim Limitation
	relative to said block boundary based on said first filter decision value calculated by said first decision value calculator; and
11[c]	said second pixel determiner is configured to determine, if said sum of said first filter decision value and said second filter decision value is below said threshold value as determined by said third comparator, how many pixels in said corresponding first line of pixels in said neighboring block to filter relative to said block boundary based on said second filter decision value calculated by said second decision value calculator.
Claim 12	
12[a]	An encoder comprising a filtering control device according to claim 5.
Claim 13	
13[pre]	A user equipment comprising:
13[a]	a memory configured to store video frames; and
13[b]	an encoder according to claim 12 configured to encode said video frames into encoded video frames, wherein said memory is further configured to store said encoded video frames.
Claim 14	
14[a]	A decoder comprising a filtering control device according to claim 5.
Claim 15	
15[pre]	A user equipment comprising:
15[a]	memory configured to store encoded video frames;
15[b]	a decoder according to claim 14 configured to decode said encoded video frames into decoded video frames; and
15[c]	a media player configured to render said decoded video frames into video data displayable on a display.
Claim 16	
16[pre]	A non-transitory computer-readable medium comprising, stored thereupon, a computer program for filtering control of a block of multiple pixels in a video frame each pixel having a respective pixel value, said computer program comprising code means which when run on a computer causes the computer to:
16[a]	calculate a first filter decision value for said block, by only using pixels p_{2i} , p_{1i} , and p_{0i} , based on: $ p_{2i}-2p_{1i}+p_{0i} $

Reference	Claim Limitation
	wherein p_{0i}, denotes a pixel value of a pixel closest to, in a first line of pixels in said block, a block boundary to a neighboring block of multiple pixels in said video frame, p_{1i} denotes a pixel value of a pixel next closest to, in said first line of pixels, said block boundary and p_{2i} denotes a pixel value of a pixel second next closest to, in said first line of pixels, said block boundary;
16[b]	calculate a second filter decision value for said neighboring block, by only using pixels q_{2i}, q_{1i}, and q_{0i}, based on: $ q_{2i}-2q_{1i}+q_{0i} $ wherein q_{0i} denotes a pixel value of a pixel in said neighboring block closest to, in a corresponding first line of pixels in said neighboring block, said block boundary, q_{1i} denotes a pixel value of a pixel of said neighboring block next closest to, in said corresponding first line of pixels, said block boundary and q_{2i} denotes a pixel value of a pixel in said neighboring block second next closest to, in said corresponding first line of pixels, said block boundary;
16[c]	determine how many pixels in a first line of pixels in said block to filter relative to said block boundary based on said first filter decision value; and
16[d]	determine how many pixels in a corresponding first line of pixels in said neighboring block to filter relative to said block boundary based on said second filter decision value,
16[e]	wherein determine how many pixels in said first line of pixels in said block to filter comprises determining how many pixels in said first line of pixels in said block to filter relative to said block boundary based on a comparison of said first filter decision value to a first threshold value; and
16[f]	determine how many pixels in said corresponding first line of pixels in said neighboring block to filter comprises determining how many pixels in said corresponding first line of pixels in said neighboring block to filter relative to said block boundary based on a comparison of said second filter decision value to a second threshold value.

I. INTRODUCTION

Intel Corporation (“Petitioner” or “Intel”) filed a petition for *inter partes* review of claims 1-3, 5-7, and 9-16 of U.S. Patent No. 9,641,841 (the “’841 Patent”) (collectively, the “Challenged Claims”), which is owned by Telefonaktiebolaget LM Ericsson (“Patent Owner” or “Ericsson”). The ’841 Patent is directed to an improved deblocking filter that achieves an improved frequency response such that the filter design uses asymmetric filtering decisions to determine how many pixels to filter using an improved filter that does not modify pixel values over a block boundary if the pixel values form a ramp in local structure, but smooths pixel values with other artifacts in the images, such as steps, in a specific way.

The Petition does not identify a single reference or combination of references that discloses the deblocking filter of the ’841 Patent. Instead, the Petition argues that a POSITA could have derived the ’841 Patent’s deblocking filter because there had been a number of previous attempts to design allegedly similar filters. The numerous attempts to design a deblocking filter, however, show that there are many design choices, each with its own benefits and disadvantages, that a POSITA would consider in designing a deblocking filter. And despite decades of research, no one had thought of the novel filter claimed in the ’841 Patent. The Petition fails to disclose a specific motivation to alter the prior art deblocking filters to use the particular filter decisions and specific offsets of the ’841 Patent, and thus, as will be

described in more detail below, Petitioner has failed to meet its burden to show a reasonable likelihood of unpatentability of any of the challenged claims. *See* 37 C.F.R. § 42.108(c). Accordingly, Patent Owner requests that the Board deny institution of *inter partes* review.

II. BACKGROUND

A. Deblocking Filters

Video coding is the process of compressing (encoding) video prior to transmission or storage and decompressing (decoding) compressed video so that it can be displayed. Ex-2001, ¶¶42-55. Video coding is important because uncompressed video takes up a significant amount of storage space and would require an impractical amount of bandwidth to transmit in real time. Modern video codecs utilizing coding schemes are all block-based. *Id.*, ¶¶ 42-47. Block-based coding can create discontinuities at block boundaries, causing the resulting images to appear “blocky.” *Id.*, ¶¶57-62.

A deblocking filter is applied to an image to address blocking artifacts created by the coding process. *Id.*, ¶¶63-67. A design goal of these deblocking filters is to remove blocking artifacts created by the coding process while leaving natural edges or other natural features of the picture intact. The challenge with deblocking filters is that they are recognized to be particularly computationally intensive. *Id.*, ¶68. For example, the List Reference, cited in the ’841 Patent, acknowledges that the H.264

loop filter, which includes the deblocking filter, “can easily account for one-third of the computational complexity of a decoder.” Ex-1024 at 614.

Given the complexity, video coding experts have not agreed on a uniform approach to deblocking filter design. Ex-2001, ¶69. As will be described in more detail below, the history of deblocking filter design shows that any change to the filter design can have a material effect on performance and the visual appearance of an image, and, as a result, there has been a continuous effort to change and improve on existing deblocking filters. *Id.*

B. The '841 Patent Identifies Problems With Prior Art Deblocking

Deblocking filters were introduced at least 20 years prior to the '841 Patent. *Id.*, ¶69. Despite significant research into the possible designs of a deblocking filter prior to the '841 Patent, the industry could not agree on a uniform approach for how to design a deblocking filter. *Id.* Instead, the industry has repeatedly engaged in efforts to research deblocking filter designs that would better balance the need to eliminate blocking artifacts from images while reducing complexity. Deblocking filter designs in the prior art vary based on a number of factors, including but not limited to (i) how many pixels to filter; (ii) whether to allow asymmetric filtering (i.e. whether different pixels can be filtered on each of the side the block boundary and/or whether different filtering can be applied to each side of the block boundary);

and (iii) how to calculate the amount of filtering, often referred to as an offset, to be applied to each pixel. *Id.*, ¶¶57-69.

The '841 Patent explains that prior art deblocking filters do not use the same criteria for determining how many pixels to filter and which pixels to filter. Ex-1001 at 1:32-36. In particular, the '841 Patent describes deblocking filters in the prior art H.264 Standard and a draft of the HEVC standard (referred to as “B205” or the “HEVC Draft”) and explains how these prior art filters take fundamentally different approaches to deciding how many pixels to filter. For example, the '841 Patent discloses that the H.264 Standard provided for a strong filter and a normal or weak filter. Ex-1001, 1:49-52, 1:65-67; Ex-2001, ¶73. In the strong filter, the same number of pixels (i.e. 3 pixels on each side of the block boundary) are always filtered. The weak filter of H.264, however, allows for asymmetric filtering and thus it is possible to filter different number of pixels on each side of the block boundary (i.e. 1-2 pixels on each side of the block boundary). The decision as to how many pixels to modify on each side of the block boundary is calculated based on the difference in pixel value between two pixels. *Id.*

The HEVC Draft also provided for a strong filter and a weak filter. In the strong filter, three pixels are always filtered on each side of the block boundary. Ex-1001 at 2:61-3:5; Ex-2001, ¶74. Contrary to the H.264 Standard, the HEVC Draft does not allow asymmetric filtering in its weak filter. Instead, when weak filtering

is applied, HEVC will always filter two pixels on each side of the block boundary. Ex-1001, 2:43-60; Ex-2001, ¶74.

As another example, the '841 Patent explains that prior art deblocking filters did not uniformly modify pixels in the same position relative to the block boundary. The prior art also demonstrates that there are fundamentally different approaches to how to modify similarly positioned pixels. Ex-2001, ¶¶89-95. For example, prior art deblocking filters do not modify pixels positioned next to the block boundary (e.g. pixels p0 and q0) based on the same filtering window and same weights and thus the smoothing achieved by these deblocking filters varies dramatically. *Id.* The prior art shows that there are multiple factors that a POSITA would consider in designing a deblocking filter that filters p0 and q0, including (i) whether to use the same offset to modify p0 and q0; (ii) which neighboring pixel values to use to calculate an offset; and (iii) how to weight those values. Notably, as shown below, Petitioner has identified at least 7 additional references that disclose deblocking filters that use different offsets for pixels p0 and q0 and thus remove and/or smooth visual artifacts differently. *Id.*, ¶95.

The following provides examples of the different approaches to modification of pixels p0 and q0 disclosed in the art cited in the '841 Patent. As an initial example, the strong and weak filters of H.264 use fundamentally different offsets for pixels p0 and q0:

Modified Pixel	H.264 Strong Filter Offset	H.264 Weak Filter Offset
p0	$(\textcolor{red}{p}2+2p1+2p0+2q0+q1+4)>>3$	$(4(q0 - p0) + (p1 - q1) + 4)>>3$
q0	$(p1+2p0+2q0+2q1+\textcolor{red}{q}2+4)>>3$	

Id., ¶96.

As shown above, one difference between the strong and weak filter is that the weak filter applies the same offset to p0 and q0, whereas the strong filter uses a different offset for p0 and q0. Further, the pixels values used in the weak filter offset are different than the pixels values used in the strong filter offset. For example, the weak filter does not use pixels p2 or q2 (highlighted in red), but the strong filter does. Ex. 1001 at 1:49-2:4; Ex-2001, ¶97. The operations required for each offset are fundamentally different. The weak filter uses differences between similarly positioned pixels (i.e. differences between q0 and p0 and p1 and q1) whereas the strong filter uses a combination of five weighted pixel values to calculate the offset. Ex-2001, ¶97.

As another example, the HEVC Draft uses different pixel values (e.g. q2 and p2), uses different weights or coefficients, and a different shift operation to calculate two different offsets for filtering pixel p0. The differences between the offsets are shown in the table below:

Modified Pixel	H.264 Weak Filter Offset	HEVC Draft Weak Filter Offset
p0	$(4(q0 - p0) + (p1 - q1) + 4)>>3$	$(\textcolor{red}{1}3(q0 - p0) + \textcolor{red}{4}(q1 - p1) - \textcolor{red}{5}(\textcolor{red}{q}2 -$

		p2) + 16)>>5
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Ex-1001, 2:43-50; Ex-2001, ¶98.

C. The '841 Patent Solves Problems With Prior Art Deblocking

The '841 Patent identified multiple problems with these prior art filters. First, the '841 Patent criticized the HEVC Draft as “lead[ing] to inaccurate deblocking filtering over block boundaries for certain blocks. In particular neighboring blocks having different levels of local structures could be handled incorrectly in HEVC by filtering one of the blocks too much to thereby represses and filter away local structure in the block.” Ex. 1001 at 3:6-12. In an application filed by the same inventors (Ex-1063), which also proposes improvements to a deblocking filter that uses the same offsets as the '841 Patent, the inventors explained that the weak deblocking filter in the HEVC Draft does not have “good low-pass characteristics,” “cannot remove high frequencies that can appear near the block border and cannot remove ringing,” and “does not adapt well to the local structure of the side of the block boundary.” Ex-1063, 3:18-33; Ex-2001, ¶¶80-82.

The inventors solved these problems through a more complex, but more adaptable, deblocking filter that also improved compression efficiency. Ex. 1001 at 1:10-2:39; Ex-2001, ¶82. Specifically, the '841 Patent is directed to a novel deblocking filter that (i) calculates separate filter decision values for each side of the block boundary; (ii) separately determines how many pixels for the current block

and its neighboring block; and (iii) provides for specific modifications or filtering of pixels near the block boundary such that local structures that form a ramp are not modified but structures in the form of a step are smoothed. Ex-2001, ¶83.

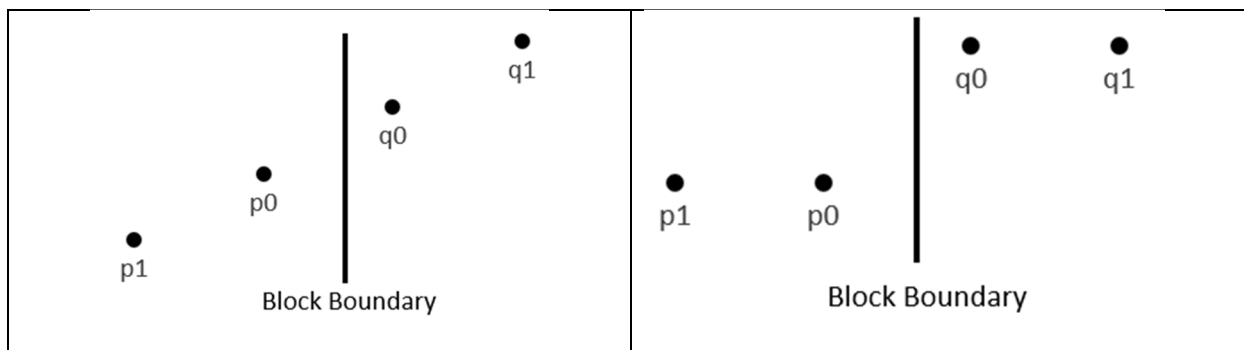
First, the '841 Patent provides for calculating a first filter decision value using only pixels from the p block based on $|p_{2i}-2p_{1i}+p_{0i}|$, and calculating a second filter decision value using only pixels from q block based on: $|q_{2i}-2q_{1i}+q_{0i}|$. Ex-2001, ¶84. Thus, the filter decision values provide information regarding the local structures on each side of the block boundary. Ex. 1001 at 3:16-5:2. Specifically, the '841 Patent provides for calculations of a filter decision value that indicate whether a local structure is a ramp or a step. For example, when the pixels p_{2i} , p_{1i} , and p_{0i} form a ramp, the filter decision value will be equal to 0. Ex-2001, ¶84.

Second, the '841 Patent provides for separately determining how many pixels to modify for the current block (p block) and its neighboring block (q block). Ex-2001, ¶85. The determination of how many pixels for the current block must be based on, but not exclusively use, a comparison of the first filter decision value to a threshold, and the determination of how many pixels for the neighboring block must be based on, but not exclusively use, a comparison of the second filter decision value to a threshold. *Id.* As a result, the '841 Patent provides for asymmetric filtering decisions, which allows the filter to be adaptive to local structures on both sides of the block boundary. Ex. 1001 at 4:62-5:2; Ex-2001, ¶85.

By combining the asymmetric decisions of how many pixels to filter with the use of the specific filter decision value calculations (e.g. $|p_{2i}-2p_{1i}+p_{0i}|$), the '841 Patent improves the deblocking filter's ability to identify block artifacts created by the decoding process and distinguish naturally occurring edges. Ex-2001, ¶86. Specifically, the filter decision value calculations (e.g. $|p_{2i}-2p_{1i}+p_{0i}|$) will identify local structures in the form of a ramp, steps, and/or lines and allow the deblocking filter to distinguish those structures from irregular structures. This information allows the deblocking filter more accurately determine how many pixels to filter to address specific local structures. *Id.*

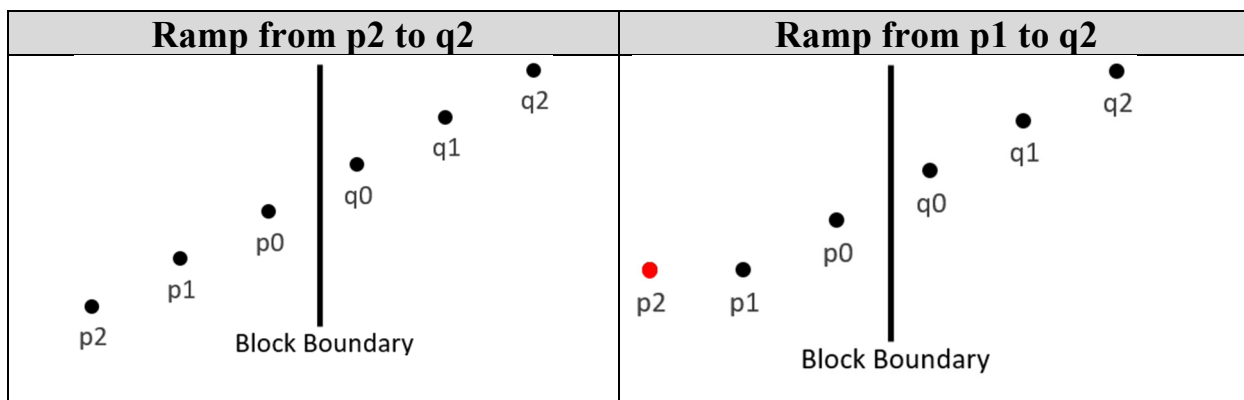
Third, the '841 Patent provides for the use of specific offsets in the filtering process. Specifically, the '841 Patents will modify the pixel values over a block boundary if these pixel values form a ramp but smooth the pixel values if they instead are in the form of a step. Ex-2001, ¶87. This results in a deblocking filter that has “good lowpass characteristics and can remove high frequencies that can appear near the block boundary.” Ex-1063 at 8:57-63. As illustrated below, a ramp is a series of linearly increasing or decreasing pixels. Ex-1063 at 13:21-24. A step occurs when there is a sudden or instantaneous change from one constant value to another in the values of adjacent pixels (i.e. a step increase or decrease). *Id.* at 13:26-27; Ex-2001, ¶87.

Ramp	Step
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To achieve this design, the '841 Patent describes utilizing a first offset based on $9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) / 16$. Ex-1001, 18:30-35; Ex-2001, ¶88. Once this improved first offset value is determined, the deblocking filter will modify the pixel values of the pixels closest to the block boundary (p_0 and q_0) using the first offset. Ex-1001, 3:55-63. In modifying the pixel values, the deblocking filter will physically alter the pixels of a video frame making the block boundary less noticeable. *Id.*

It is important to the design of the '841 and '659 Patents that the pixels p_0 and q_0 be modified based on the structure of p_1 , p_0 , q_1 and q_0 . Ex-2001, ¶89. The following structures illustrate two ramps:

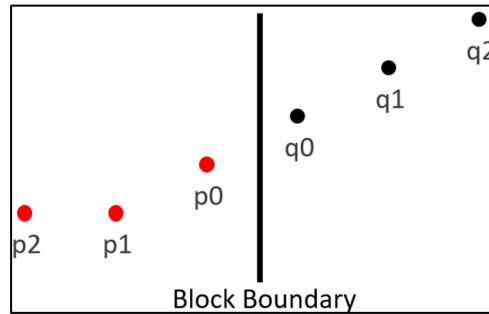


Ex-2001, ¶89. The figure on the left includes a ramp that extends from pixel p2 through q2, but the ramp on the figure on the right only extends from pixels p1 through q1. *Id.*, ¶90. The ramp in the figure on the right is more limited because the transition from pixel p2 and p1 does not form a ramp. Despite the difference between the figures, the offset for p0 and q0 will be 0 in both examples because the first offset of the '841 Patent ignores the pixel p2. *Id.*

Fourth, the '841 Patent's Second and Third Offset provide localized modification of pixels p1 and q1 of a video frame. Ex-2001, ¶91. The inventors explained that the prior art HEVC Draft "show slight amplifications of higher frequencies when filtering the second pixel ($p1_i$ and $q1_i$) from the block boundary, which can result in worse rate-distortion (RD) performance of the coder." Ex-1063, 3:24-33. The inventors also criticized the HEVC Draft for not allowing offsets of different magnitudes for different sides of the block boundary. *Id.*; Ex-2001, ¶91.

The '841 Patent thus provides for a second and third offset that allow for local adaption to the block boundary. Ex-1063, 14:4-10; Ex-1001, 18:1-23; Ex-2001, ¶¶92-93. Specifically, the '841 Patent disclose that the pixel p1 should be modified by a second offset calculated based on $(p2+p0-2\times p1+2\times\Delta)/4$, and the pixel q1 should be modified by a third offset calculated based on $(q2+q0-2\times q1-2\times\Delta)/4$. Because different pixels are used for each offset, the two offsets can take into account the local structures on each side of the block boundary. For example, when considering

the figure below, the second and third offsets will not be the same because the localized structures on each side of the block boundary are not the same. Ex-2001, ¶92.



Specifically, the second offset, which is based on the p-pixels highlighted in red, will be non-zero (i.e. a positive value) because the local structure is not a ramp. The third offset, however, will be zero because the localized structure on the right side of the block boundary is still a ramp. Ex-2001, ¶93. Thus, the '841 Patent provides for a specific deblocking filter that accounts for localized structures on each of the block, does not filter ramps within the localized structure, but smooths steps. Ex-2001, ¶93.

III. Petitioner's Asserted Prior Art References

A. Primary References

The following is a description of the primary references identified in the Petition and an initial description of how those references are fundamentally different from the '841 Patent

1. May 2000 - Bjontegaard and Bjontegaard's Code (Ex.-1009-1015)

Q15-J-28 (referred to as “Bjontegaard”) describes the coding model proposed by Telenor in May 2000 for VCEG’s Tenth Meeting in Osaka, Japan. Ex-2001, ¶134. Q15-J-29 (“Bjontegaard’s Code”) was also submitted to ITU-T in May 2000. Ex-1015 at 1. This meeting was part of the development of the H.26L Test Model, which led to the standardization of H.264, and Bjontegaard and Bjontegaard’s Code were technical submissions that were evaluated by the standards body. The H.264 Standard, however, went in another direction (as described in the List reference cited in the ’841 Patent), and thus these submissions were rejected. *See* Ex-2001, ¶144.

Bjontegaard and Bjontegaard’s Code describe a fundamentally different filter from the ’841 Patent because the references do not (i) calculate filter decision values and determine how many pixels to filter based on filter decision values and (ii) do not use the offsets of the ’841 Patent. Ex-2001, ¶¶139-141, 254, 271. Instead, Bjontegaard and Bjontegaard’s Code disclose filtering four pixels in every line and using offsets that are fundamentally different than the ’841 Patent. Ex-2001, ¶¶135-155; 280, 283.

It is notable that the Petition does not identify any meaningful difference between the operation of Bjontegaard and Bjontegaard’s Code, and thus any argument with respect to Bjontegaard also applies to Bjontegaard’s Code.

a. Bjontegaard and Bjontegaard’s Code do not calculate filter decision values and determine how many pixels to filter

Bjontegaard and Bjontegaard's Code are not configured to determine how many pixels to modify and then apply a filter to those pixels. Instead, Bjontegaard and Bjontegaard's Code always filter pixels c, d, e, and f. Ex-2001, ¶ 139-141, 254, 271

For example, for pixels d and e (which are the closest pixels to the block boundary on the left and right side, respectively), the offset (i.e., the variable "Diff") is calculated and then used to modify the pixel value of d to yield d_{modified} , and subtracted from the pixel value e to yield e_{modified} . Ex-2001, ¶139. The specific steps for calculating Diff are shown below:

Initially set $\text{Diff} = 0$

If Act_{edge} equals 1 or 2: $\text{Diff} = (3(c - f) - 8(d - e))/16$

If Act_{edge} equals 3: $\text{Diff} = (b + c - 8(d - e) - f - g)/16$

$\text{Diff} = \max(-\text{Clip}_{\text{edge}}, \min(\text{Clip}_{\text{edge}}, \text{Diff}))$

$d_{\text{modified}} = d + \text{Diff}$ (clipped to stay in the range 0-255)

$e_{\text{modified}} = e - \text{Diff}$ (clipped to stay in the range 0-255)

Ex-2001, ¶139. As shown, while the value of Diff can change based on other variables (e.g. Act_{edge}), Diff is always calculated and always used to modify pixels d and e. Ex-2001, ¶260, 272.

Similarly, Bjontegaard provides that pixel c, which is the second closest pixel to the block boundary on the left side, is always modified by an offset:

Initially set $\text{Diff} = 0$

If Act_{11} equals 2: $\text{Diff} = 5(b - 2c + d)/16$

If Act_{11} equals 3: $\text{Diff} = 3(a + b - 4c + d + e)/16$

$\text{Diff} = \max(-\text{Clip}(\text{qp}, \text{Strength}_1), \min(\text{Clip}(\text{qp}, \text{Strength}_1), \text{Diff}))$

$c_{\text{modified}} = c + \text{Diff}$ (clipped to stay in the range 0-255)

Ex-1009, 20; Ex-2001, ¶260. Again, while the value of Diff can change based on other variables (e.g. Act_{11}), Diff is always calculated and always added to pixel c. *Id.*

The operation for modifying pixels f are similar to pixel c, but Diff changes based on Act_{22} . The specific operations are shown below.

Initially set $\text{Diff} = 0$

If Act_{22} equals 2: $\text{Diff} = 5(e - 2f + g)/16$

If Act_{22} equals 3: $\text{Diff} = 3(d + e - 4f + g + h)/16$

$\text{Diff} = \max(-\text{Clip}(\text{qp}, \text{Strength}_2), \min(\text{Clip}(\text{qp}, \text{Strength}_2), \text{Diff}))$

$f_{\text{modified}} = f + \text{Diff}$ (clipped to stay in the range 0-255)

Ex-2001, ¶272. Similar to pixel c, pixel f is always modified. *Id.*

Diff is always calculated and added to each pixel. In other words, there is no separate decision of whether or not to apply Diff to pixel c or f. *Id.* Accordingly, this filter is fundamentally different from the claimed filter of the '841 Patent, which is further depicted by Dr. Richardson's simulation results below. *See infra* § IV; *see also* Ex-2001 §XI.

b. Bjontegaard's offsets are different than the offsets of the '841 Patent

The following is a comparison of the '841 Patent's offsets and Bjontegaard's offsets. *See* Ex-2001, ¶¶139-144; Ex-1009 at 20..

Pixel	Bjontegaard ¹	'841 Patent
P0	Diff= $\frac{(8(q_0-p_0)-3(q_1-p_1))}{16}$ OR Diff= $(p_2 + p_1 - 8(p_0 - q_0) - q_1 - q_2)/16$	$\frac{(9(q_0 - p_0) - 3(q_1 - p_1))}{16}$
Q0	Diff= $\frac{(8(q_0-p_0)-3(q_1-p_1))}{16}$ OR Diff= $\frac{(p_2+p_1-8(p_0-q_0)-q_1-q_2)}{16}$	$\frac{(9(q_0 - p_0) - 3(q_1 - p_1))}{16}$
P1	Diff= $\frac{5(p_2-2p_1+p_0)}{16} + \frac{5\Delta}{16}$ OR Diff= $3(p_3+p_2-4p_1+p_0+q_0)/16$	$\frac{p_2 - 2p_1 + p_0}{4} + \frac{\Delta}{2}$
Q1	Diff= $\frac{5(q_2-2q_1+q_0)}{16} + \frac{5\Delta}{16}$ OR Diff= $3(p_0+q_1-4q_1+q_2+q_3)/16$	$\frac{q_2 - 2q_1 + q_0}{4} + \frac{\Delta}{2}$

2. March 2001 - Aksu (Ex-1019)

¹The table uses Dr. Schonfeld's normalized version of Bjontegaard's offsets for comparison.

PCT/FI01/00049 (“Aksu”) is directed to a “method and associated device for filtering digital video images, and discloses that it relates to a method for reducing visual artefacts in a frame of a digital video signal, which is coded by blocks and then decoded. Ex-1019, 1:1-5. Aksu references prior art video transmission systems, for example according to the ITU-T H.261/H.263 recommendations. Ex-2001, ¶¶177-178.

The deblocking filter in Aksu is also fundamentally different from the ’841 Patent. *See, e.g.*, Ex-2001, ¶328. Aksu calculates d_r and d_l , which Petitioner allege are a first and second filter decision value based on a series of difference calculations. Ex-2001, ¶¶183-184. These differences are intended to provide information regarding the flatness of the pixels near the block boundary. Ex-2001, ¶321. Thus, Aksu does not use the same calculations as the ’841 Patent (which calculates its decision values based on, e.g., $p_{2i}-2p_{1i}+p_{0i}$). Ex-2001, ¶¶325.

A definition d_r is given by:

$$\begin{aligned} d_r &= 6, \text{ if } |r_1 - r_j| \leq \beta/j \text{ with all } j \in [1,6], \\ \text{otherwise: } d_r &= i, \text{ where } i \text{ fulfils the conditions} \\ &\quad i \in [1, n_{tr}], \quad (4) \\ &\quad |r_1 - r_{i+1}| > \beta/i, \text{ and} \\ &\quad |r_1 - r_j| \leq \beta/j \text{ with all } j \in [1,i]. \end{aligned}$$

Ex-1019 at 13:15-20; Ex-2001, ¶183. Aksu discloses that the value of d_l is determined similarly, except all r ’s are replaced with l ’s. Ex-1019, 13:20-23; Ex-

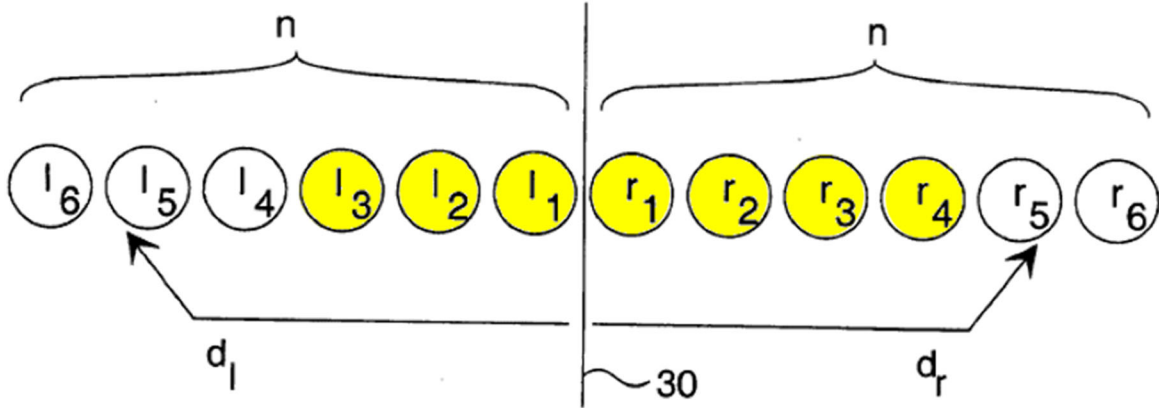
2001, ¶184. Importantly, because this calculation depends on n_{tr} , the number of pixels used for the calculation of d_r and d_l can vary based on the quantization parameters and region type for the corresponding block. Ex-2001, ¶¶180-184.

Table 2 of Aksu shows the determination of the width of the filtering window for the pixels r_1 , r_2 , and r_3 according to the value of d_r . The values of l_1 , l_2 , and l_3 are determined in the same manner according to the value of the d_l . Ex-1019 at Table 2; Ex-2001, ¶187. In Table 2, Aksu explains that “X” means that the pixel in question is not filtered at all, and a number of means that the filtering window will use the specified number of pixels on each side of the pixel being examined. Ex-1019, 15:15-24.

$d_r (d_l > 1)$	r_1	r_2	r_3
1	X	X	X
2	1	X	X
3	1	1*	X
4	2	2	X
5	2	2	2**
6	3 or 2***	3	3

Ex-1019 at Table 2; Ex-2001, ¶186.

Aksu discloses an averaging filter that is based on a sliding filtering window. The pixels in the filtering window of Aksu include zero to seven possible pixels, centering on the pixel to be filtered. Ex-2001, ¶¶186-189. For example, if r_1 is the pixel to be filtered and the filtering window includes three pixels on either side of r_1 , then filtering window used to calculate the offset is shown below. *Id.*, ¶188.



The offset applied to r_1 is given by:

$$\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$$

Ex-1019, Fig. 2, 15:2-15; Ex-2001, ¶188. This filter based on the average pixel values of the pixels in the filtering window is another fundamentally different filter than the filter disclosed in the '841 Patent. Ex-2001, ¶The possible filters that can be applied to r_1 (which corresponds to p_0) are described as follows:

	Offset to Modify r_1
3-pixel window	$\frac{l_1 + r_1 + r_2}{3}$
5-pixel window	$\frac{l_2 + l_1 + r_1 + r_2 + r_3}{5}$
7-pixel window	$\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$

See Ex-2001, ¶181.

This filter based on the average pixel values of the pixels in the filtering window is fundamentally different that the first, second, and third offsets applied to modify the pixels in the '841 Patent. Ex-2001, ¶¶182, 360.

B. Secondary References

As described above, a deblocking filter is one of the most complex components of a decoder. Ex-2001, ¶68. As result, deblocking filters have been the subject of research for at least 20 years prior to the '841 Patent. Ex-2001, ¶69. Petitioner attempts to use that work to argue that any deblocking filter is necessarily obvious, but the evidence, including the prior art cited by Petitioner, shows that the industry could not agree on a uniform approach for how to design a deblocking filter, and the industry was constantly researching deblocking filter designs that would better balance the need to eliminate blocking artifacts from images while reducing complexity. Ex-2001, ¶¶94-95. For example, as shown below, the various deblocking filters use different offset equations that use different pixels in different combinations to achieve fundamentally different designs.

1. 2006 - H.241

H.241 is a 2006-published specification for extended procedures for implementation of the H.264 Standard on certain devices. Ex-1017 at 1; Ex-2001, ¶164. Petitioner relies on H.241 for its disclosure of an alleged second and third offset. The following is a list of potential offsets that H.241 discloses could be

applied to pixels P0, Q0, P1, and Q1, depending on whether the block edge is part of a macroblock edge or not: Ex-1017 at 29; Ex-2001, ¶168.

Pixel	H.241's Offset Calculations
P0	$\Delta = (q0 + ((p2 + q1) \gg 1)) \gg 1 - ((p0 + ((q2 + p1) \gg 1)) \gg 1)$ OR $\Delta = (q0 + (q1 \gg 1)) \gg 1 - ((p0 + (q2 \gg 1)) \gg 1)$
Q0	$\Delta = (q0 + ((p2 + q1) \gg 1)) \gg 1 - ((p0 + ((q2 + p1) \gg 1)) \gg 1)$ OR $\Delta = (q0 + (q1 \gg 1)) \gg 1 - ((p0 + (q2 \gg 1)) \gg 1)$
P1	$\Delta/2 = ((q0 + ((p2 + q1) \gg 1)) \gg 1 - ((p0 + ((q2 + p1) \gg 1)) \gg 1)) / 2$ OR $((q0 + (q1 \gg 1)) \gg 1 - ((p0 + (q2 \gg 1)) \gg 1)) / 2$
Q1	$\Delta/2 = ((q0 + ((p2 + q1) \gg 1)) \gg 1 - ((p0 + ((q2 + p1) \gg 1)) \gg 1)) / 2$ OR $((q0 + (q1 \gg 1)) \gg 1 - ((p0 + (q2 \gg 1)) \gg 1)) / 2$

2. July 2009 - B205

The ITU-T's and ISO/IEC's Joint Collaborative Team on Video Coding (JCT-VC) published B205, titled "Test Model Under Consideration," is a draft of its High-Efficiency Video Coding (HEVC) Standard. Ex-1018 at 1. B205 is mentioned in the Background of the '841 Patent as a draft of the HEVC standard with several problems. Ex-1001, 2:5-8; Ex-2001, ¶170. B205 does not allow for asymmetric

filtering, and as described above, the inventors expressly identified the B205's deblocking filter as having poor low-pass characteristics. Ex-2001, ¶171.

The following is a list of potential offsets that B118 discloses could be applied to pixels P0, Q0, P1, and Q1:²

Pixel	B-205's Offset Calculations
P0	$\Delta = (13 * (q0 - p0) + 4 * (q1 - p1) - 5 * (q2 - p2) + 16) >> 5$
Q0	$\Delta = (13 * (q0 - p0) + 4 * (q1 - p1) - 5 * (q2 - p2) + 16) >> 5$
P1	$((13 * (q0 - p0) + 4 * (q1 - p1) - 5 * (q2 - p2) + 16) >> 5) / 2$
Q1	$((13 * (q0 - p0) + 4 * (q1 - p1) - 5 * (q2 - p2) + 16) >> 5) / 2$

Ex-1018 at 131; Ex-2001, ¶176.

3. 2008 - Gonzalez (Ex-1020)

The Gonzalez reference is a textbook by Rafael Gonzalez and Richard E. Woods titled Digital Image Processing that was published in 2008. Ex-2001 ¶190. Gonzalez does not disclose a deblocking filter.

Instead, it discloses general principles that Petitioner relies on related to the properties of certain equations. Ex-1020 at 158. For example, the Petition relies on chapters related to “Filtering the Frequency Domain” and “Spatial Filtering,” which

² This table does not include clipping operations.

discuss high level concepts including the use of a Laplacian equation and low-pass and high-pass filtering. Ex-2001, ¶190; Ex-1020, 144.

4. August 2008 - Fu (Ex-1022)

The Fu reference is an International Patent Application that on its face identified an international filing date of August 21, 2008, and a publication date of March 19, 2009. Ex-2001, ¶184; Ex-1022. The following is a summary of the different offset calculations disclosed by Fu:

Pixel	Fu's Potential Offset Calculations
P0	Process 1 & Process 2: $(2 \times p1 + p2 + 2 \times (p0 + q0) + q1 + 4) \gg 3$ or $(2 \times p0 + p1 + q0 + 2) \gg 2$ Process 3: $delta = ((q0 - p0) \times 3 + (p1 - q1) + 4) \gg 3$
Q0	Process 1 & Process 2: $(2 \times q1 + q2 + 2 \times (q0 + p0) + p1 + 4) \gg 3$ or $(2 \times q0 + q1 + p0 + 2) \gg 2$ Process 3: $delta = ((q0 - p0) \times 3 + (p1 - q1) + 4) \gg 3$
P1	Process 1 & Process 2: $(p0 + 2 \times p1 + q0 + 2) \gg 2$ or $p1$ Process 3: $(P_0 - p1) \times 3 + (p2 - (q0 - delta)) + 4) \gg 3$
Q1	Process 1 & Process 2: $(q0 + 2 \times q1 + p0 + 2) \gg 2$ or $q1$ Process 3: $(q1 - Q_0 + 3 + ((p0 + delta) - q) + 4) \gg 3$

Ex-2001, ¶¶191-198. The offsets are organized by “Process” because Fu discloses that different offsets could be used depending on the filtering mechanisms. *Id.*

5. March 2002 - B118 (Ex-1023)

B118 reference is the Working Draft Number 2 (WD-2) released by the Joint Video Team (JVT) that described the draft standard developed for H.26L, which eventually became H.264. Ex-1023 at 1; Ex-2001, ¶197. The Petition relies on the disclosure of the following offsets in B118 for pixels P0, Q0, P1, and Q1:³⁴

Pixel	B118’s Offset Calculations
P0	$\Delta = ((q1 - p1) \ll 2 + (p2 - q2) + 4) \gg 3$
Q0	$\Delta = ((q1 - p1) \ll 2 + (p2 - q2) + 4) \gg 3$
P1	$(p3 + p1 + \Delta - p2 \ll 1) \gg 1$
Q1	$(q3 + q1 - \Delta - q2 \ll 1) \gg 1$

Ex-2001, ¶¶201-204. In some cases, the deblocking filter in B118 performs stronger filtering instead of default filtering, which uses different offsets applied to P0, P1, Q0, and Q1. Ex-2001, ¶205. However, Petitioner does not identify those offsets as relevant here.

C. Unasserted References

1. March 2001 - VCEG-M21

³ Pixels P0, Q0, P1, P2 correspond to pixels p1, q1, p2, and q2 in B118.

⁴ This table does not include clipping operations.

VCEG-M21 is a technical proposal to Study Group 16 of the Video Coding Expert Group that was working on the development of H.264. Ex-1069 at 1. Even though VCEG-M21 is not an asserted reference, Petitioner relies on VCEG-M21's disclosure of an alleged first offset given by $8(q_0 - p_0) - 2.5(q_1 - p_1)/16$ as part of the prior art offsets that would have formed the knowledge of a POSITA. Petition at 15. Not only is VCEG-M21's offset different than the '841 Patent's first offset, but the second coefficient being 2.5 significantly undermines Petitioner's argument that it would have been obvious to select a coefficient of 3 to arrive at the offset of the '841 Patent because having integer value coefficients was a known design constraint. Petition at 28; Ex-1003, ¶280; Ex-2001, ¶206.

2. October 2005 - Bjontegaard-048

U.S. Patent Application Publication US2006/0078048 ("Bjontegaard '048") was filed October 13, 2005. Bjontegaard '048 explicitly states that it seeks to improve the prior art method for removing blocking noise described in H.264. Ex-1025 at ¶[0022]; Ex-2001, ¶207. While Petitioner does not assert Bjontegaard '048 as a reference against the '841 Patent, Petitioner relies on Bjontegaard '048 for an example of a first offset given by that can be written as $(8(q_0 - p_0) + 4(q_1 - p_1) - 4(q_2 - p_2))/16$ See Ex-1003, ¶243. However, this disclosure undermines Petitioner and Dr. Schonfeld's assertion that the claimed first offset would have been obvious because Bjontegaard '048 discloses a fundamentally different offset design that uses

six pixels instead of four pixels, which teach away from the claimed first offset. Ex-2001, ¶207. Further, Bjontegaard '048 discloses the same first offset equation as H.241 described above. Ex-1003, ¶243.

D. Person of Ordinary Skill In The Art (POSITA)

A person of ordinary skill in the art (“POSITA”) for the '841 Patent would have had a bachelor’s degree in electrical engineering, computer engineering, or a related field, with about two years of experience in video decoding or encoding technologies as of the priority date of the '841 Patent. Ex-2001, ¶¶36-37. Largely, Petitioner agrees with this definition of a POSITA, except that it further asserts that advanced graduate studies with coursework and/or research focusing on video and/or image coding and processing could be a substitute for the two years of working experience in the field. *See* Petition at 13; Ex-1003, ¶165. The asserted references fail to disclose or render obvious the challenged claims under either proposed definition. Ex-2001, ¶38.

IV. SIMULATIONS SHOW THAT PETITIONER GROSSLY OVERSTATES THE SIMILARITIES BETWEEN DEBLOCKING FILTER DESIGNS

Petitioner’s asserted grounds, discussed below, are based on cobbling together different aspects (e.g., different offsets) from different deblocking filter designs and arguing that, even though these combined references still do not disclose the claimed offsets in claim 10 of the '841 Patent, it nonetheless would have been obvious to a

POSITA to further modify the coefficients and weights of the offset equations disclosed in these disparate references to arrive at the claimed deblocking design of the '841 Patent. Underlying this argument is an oversimplification of the effect of a deblocking filter. Ex-2001, ¶¶210-211. The offsets in the prior art references and the '841 Patent represent the filter that is applied to actually modify the pixel value. These filters have carefully designed frequency responses and different behavior to different block structures that are sensitive to changes in the design, including but not limited to which pixels are used or the filter coefficients used in the offset equations. *See, e.g.*, Ex-2001, ¶304. Accordingly, any change to the filter will not necessarily yield predictable results. *UCB, Inc. v. Actavis Labs. UT, Inc.*, 65 F.4th 679, 693 (Fed. Cir. 2023) (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art).

Petitioner argues that “[t]he only difference between Bjontegaard and the claimed [first offset] equation is that the first coefficient is an ‘8’ instead of a ‘9.’” .” Petition, 30. Petitioner makes a similar argument for the second and third offsets and for Aksu in combination with B118 and Fu. *Id.*, 37, 39. However, the differences between the invention of the '841 Patent and the references relied upon by Petitioner cannot be so oversimplified, because these differences presented as slight by Petitioner, result in significantly different filtering outcomes. Ex-2001, ¶210

To illustrate these differences, Dr. Richardson conducted test simulations to compare the '841 Patent and Bjontegaard and Bjontegaard's Code. Dr. Richardson's simulations created 8x8 neighboring blocks of pixel values wherein the pixel values of the block were randomly generated in a way that is intended to represent a typical image sample block in real-world video coding applications. Ex-2001, ¶218. In total, the simulations generated 1000 blocks of pixels and tested 8000 lines of pixels. *Id.*, ¶216. Dr. Richardson made the following observations:

- The offset applied to the P0 and Q0 pixels was different between the '841 Patent and Bjontegaard in 40% of the lines tested.
- The offset applied to the P1 pixel was different between the '841 Patent and Bjontegaard in 76.8% of the lines tested.
- The offset applied to the Q1 pixel was different between the '841 Patent and Bjontegaard in 76.8% of the lines tested.

Id., ¶¶229-244. Dr. Richardson also explained that these testing results are conservative as the range of pixels generated in his blocks was purposefully limited to avoid critique of overly inflated numbers. *Id.*, ¶244. But Dr. Richardson explained that increasing the range of values, which would be likely in certain contexts (e.g. high dynamic range video that is played on newer displays), would cause the variance between the two systems to increase. *Id.*

Thus, Dr. Richardson’s test simulations illustrate that deblocking filtering designs cannot be oversimplified to mere coefficients, and any change to the design, including to the coefficients, result in significant differences in the filtering. *Id.*, ¶¶209-244.

V. CLAIM CONSTRUCTION

In the proceedings before the ITC, the parties dispute the appropriate meaning of several terms of the ’841 Patent, including the proper construction of the “determining” limitations of independent claims 1, 5, and 16. Here, Petitioner states that, for Ground 1, Petitioner adopts Ericsson’s construction while, for Ground 2, Petitioner adopts Lenovo’s proposed construction. It is unclear from the Petition how their approach differs for Ground 1 and Ground 2, but, regardless, none of the asserted grounds disclose or render obvious the Challenged Claims under the plain meaning of the claims (which is Ericsson’s proposed construction) or under Lenovo’s narrower proposed construction.

VI. PETITIONER HAS FAILED TO ESTABLISH A REASONABLE LIKELIHOOD THAT ANY CHALLENGED CLAIM IS UNPATENTABLE UNDER 37 C.F.R. § 42.108(c).

Petitioner has failed to meet its initial burden with respect to any of the Challenged Claims of the ’841 Patent. Pursuant to 37 C.F.R. § 42.108(c), Petitioner must demonstrate a reasonable likelihood that “at least one of the claims challenged

in the petitioner is unpatentable to warrant institution of an *inter partes* review. Petitioner has not done so for any of the Grounds asserted in the Petition.

A. Petitioner Has Failed To Establish A Reasonable Likelihood That Bjontegaard In View Of Bjontegaard's Code Render Obvious Any the Challenged Claims (Ground 1A).

Bjontegaard and Bjontegaard's Code describe a fundamentally different filter from the '841 Patent because the references do not (i) calculate filter decision values and determine how many pixels to filter based on filter decision values and (ii) do not use the offsets of the '841 Patent. Ex-2001, ¶¶247-248, 253-262. Instead, Bjontegaard and Bjontegaard's Code disclose filtering four pixels in every line and using offsets that are fundamentally different than the '841 Patent. *Id.* Thus, Bjontegaard in view of Bjontegaard's Code do not render obvious any Challenged Claim including claims 1, 3, 5, 7, 9, 10, 12-16

1. Ground 1A does not render obvious the First Decision Value Elements 1[a], 5[a], 16[a] or the Determining Elements 1[c], 5[c], 5[e], 16[c]

Limitations 1[a], 5[a], and 16[a] require calculating a first filter decision value for a block by only using pixels only pixels p_{0i} , p_{1i} , and p_{2i} , based on: $|p_{2i} - 2p_{1i} + p_{0i}|$. Limitations 1[c], 5[c] & 5[e] collectively, and 16[c] then require determining how many pixels in said first line of pixels in said block to filter relative to said block boundary based on a comparison of said first filter decision value to a first threshold value.

The combination of Bjontegaard and Bjontegaard's Code do not render obvious these claim elements. Specifically, Bjontegaard and Bjontegaard's Code do not disclose or suggest determining how many pixels to filter, yet alone make the determination based on a first filter decision value calculated as required by the claims. Instead, Bjontegaard and Bjontegaard's Code teach calculating offsets for four pixels (c, d, e, and f) and always applying those offsets. Ex-2001, ¶¶260-264, 280-281.

Petitioner points to the value $S0_1$ as the first filter decision value because it would be that the variable would be calculated as " $S0_1 = 12\text{abs}(b - 2c + d)$." Petition at 20-21. The Petition then alleges that the alleged determination of how many pixels to modify is based on $S0_1$ because the value of $S0_1$ impacts the value of Act_1 and Act_{11} , which are used to calculate the value of Diff as set forth below:

Initially set Diff = 0

If Act_{11} equals 2: $Diff = 5(b - 2c + d)/16$

If Act_{11} equals 3: $Diff = 3(a + b - 4c + d + e)/16$

$Diff = \max(-\text{Clip}(qp, \text{Strength}_1), \min(\text{Clip}(qp, \text{Strength}_1), Diff))$

$c_{\text{modified}} = c + Diff$ (clipped to stay in the range 0-255)

Ex-2001, ¶141; Ex-1009 at 20. Contrary to the Petition, as shown here, Bjontegaard discloses that the pixel c is always filtered using Diff, and thus the Petition has not

shown that $S0_1$ is a filter decision value or that a determination of how many pixels to filter is made based on that value. Ex-2001, ¶¶260-264.

The Petition thus appears to conflate two concepts. A POSITA, and the '841 Patent, separate the determination of the number of pixels to modify from the calculation of the offset. For example, Figure 1 of the '841 Patent shows the steps necessary to calculate the number of pixels to filter the p and q block, and Figure 6 performs the calculation of the offsets and modification of the pixels. Ex-2001, ¶¶259-261; Ex-1001, Fig. 6 It is entirely possible, and likely with the design of the '841 Patent, that a determination will be made to filter a pixel, but then a filter offset of 0 is applied. Thus, a filter offset of 0 is not a determination not to filter a pixel. Ex-2001, ¶¶259-261.

For example, using a hypothetical where ramp is present (e.g. $p1 = 10$, $p2 = 20$, $p3=30$, and $p4=40$), the first filter decision value of the '841 Patent will be 0. *Id.* Although the first filter decision value is 0, the '841 Patent provides examples where the determination of the number of pixels to filter would be to filter 2 pixels. *Id.* However, because of the presence of a ramp, each of the offsets of the '841 Patent would also be 0. Thus, the '841 Patent contemplates scenarios where the deblocking filter would decide to filter a number of pixels but the filter offset would be 0. Thus, a filter offset of 0 is not a decision not to filter a pixel. *Id.*

Notably, the Petition tacitly acknowledges this point as it states that filtering is always performed for pixel d (Petition at 17) but the filter allows for a filter offset of 0 as shown below:

Initially set Diff = 0

If Act_{edge} equals 1 or 2: Diff = (3(c – f) – 8(d – e))/16

If Act_{edge} equals 3: Diff = (b + c – 8(d – e) – f – g)/16

Diff = max(-Clip_{edge} ,min(Clip_{edge} ,Diff))

d_{modified} = d + Diff (clipped to stay in the range 0-255)

e_{modified} = e – Diff (clipped to stay in the range 0-255)

Ex-1019 at 20; Ex-2001, ¶260. Specifically, if Act_{edge} is 0 then Diff will be 0. *Id.*

The Petition does not address this distinction and does not argue obviousness in light of the correct interpretation of Bjontegaard and Bjontegaard’s Code. Ex-2001, ¶262. Accordingly, the Petition has failed to show that the First Decision Value Elements 1[a], 5[a], 16[a] or the Determining of Elements 1[c], 5[c], 5[e], 16[c] are obvious.

2. Ground 1A does not render obvious the Second Decision Value Elements 1[b], 5[b], 16[b] or the Determining Elements 1[d], 5[d] & 5[f] and 16[d]

Limitations 1[b], 5[b], 16[b] require calculating a second filter decision value for a neighboring block by only using pixels only pixels q_{0i}, q_{1i}, and q_{2i}, based on: |q_{2i}–2q_{1i}+q_{0i}|. Limitations 1[d], 5[d] & 5[f] collectively and 16[d] then require determining how many pixels in said corresponding first line of pixels in said

neighboring block to filter relative to said block boundary based on a comparison of said second filter decision value to a second threshold value.

The combination of Bjontegaard and Bjontegaard's Code do not render obvious these claim elements. Specifically, Bjontegaard and Bjontegaard's Code do not disclose or suggest determining how many pixels to filter, yet alone make the determination based on a second filter decision value calculated as required by the claims. Instead, Bjontegaard and Bjontegaard's Code teach calculating offsets for four pixels (c, d, e, and f) and always applying those offsets. Ex-2001, ¶283.

Petitioner points to the value $S0_2$ as the first filter decision value because it would be that the variable would be calculated as " $S0_2=12\text{abs}(e-2f+g)$." Petition at 21. The Petition then alleges that the alleged determination of how many pixels to modify in the neighboring block is based on $S0_2$ because the value of $S0_2$ impacts the value of a number of variables, including Act_2 and Act_{22} , which are then used to calculate the value of Diff as set forth below:

Initially set Diff = 0

If Act_{22} equals 2: $Diff = 5(e - 2f + g)/16$

If Act_{22} equals 3: $Diff = 3(d + e - 4f + g + h)/16$

$Diff = \max(-\text{Clip}(qp, \text{Strength}_2), \min(\text{Clip}(qp, \text{Strength}_2), \text{Diff}))$

$f_{\text{modified}} = f + \text{Diff}$ (clipped to stay in the range 0-255)

Similar to the prior element and contrary to the Petition, Bjontegaard discloses that the pixel e is always filtered using Diff, and thus the Petition has not shown that $S0_2$ is a filter decision value or that a determination of how many pixels to filter is made based on that value. Ex-2001, ¶283.

The Petition does not address this distinction and does not argue obviousness in light of the correct interpretation of Bjontegaard and Bjontegaard's Code. Accordingly, the Petition has failed to show that the Second Decision Value Elements 1[b], 5[b], 16[b] or the Determining Elements 1[d], 5[d] & 5[f] and 16[d] are obvious.

In addition, Claim 3 depends from Claim 1, Claims 7, 9, 12-15 depend from Claim 5. Thus the Petition fails for the same reasons stated above for Claims 1 and 5.

B. Petitioner Has Failed To Establish A Reasonable Likelihood That Bjontegaard In View Of Bjontegaard's Code, H.241, B205/AAPA Render Obvious Claims 2, 6, and 11 (Ground 1B).

Claims 2, 6, and 11 depend on claims 1, 5, and 10 respectively. This Ground does not raise any new arguments with respect to the independent claims, and thus the Petition fails for the same reasons stated above with respect to ground 1A.

3. Ground 1A does not render obvious Claim 10

Claim 10 depends from Claim 5, therefore, Bjontegaard and Bjontegaard's Code and a POSITA's knowledge does not teach or suggest Claim 10 for at least the

same reasons described above for Claim 5. *See supra* §VI.A. In addition for the reason stated below, Bjontegaard and Bjontegaard's Code do not render obvious the additional limitations of claim 10.

a. 10[a]

Petitioner alleges that Bjontegaard in view of Bjontegaard's Code and a POSITA's knowledge discloses or suggests element 10[a]. Petition at 30. Petitioner has not shown a motivation to alter Bjontegaard to reach the first offset of the '841 Patent.

As described above, the deblocking filter of the '841 Patent does not "modify the pixel values over a block boundary if these pixel values form a ramp but smooths the pixel values if they instead are in the form of a step." Ex-1063 at 8:57-60.

There is no disclosure in Bjontegaard that its offset design was intended to not filter ramp structures and smooth step structures. Rather, Bjontegaard's filter does in fact filter ramp structures, nor does it smooth step structures in the same way that the '659 Patent accomplishes. Ex-2001, ¶289. This is illustrated by Dr. Schonfeld's own analysis:

						'841 Patent	Bjontegaard
p2	p1	p0	q0	q1	Type	$\frac{9(q_0 - p_0) - 3(q_0 - p_0)}{16}$	$\frac{8(q_0 - p_0) - 3(q_0 - p_0)}{16}$
200	150	150	150	150	Step (p1)	0	0
200	200	150	150	150	Step (p0)	9	9
200	200	200	150	150	Step (q0)	-19	-16
150	160	170	180	190	Ramp (10)	0	-1
125	150	175	200	225	Ramp (25)	0	-2
200	250	200	250	200	Alternating	38	34
255	50	50	255	255	Line	77	64
255	255	50	50	255	Line	0	0
175	200	150	150	175	Random	5	5
50	125	100	150	125	Random	28	25
75	100	150	75	125	Random	-47	-42

Ex-1003, ¶253 (annotated); Ex-2001, ¶288.

Petitioner urges the Board to find a motivation to modify the first offset of Bjontegaard, but Petitioner improperly ignores that modifying one offset in a system will impact how all other aspects of the filter function. For example, Bjontegaard describes applying different offsets (Diff values) to pixels c and f (corresponding to p1 and q1), but Petitioner fails to provide any explanation as to how modifying the first offset (which modified pixels d and e—corresponding to pixels p0 and q0) would impact these other pixels. Ex-2001, ¶293. This failure to provide any analysis

is fatal to the petition. Specifically, Petitioner fails to show that the modification of Bjontegaard to use a different first offset would yield predictable results and a functioning filter design. *UCB, Inc*, 65 F.4th at 693 (Fed. Cir. 2023) (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art).

Even if there was a motivation to modify Bjontegaard, Petitioner’s argument that the first offset of the ’841 Patent would have been obvious because it could be identified with only “routine experimentation” is contrary to the law and the evidence. Ex-2001, ¶¶291-296; *Leo Pharm. Prods. v. Rea*, 726 F.3d 1346, 1356 (Fed. Cir. 2013) (holding that the “breadth of choices and numerous combinations” available for formulating a composition did not render obvious the selection of the correct formulation from those available alternatives).

Petitioner ignores the mass of evidence showing that decades of experimenting with deblocking filtering never resulted in the claimed first offset expressions in the ’659 Patent. Ex-2001, ¶290

Experts in the field have tried for decades to develop a solution to the same deblocking problem. For example, Dr. Schonfeld included the following set of offset equations, which were proposed and/or adopted into video coding standards over a nearly a decade. *Id.*

'841 Patent	$\frac{9(q_0 - p_0) - 3(q_1 - p_1)}{16}$
Bjontegaard	$\frac{8(q_0 - p_0) - 3(q_1 - p_1)}{16}$
B-118	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
Fu	$\frac{6(q_0 - p_0) - 2(q_1 - p_1)}{16}$
H.264, List	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
VCEG-M21	$\frac{8(q_0 - p_0) - 2.5(q_1 - p_1)}{16}$
H.241 Bjontegaard '048	$\frac{8(q_0 - p_0) + 4(q_1 - p_1) - 4(q_2 - p_2)}{16}$
B205	$\frac{7.5(q_0 - p_0) + 2(q_1 - p_1) - 2.5(q_2 - p_2)}{16}$

Ex-1003, ¶235.

As can be seen from this table, the proposals used (i) different “coefficients” and (ii) different sets of pixels (e.g. B205 uses the pixels q2 and p2). These changes lead to fundamentally different filters. Ex-2001, ¶¶291-296. For example, as Dr. Richardson’s testing showed, changing an “8” to a “9”, as Petitioner alleges would have been obvious by modifying Bjontegaard, could cause a 40% change in the resulting offset used. *Id.*, ¶¶295, §XI. This is because when the simulation of the '841 Patent and the simulation of Bjontegaard were applied to the same set of pixels in thousands of instances, they filtered pixel p0 differently 40% of the time. *Id.*, ¶243. Accordingly, Petitioner has not provided any justification for its assertion that an increase in Bjontegaard’s coefficient from “8” to “9” would have

been a simple step for a POSITA that would yield predictable results. *UCB, Inc.*, 65 F.4th at 693.

It is notable that Petitioner also failed to include all the possible first offsets in its examples of a POSITA's knowledge of prior art first offsets. Instead, Petitioner only identifies offsets that appear similar to an untrained eye to that of the '841 Patent. For example, Bjontegaard discloses an alternative offset that could be applied to p_0 and q_0 (d and e in Bjontegaard) under certain conditions. If this is the case, then the first offset is $b + c - 8(d - e) - f - g/16$ instead of the offset identified by Petition. Ex-2001, ¶264, 139. An even more severe example is Petitioner's exclusion of the first offset disclosed in Aksu, Aksu describes an averaging filter that centers on the pixel to be filtered based on a sliding, adjustable filtering window. *Id.*, ¶¶187-189. Not only is Aksu's filter centered on the pixel to be filtered instead of the block boundary so that the pixels used to calculate the offset are not fixed, but the pixels used can also range from 3 pixels to 7 pixels. *Id.* This fundamentally different filter is notably absent from Petitioner's description of the prior art first offsets, because it significantly undermines Petitioner's argument that the possible first offset equations were limited by particular design constraints such that the claimed offset would have been obvious. Petitioner's attempt to conjure "design constraints" to guide a POSITA are unsupported and riddled with impermissible hindsight.

Because Petitioner cannot identify the first offset of the '841 Patent in Bjontegaard, nor identify a single clear motivation to use that offset, Petitioner alleges that modifying the coefficients of Bjontegaard would have been within the routine skill of a POSITA because coefficients and number of pixels used are points of routine experimentation. Petition at 31-32. However, Petitioner's manufactured set of set of rules, which it refers to as "design constraints," do not survive scrutiny and fail to establish that changing Bjontegaard's first offset to arrive at the claimed offset would have been obvious. Ex-2001, ¶292.

Petitioner fails to cite any support that these are hard and fast rules of design, nor do any the "design constraints" limit the potential solutions in any meaningful way. Instead, as the history of deblocking filter development shows, deblocking filters requires significant testing and experimentation, and Dr. Richardson's testing shows that any change can have a significant impact on the operation of the filter. Ex-2001, §IX.

First, Petitioner alleges that a POSITA would have experimented with six "design constraints" to optimize Bjontegaard's offset equation, including (i) the magnitude of the coefficients applied that controls the "width" of the filter, (ii) the sum of the coefficients in the numerator and division by the denominator, (iii) the "window" used to calculate the offset, (iv) the "DC" gain of the offset equaling one; (v) the value of the offset's right-shift being between three and six; and (vi) the use

of integer coefficients instead of decimal coefficients. Petition at 32-33. Petitioner’s argument collapses in view of the references it relies on as showing the prior art was “replete” with first offsets. *Id.* Specifically, despite the significant experimentation in the art with different deblocking filters spanning over the period of at least decade, not a single reference or codec used or experimented with the particular offset claimed in the ’841 Patent, with its specific combination of coefficients, window, DC gain, and right shift. Ex-2001, ¶292. Nor did anyone recognize the benefits to avoiding filtering ramp and smoothing steps in a particular way. *Id.*

The Petition fails to consider the number of possible design choices created by these alleged constraints. When combining the possibilities generated by all of the options presented in the Petition, there are well over 100 possibilities, and the Petition provides no motivation to why a POSITA would have selected one design over the other. *Id.* Thus, even apply Petitioner’s design constraints, the task of finding an optimal deblocking filter would not be the subject of routine experimentation. Ex-2001, ¶¶292-296; *Rolls-Royce, PLC v. United Techs. Corp.*, 603 F.3d 1325, 1339 (Fed. Cir. 2010) (finding the claimed invention nonobvious because of the “broad selection of choices for further investigation available to a person of ordinary skill included any degree of sweep”); *Takeda Chem. Indus. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1359 (Fed. Cir. 2007) (holding the invention

not obvious to try because the prior art disclosed a broad selection of compounds that an ordinarily skilled artisan could have selected for further investigation).

Thus, Petitioner’s argument that these alleged design constraints would have been used by a POSITA to modify the first offset in Bjontegaard to arrive at the claimed offset amounts to nothing more than hindsight bias. Such hindsight bias is fatal to the Petition because Petitioner does not and cannot explain how these understandings would facilitate the discovery of the ’841 Patent’s invention, absent a template from the ’841 Patent itself. *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1320 (Fed. Cir. 2004) (quoting *Ecolochem, Inc. v. Co. Cal. Edison Co.*, 227 F.3d 1361, 1371-72 (Fed. Cir. 2000)) (additional citations omitted) (holding that it is impermissible to use “the inventor’s disclosure as a blueprint for piecing together the prior art to defeat patentability—the essence of hindsight.”). Even if these constraints could form the basis of a brute-force level of “routine experimentation” to ultimately arrive at the ’841 Patent’s coefficients and offsets, “routine experimentation does not necessarily preclude patentability.” *Honeywell Int’l Inc. v. Mexichem Amanco Holding S.A. De C.V.*, 865 F.3d 1348, 1356 (Fed. Cir. 2017).

In addition, Petitioner’s design constraints do not survive scrutiny. For example, Petitioner argues that a POSITA would have known that the workable range would typically be defined such that “summing the coefficients in the

numerator and dividing by the denominator produces a fraction between $\frac{1}{4}$ and $\frac{1}{2}$.” Petition at 32. Because the claimed offset of the ’841 Patent uses the coefficients $\frac{9}{16}$ and $\frac{3}{16}$, the sum would be $\frac{12}{16}$ or $\frac{3}{4}$, which is outside of the range suggested by Petitioner. Ex-2001, ¶294. Thus, if the design constraint was legitimate, it would actually show that the ’841 Patent’s offset was outside of the routine range. *Id.*

Third, contrary to the arbitrary design constraints manufactured for the Petition, Dr. Richardson’s test results show that any one of the changes suggested by the Petition can result in large objective and subjective changes in the filtering results. Ex-2001, ¶295, §IX.

Thus, Petitioner’s “routine experimentation” is nothing more than hindsight-driven analysis that uses the claimed coefficients as a guide to reach a conclusion that no POSITA reached in over a decade of development in trying to find solutions to the same problem (the problem of efficient and effective deblocking). Ex-2001, ¶296; 290. Optimizing the filter response in the context of the overall in-loop filter design requires extensive objective and subjective testing that goes far beyond routine experimentation. Ex-2001, ¶69. Thus, a POSITA would not have a reasonable expectation of success in substituting different elements from different deblocking designs. Ex-2001, ¶293.

b. 10[d]

Bjontegaard combined with Bjontegaard's Code and a POSITA's knowledge does not teach or suggest calculating the second offset based on $\frac{p0j+p2j-2p1j+2\Delta}{4}$ if the first filter decision value is below said first threshold value as required in element 10[d].

First, Petitioner has not set forth any analysis that the Diff equation in Bjontegaard that Petitioner asserts corresponds to the claimed second offset is calculated *if said first filter decision value is below said first threshold value*, as the claims require. This alone is fatal. Petitioner argues that $S0_1$ in Bjontegaard in the first filter decision that is compared to a first threshold value $\text{lim}(qp)$. *See, e.g.*, Petition at 38. However, Petitioner has not argued that the particular Diff equation it points to as the second offset is calculated if $S0_1$ is below $\text{Lim}(qp)$, which is critical because, as set forth above, Diff could also be calculated as $\text{Diff}=0$ or $\text{Diff}=3(a+b-4c+d+e)/16$. Diff is only equal to $5(b-2c+d)/16$ if $\text{Act}_{11} = 2$ and Petitioner has not alleged or shown that this condition occurs when $S0_1$ is below $\text{Lim}(qp)$. Ex-2001, ¶298.

Next, Petitioner arbitrarily modifies the Diff equation in Bjontegaard to get the offset to appear closer to the '841 Patent. Petitioner cannot show that a POSITA would have understood $\text{Diff} = 5(b-2c+d)/16$ to be based on $\frac{p0j+p2j-2p1j+2\Delta}{4}$ because a POSITA would not have read Bjontegaard's alleged second offset equation as $\text{Diff} = 5(b-2c+d + \Delta)/16$, because, as Dr. Richardson explains, using d_{modified} instead of d

would not make sense to a POSITA because the authors of Bjontegaard, having defined d_{modified} in Section 4.5.5, chose to use d in 4.5.6.1 and 4.5.6.2, even though the defined d_{modified} was available to use in the Diff equations. Ex-2001, ¶299.

Even assuming that d_{modified} was used instead of d , the Diff equation identified by Petitioner is different from the claimed second offset expression. Ex-2001, ¶300. Petitioner argues that the only difference between the claimed equation and Bjontegaard’s Equation is the “coefficient assigned to each component”. Petition at 37.

Claimed Equation	Bjontegaard’s Equation
$\Delta = \frac{1(p_2 - 2p_1 + p_0)}{4} + \frac{1\Delta}{2}$	$\Delta = \frac{5(p_2 - 2p_1 + p_0)}{16} + \frac{5\Delta}{16}$

However, a POSITA would not have minimized these coefficient differences as Petitioner does, because the coefficients of the second offset reflect a very specific design that affects the frequency response of the filter. Ex-2001, ¶302. The coefficients ensure that structures, such as line structures and step structures, are smoothed in a particular way. *Id.*

The differences between these two offsets is further illustrated when the previously-calculated first offset (“ Δ ”) is considered. Specifically, while both offsets include a Δ (assuming, arguendo, that Petitioner’s interpretation is correct),

the Δ is a reference to the first offset. Thus, the following table reflect the actual deblocking filters normalized based on the value of Δ . Ex-2001, ¶303

	Second Offset
841 Patent	$\frac{64(p_2 - 2p_1 + p_0) + 72(q_0 - p_0) - 24(q_1 - p_1)}{256}$
Bjontegaard	$\frac{80(p_2 - 2p_1 + p_0) + 40(q_0 - p_0) - 15(q_1 - p_1)}{256}$

Petitioner ignores these differences and merely argues that it would have been obvious to a POSITA to reach the claimed second offset expressions using routine experimentation. Ex-2001, ¶304. Petitioner then cites to a number of prior art references, but Petitioner again fails to account for the fact that the Δ in each equation is a reference to the first offset. Petitioner has made no attempt to account for how the combination of offsets would impact the overall filter design nor has the petition shown that any specific motivation exists in the art to combine the teachings of several references. *Id.* In contrast, Dr. Richardson's testing showed that any change to the filter design, including to the second offset, could have a significant impact on the operation of the filter. Ex-2001, §IX. For example, Dr. Richardson showed that, when applied to the same pixel values, the simulation of the '841 Patent and Bjontegaard filtered the pixel p_1 (to which the second offset would apply) differently 76.8% of the time. Ex-2001, ¶¶229-244.

Moreover, Petitioner’s argument is undermined by Dr. Schonfeld’s analysis of the effects of the different coefficients of Bjontegaard and the ’841 Patent. Specifically, the ’841 Patent second offset will not filter ramp structures and will smooth step structures in a particular way. Ex-2001, ¶304. In contrast, Bjontegaard’s second offset will filter ramp structures and smooths step structures differently than the ’841 Patent. *Id.*

						’841 Patent	Bjontegaard
p2	p1	p0	q0	q1	Type	$\frac{1(p2 - 2p1 + p0)}{4} + \frac{1\Delta}{2}$	$\frac{5(p2 - 2p1 + p0)}{16} + \frac{5\Delta}{16}$
200	150	150	150	150	Step (p1)	13	16
200	200	150	150	150	Step (p0)	-8	-13
200	200	200	150	150	Step (q0)	-10	-5
150	160	170	180	190	Ramp (10)	0	0
125	150	175	200	225	Ramp (25)	0	-1
200	250	200	250	200	Alternating	-6	-21
255	50	50	255	255	Line	90	84
255	255	50	50	255	Line	-51	-64
175	200	150	150	175	Random	-16	-22
50	125	100	150	125	Random	-11	-23
75	100	150	75	125	Random	-17	-5

Ex-1003, ¶552 (annotated). Thus, Petitioner has failed to show that the claimed second offset is non-obvious.

c. 10[f];

Bjontegaard combined with Bjontegaard's Code and a POSITA's knowledge does not teach or suggest the third offset based on $\frac{q_0j+q_2j-2q_1j-2\Delta}{4}$ disclosed in 10[f].

First, as discussed with respect to the second offset, Petitioner has not set forth any analysis that the Diff equation in Bjontegaard that Petitioner asserts corresponds to the claimed third offset is calculated *if said second filter decision value is below said second threshold value*, as the claims require. This is fatal. Petitioner has not argued that the particular Diff equation it points to as the third offset is calculated if S_{02} is below $\text{Lim}(qp)$, which is critical because, as set forth above, Diff is only equal to $5(e-2f+g)/16$ if $\text{Act}_{22} = 2$ and Petitioner has not alleged or shown that this condition occurs when S_{02} is below $\text{Lim}(qp)$. Ex-2001, ¶309.

Additionally, Petitioner cannot show that a POSITA would have understood $\text{Diff} = 5(e-2f+g)/16$ to be based on $\frac{q_0j+q_2j-2q_1j+2\Delta}{4}$. For the same reasons explained above, a POSITA would not understand that e_{modified} instead of e would be used. Ex-2001, ¶310.

Even assuming that e_{modified} was used instead of e , the Diff equation identified by Petitioner is still different from the claimed third offset expression. *Id.*, ¶311.

For similar reasons discussed above with respect to the second offset, which are incorporated by reference herein, Petitioner cannot show that the claimed third offset would have been obvious to a POSITA. Petitioner argues that the offsets are

only different in their coefficients. However, a POSITA would not have minimized these coefficient differences as Petitioner does, because the coefficients of the third offset reflect a very specific design that affects the frequency response of the filter. The coefficients ensure that structures, such as line structures and step structures, are smoothed in a particular way. Ex-2001, ¶¶312, 304.

The differences between the claimed offset and Bjontegaard's offset is further illustrated when the previously-calculated first offset, Δ is considered. Specifically, while both offsets include a Δ (assuming, arguendo, that Petitioner interpretation of Bjontegaard is correct), the delta is a reference to the first offset. Thus, the same normalization set forth above for the second offset to reflect the actual deblocking filters based on the value of Δ can be calculated for the third offset. Ex-2001, ¶314 Petitioner completely ignores the resulting differences and merely argues that it would have been obvious to a POSITA to reach the claimed third offset expressions using routine experimentation. Ex-2001, ¶315. Petitioner then cites to a number of prior art references, but Petitioner again fails to account for the fact that the Δ in each equation is a reference to the first offset. Petitioner has made no attempt to account for how the combination of offsets would impact the overall filter design, nor has the petition shown that any specific motivation exists in the art to combine the teachings of several references. *Id.* In contrast, Dr. Richardson's testing showed that any change to the filter design, including to the third offset, could have a

significant impact on the operation of the filter. *Id.*, §IX. For example, Dr. Richardson showed that when applied to the same pixel values, the simulation of the '659 Patent and Bjontegaard, which have different first offsets and different third offsets, filtered the pixel q_1 (to which the third offset would apply) differently 76.8% of the time. Ex-2001, ¶¶229-244.

C. Petitioner Has Failed To Establish A Reasonable Likelihood That Aksu In View Of Gonzalez Render Obvious Any Of the Challenged Claims (Ground 2A).

Ground 2A fails to show that the Challenged Claims are obvious for the reasons discussed below.

1. Claims 1, 5, and 16 (Ground 2A)

a. Ground 2A does not render obvious Elements 1[a], 5[a], 16[a]:

1[a], 5[a], and 16[a] require calculating a first filter decision value using only pixels p_{2i} , p_{1i} , and p_{0i} using only pixels p_{2i} , p_{1i} , and p_{0i} based on $|p_{2i} - 2p_{1i} + p_{0i}|$. Aksu in view of Gonzalez do not render obvious these claim elements.

Aksu discloses d_r and d_l , which are filter decision values, but Aksu does not disclose calculating those values using only pixels p_{2i} , p_{1i} , and p_{0i} based on $p_{2i} - 2p_{1i} + p_{0i}$. Ex-2001, ¶325. As described above, the Aksu filter will measure the activity in 1 to 6 pixels (based on parameter n and n_{tr}) on each side of the block boundary to calculate a decision value for a block and its neighboring block. *Id.* The

decision value is stored in d_r and d_l . An example of the specific calculations for d_r are shown below

$$\begin{aligned}
 & d_r = 6, \text{ if } |r_1 - r_j| \leq \beta/j \text{ with all } j \in [1, 6], \\
 & \text{otherwise: } d_r = i, \text{ where } i \text{ fulfils the conditions} \\
 & \quad i \in [1, n_{tr}], \quad (4) \\
 & \quad |r_1 - r_{i+1}| > \beta/i, \text{ and} \\
 & \quad |r_1 - r_j| \leq \beta/j \text{ with all } j \in [1, i].
 \end{aligned}$$

Ex-1019 at 13:15-20; Ex-2001, ¶325..

The values of d_r and d_l are then used to identify the number of pixels to use in the filtering window. For example, for d_r , Table 2 of Aksu shows the determination of the width of the filtering window for the pixels r_1 , r_2 , and r_3 according to the value of d_r .

d_r ($d_l > 1$)	r_1	r_2	r_3
1	X	X	X
2	1	X	X
3	1	1*	X
4	2	2	X
5	2	2	2**
6	3 or 2***	3	3

Ex-1019 at Table 2 Ex-2001, ¶326.

Petitioner acknowledges that Aksu alone does not disclose or render obvious the filter decision value of the claims, but argues that it would be obvious to modify Aksu to use “a ‘second-order’ Laplacian.” Petition at 55-56. Specifically, Petitioner alleged that it would have been obvious to substitute Aksu’s use of a series of

absolute difference calculations with a single three-pixel Laplacian. However, the Petition does not identify any motivation in Aksu or Gonzalez to substitute a three-pixel Laplacian. *Virtek Vision It'l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 888 (Fed. Cir. 2024); *KSR v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (“[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. . . . [I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.”).

Moreover, the substitution of Aksu’s absolute difference calculations for determining d_r with a three-pixel Laplacian would not have been obvious to a POSITA. Ex-2001, ¶¶328-335. Contrary to Petitioner’s assertions, a POSITA would not have had a reasonable expectation of obtaining a successful deblocking filter by modifying Aksu because Petitioner’s proposal requires extensive changes to Aksu, including (i) changing the metric by which image activity is measured (e.g. measuring slope instead of flatness), (ii) changing and limiting the number of pixels considered for measuring that activity, (iii) changing the measurement from a series of equations to one equation, and (iv) comparing the modified singular equation to a single threshold, instead of comparing each series of equations to a threshold. Ex-

2001 ¶328. There is no evidence that these significant changes would not be extensive and require undue testing. Ex-2001, ¶¶328-335

Further, modifying Aksu to replace n and d_i with a single three-pixel Laplacian would lead to a less accurate measurement of activity. Ex-2001, ¶¶332-333. Aksu's granular calculation of the differences between each pixel in an up to 6-pixel window more accurately capture the activity on one side of the block boundary than a single calculation based only on the three pixels closest to the boundary. *Id.* Contrary to Petitioner's argument, first-order difference calculations detect image details that preclude filtering (e.g., flatness) because a flat line is more likely to be a blocking artifact while "ramps" which are measured by Laplacians are more likely to be the actual image signal. Thus, contrary to the Petition, the first-order difference calculations of Aksu could in fact be used to preclude filtering. Ex-2001, ¶333

Moreover, Petitioner's "most critical" reason that a POSITA would have been motivated to substitute a Laplacian in Aksu because "similar modifications" were made "during subsequent prior-art standards developments" fails. Among the seven references that Petitioner alleges can be combined to reach the invention of the '841 Patent, there are no two references that disclose a uniform approach to designing a deblocking filter. Ex-2001, ¶338. Among the significant differences, several of the asserted references use first-order difference calculations (e.g., Aksu and B118), while several other references, both earlier and later in time in the standards

development process, use Laplacians for measuring image activity (e.g., Bjontegaard, H.241, B205). *See* Ex-2001, §X. As an example, the H.264 Standard, which was finalized after Aksu, uses first-order difference calculations. Ex-2001, §101. Petitioner’s “critical” reason thus does not pass scrutiny.

Accordingly, Aksu in view of Gonzalez does not teach or suggest 1[a], 5[a], and 16[a].

a. Ground 2A does not render obvious Elements 1[b], 5[b], 16[b]:

Petitioner’s obviousness argument requires Aksu’s d_r value to undergo the same significant changes as d_l from 1[a] above. For the reasons stated in the prior section, it would not have been obvious to a POSITA to replace the multiple absolute difference calculations comprising the calculation of d_r with a single Laplacian disclosed in Gonzalez. Ex-2001, ¶¶341-343. Thus, Aksu in combination with Gonzalez does not teach or suggest 1[b], 5[b], and 16[b] for the same reasons as 1[a], 5[a], and 16[a] above. *See supra* §VI.C.a.

b. Ground 2A does not render obvious Elements 1[c], 5[c], 5[e], 16[c]

Petitioner asserts that Aksu renders obvious these Elements because “ d_r is determined by comparing each of Aksu’s first-order difference calculations to a threshold based on β , Aksu, 13:15-19 (explaining $d_r=i$ where $|r_1-r_{i+1}|>\beta/i$, and $|r_1-$

$r_j \leq \beta/j$, where j includes all values between 1 and i), and d_r controls how many pixels are filtered.” Petition at 59-60. Petitioner’s argument is fatally flawed.

Contrary to the Petition, the determination of how many pixels to modify in Aksu is not based on the comparison of the alleged first filter decision value, d_r , to the thresholds based on β . Instead, d_r is assigned an integer value, i , and the decision of the number of pixels to modify is based on the value of that integer without comparing d_r to any threshold, such as β . Ex-2001, ¶345. For example, the table below shows how the integer value could result in certain pixels (marked with an “X”) not being filtered.

$d_r (d_i > 1)$	r_1	r_2	r_3
1	X	X	X
2	1	X	X
3	1	1*	X
4	2	2	X
5	2	2	2**
6	3 or 2***	3	3

Ex-2001, ¶346.

Petitioner tries to cure this fundamental difference between Aksu and the ’841 Patent using the combination of Aksu with Gonzalez’s second-order Laplacian. Specifically, Petitioner makes the unsupported assertion that, when Aksu is combined with Gonzalez, the table above would be unnecessary because “only one activity-measure calculation would be performed.” Petition at 60-61. Petitioner does

not, however, explain how the proposed combination would satisfy the limitations requiring determining *how many* pixels to filter *based on a comparison of the first filter decision value to a first threshold value*, but merely states that the combination would generally filter more pixels when the activity level is below a threshold, and generally filter less when the activity is equal to or exceeds the threshold. *Id.* These conclusory statements are insufficient to show a motivation to modify Aksu, and ignore that neither Aksu or Gonzalez provide any indication of what that threshold should be. Ex-2001, ¶¶347. Again, the Petition is premised on the fundamental error that d_r is compared to β . *Id.*

For the reasons above, Aksu in view of Gonzalez does not teach 1[c], 5[c], 5[e], and 16[c].

c. Ground 2A does not render obvious Elements 1[d], 5[d], 5[f], 16[d]:

The Petition ties its arguments with respect to these elements to 1[c], 5[c], 5[f] and 16[c]. Thus, for the reasons stated in the prior element, Aksu in view of Gonzalez does not render obvious these elements. *See supra* §VI.C.b.

In addition, Claim 3 depends from Claim 1, Claims 7, 9, 12-15 depend from Claim 5. Thus the Petition fails for the same reasons stated above for Claims 1 and 5.

D. Petitioner Has Failed To Establish A Reasonable Likelihood That Aksu In View Of Gonzalez, H.241, and B205 Render Obvious Claims 2, 6, and 11 (Ground 2B).

Claims 2, 6, and 11 depend on claims 1, 5, and 10 respectively. This Ground does not raise any new arguments with respect to the independent claims, and thus the Petition fails for the same reasons stated above with respect to ground 2A.

E. Petitioner Has Failed To Establish A Reasonable Likelihood That Aksu In View Of Gonzalez, Fu, and/or B118 Render Obvious Any Of the Challenged Claims (Ground 2C).

1. Claim 10 (Ground 2C)

a. 10[a]

Aksu in combination with Gonzalez, Fu, B118, and a POSITA's knowledge does not teach or suggest Limitation 10[a].

Petitioner has not shown a motivation to alter Aksu's averaging filter to reach the first offset of the '841 Patent. The particular design of the '841 Patent first offset is not modifying the pixel values over a block boundary if they form a ramp structure but smoothing the pixel values if they form a step structure. This is fundamentally different from Aksu's averaging filter that is designed to modify a given pixel value by the average of a sliding filtering window centered on the given pixel. Ex-2001, ¶360. In spite of these irreconcilable difference, Petitioner urges the Board to find a motivation to substitute Aksu's filter with a "weighted offset" equation such as that disclosed by Fu or B-118, and further modify the resulting combination to arrive at the claimed first offset. Petition improperly ignores the necessary impact of such a substitution on the other aspects of the filter function. Ex-2001, ¶¶363, 365. For example, Aksu's adjustable averaging filter is bound up with the calculation of d_r

and d_l , which is assigned an integer value which determines the width of the adjustable filtering window used to calculate the filter. Ex-2001, ¶¶360-363. Petitioner fails provide any explanation as to how substituting a “weighted coefficient” equation impact adjustable width filtering window based on the integer assigned to d_r or d_l . *Id.* This is fatal to the petition because Petitioner fails to demonstrate that the modification of Aksu to use a different first offset would yield predictable results and a functioning filter. *Id.*; *UCB, Inc.*, 65 F.4th at 693 (Fed. Cir. 2023) (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art).

The results of not filtering ramp and smoothing other structures in a certain way using the offsets of the '841 Patent is “a difference in kind,” rather than a “difference in degree,” in comparison to the results of Aksu’s averaging filter, which is persuasive that Petitioner’s proposed modification of the prior art would not yield predictable results. *Id.* Ex-2001, ¶¶360-363.

Even if there was a motivation to modify Aksu’s averaging filter Petitioner’s argument that the claimed first offset would have been obvious because it could be identified with only routine experimentation is contrary to the law and the evidence. *Rolls-Royce, PLC v. United Techs. Corp.*, 603 F.3d 1325, 1339 (Fed. Cir. 2010) (finding the claimed invention nonobvious because of the “broad selection of choices for further investigation available to a person of ordinary skill included any

degree of sweep”); *Bayer Schering Pharma AG, Inc.*, 575 F.3d at 1347 (“[A]n invention would not have been obvious to try when the inventor would have to try all possibilities in a field unreduced by direction of the prior art.”). Petitioner ignores the evidence demonstrated by Dr. Schofeld that decades of experimenting with deblocking filtering never resulted in the claimed first offset. Ex-2001, ¶364. Experts in the field have tried for decades to develop a solution to the same deblocking problem. *Id.* For example, Dr. Schonfeld included the following set of offset equations, which were proposed and/or adopted into video coding standards over a nearly a decade. This table demonstrates that different proposals used different coefficients and different pixels. *Id.* Notably, Aksu’s filter is missing from this table, as it demonstrates even greater possibility of variation in approach to deblocking design.

'841 Patent	$\frac{9(q_0 - p_0) - 3(q_1 - p_1)}{16}$
Bjontegaard	$\frac{8(q_0 - p_0) - 3(q_1 - p_1)}{16}$
B-118	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
Fu	$\frac{6(q_0 - p_0) - 2(q_1 - p_1)}{16}$
H.264, List	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
VCEG-M21	$\frac{8(q_0 - p_0) - 2.5(q_1 - p_1)}{16}$
H.241 Bjontegaard '048	$\frac{8(q_0 - p_0) + 4(q_1 - p_1) - 4(q_2 - p_2)}{16}$
B205	$\frac{7.5(q_0 - p_0) + 2(q_1 - p_1) - 2.5(q_2 - p_2)}{16}$

b. 10[d]

Aksu in combination with Gonzalez, Fu, B118, and a POSITA's knowledge does not teach or suggest 10[d].

Petitioner alleges that d_r in Aksu is the first filter decision value, but Aksu does not disclose or suggest calculating its averaging filter if d_r is less than a threshold, which is required by the claims. Ex-2001 ¶369. Indeed, Petitioner fails to make any argument that Aksu in combination with any other reference contains any such disclosure. Petition at 80-82.

Petitioner failed to show a motivation to modify Aksu's averaging filter to reach the claimed second offset. Aksu and the '841 Patent take fundamentally different approaches to filter. Ex-2001, ¶370. While Aksu discloses that a suitable

filter should be used, Aksu does not provide a “natural” motivation to explore alternative filters because it did not provide other options for a filter. Instead, it discloses an averaging filter in a preferred embodiment. Ex-2001, ¶¶187-189.

Reference	Second Offset Equation
'841 Patent	$\frac{p_2 - 2p_1 + p_0}{4} + \frac{2\Delta}{4}$
Aksu	$\frac{l_1 + r_1 + r_2}{3}$ $\frac{l_2 + l_1 + r_1 + r_2 + r_3}{5}$ $\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$

Petitioner ignores these significant incompatibilities and its argument that a POSITA would have replaced Aksu’s filter with a weighted-offset equation because of better filter control fails as a result because Petitioner has not provided any analysis as to how a substitution of Aksu’s averaging filter with a weighted offset equation would affect other aspects of the overall filter. As demonstrated by Dr. Richardson’s testing, any change in the deblocking design will lead to significantly different filtering results. Ex-2001, §IX. Petitioner’s failure to provide this analysis is fatal because Petitioner cannot show a reasonable expectation of success. Ex-2001, ¶370; *In re Stepan Co.*, 868 F.3d 1342, 1347 (Fed. Cir. 2017) (additional citations omitted) (“[T]o have a reasonable expectation of success, one must be

motivated to do more than merely to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result.").

Further, even if there was a motivation to modify Aksu using the equations of B118 or Fu, Petitioner fails to demonstrate that the particular coefficients of the '841 Patent second offset would have been selected through routine experimentation for the same reasons set forth above for element 10[a]. Ex-2001, ¶371; *infra* §VI.E.1.b.

c. 10[f]

Petitioner alleges that d_l in Aksu is the second filter decision value, but Aksu does not disclose or suggest calculating its averaging filter if d_l is less than a threshold, which is required by the claims. Ex-2001 ¶375. Indeed, Petitioner fails to make any argument that Aksu in combination with any other reference contains any such disclosure.

Petitioner failed to show a motivation to modify Aksu's averaging filter to reach the claimed third offset. Aksu and the '841 Patent take fundamentally different approaches to filter. Ex-2001, ¶376. For example, the '841 Patent third offset is designed not to filter ramp structures whereas Aksu's averaging filter that modifies a specific pixel using the average pixel value in an adjustable window. *Id.* While Aksu discloses that a suitable filter should be used, Aksu does not provide a "natural" motivation to explore alternative filters because it did not provide other options for

a filter. Instead, it discloses an averaging filter in a preferred embodiment. Ex-2001, ¶¶187-189.

Petitioner ignores these significant incompatibilities and its argument that a POSITA would have replaced Aksu's filter with a weighted-offset equation because of better filter control fails as a result because Petitioner has not provided any analysis as to how a substitution of Aksu's averaging filter with a weighted offset equation would affect other aspects of the overall filter. Ex-2001, ¶377. As demonstrated by Dr. Richardson's testing, any change in the deblocking design will lead to significantly different filtering results. *Id.*, §IX. Petitioner's failure to provide this analysis is fatal because Petitioner cannot show a reasonable expectation of success. Ex-2001, ¶377. *In re Stepan Co.*, 868 F.3d at 1347.

Further, even if there was a motivation to modify Aksu using the equations of B118 or Fu, Petitioner fails to demonstrate that the particular coefficients of the '841 Patent second offset would have been selected through routine experimentation for the same reasons set forth above for element 10[a]. Ex-2001, ¶377.

VII. THE PETITION SHOULD BE DENIED AS CUMULATIVE OF PREVIOUSLY PRESENTED ARGUMENTS PURSUANT TO 35 U.S.C. § 325(d)

The Petition should be denied because it proceeds on grounds that are cumulative of previously presented art and argument during the prosecution of the '841 Patent. Section 325(d) applies because (1) substantially the same art was

previously presented to the Patent Office; and (2) Petitioner has not demonstrated that the Patent Office erred in a manner material to the patentability of the challenged claims. *Adv. Bionics, LLC v. MED-EL Elektromedizinische Gerate GmbH*, IPR2019-01469, Paper 6 (Feb. 13, 2020) (designated precedential Mar. 24, 2020).

During prosecution of the '841 Patent, the examiner cited Bjontegaard '048 (US 2006/0078048) (Ex-1025) in view of List (Ex-1024) to reject claims 34-42 and 44-50 under § 103. Ex-2001 ¶126; Ex-1002 at 410-17. The examiner's rejection was based on Bjontegaard 048's teaching of an equation used for filtering decisions based on the sum of Laplacian equations compared to a threshold. *Id.*

The List reference the examiner cited against the '841 Patent is explicitly referenced in the '841 Patent's specification as describing deblocking in the H.264 Standard. Ex-1001 at 2:1-4. List describes the same separate evaluations of absolute difference calculations to measure activity on either side of the block boundary for filtering decisions that are used to determine the extent of the filtering (e.g., how many pixels to filter) that is disclosed in Aksu. Ex-1024 at 617; Ex-1019 at 13:15-20; Ex-2001, ¶130.

Thus, the deblocking decision disclosed in Bjontegaard '048 that uses Laplacian equations as discussed above was considered by the examiner during prosecution, in combination with the asymmetric filtering decisions applied to the "p" block and the "q" block shown in List (Ex-1024) and H.264 (Ex-1037). Ex-2001

¶132. All claims of the '841 Patent were allowed over this rejection. At least with respect to Grounds 2A-2C, the combination of Aksu, which Petitioner asserts discloses determining how many pixels to filter based on separate measures of activity on each side of the block boundary, with the Laplacian disclosed in Gonzalez, is cumulative of the previously presented and traversed combination of Bjontegaard '048 and List considered during prosecution. In addition, Petitioner has not alleged, let alone demonstrated, that the Patent Office erred in a manner material to the patentability of the challenged claims. Thus, the Petition should be denied at least with respect to Ground 2A-2C.

VIII. CONCLUSION

For the foregoing reasons, institution should be denied.

Date: September 20, 2024

Respectfully Submitted

/ David Frist /

David Frist, Reg. No. 60,511

John Haynes, Reg. No. 44,754

Christopher TL Douglas, Reg. No. 56,950

Stephen R. Lareau, Reg. No. 63,273

CERTIFICATION UNDER 37 CFR § 42.24(d)

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Patent Owner's Response to Petition totals 13,178 which is less than the 14,000 allowed under 37 CFR § 42.24(b)(1).

Date: September 20, 2024

By: / David Frist /
David Frist (Reg. No. 60,511)

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e)(4), the undersigned certifies that on September 20, 2024, a complete and entire copy of this Patent Owner's Preliminary Response and its supporting exhibits were provided via email, to the Petitioner by serving the email correspondence addresses of record as follows:

kaiser-ptab@perkinscoie.com
Sathe-ptab@perkinscoie.com
Lembo-ptab@perkinscoie.com
Kendrick-ptab@perkinscoie.com
Onley-ptab@perkinscoie.com
yang-ptab@perkinscoie.com
Intel-Ericsson-IPRs@perkinscoie.com

Date: September 20, 2024

By: / David Frist /
David Frist (Reg. No. 60,511)