**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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AMAZON.COM SERVICES LLC,

Petitioner

v.

INTERDIGITAL, INC.,

Patent Owner.

_____

IPR2026-00192

U.S. Patent No. 12,143,606

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# PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 12,143,606

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| 1002 | File History of the '606 patent |
| 1003 | Declaration of Dr. Joseph P. Havlicek, Ph.D. ("Havlicek") |
| 1004 | Curriculum Vitae of Dr. Joseph P. Havlicek, Ph.D. |
| 1005 | U.S. Patent Pub. No. 2008/0170615 ("Sekiguchi") |
| 1006 | Enlarging MB size for high fidelity video coding beyond HD ("VCEG-AJ21"), available at https://www.itu.int/wftp3/av-arch/video-site/0810_San/VCEG-AJ21.zip |
| 1007 | WO2006/026903 ("Xiong") |
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| 1017 | Recommendation H.264 (2005) Amendment 2 (04/07) (Munford, Appendix H26403) (“Amendment 2”) |
| 1018 | Fu et al., Fast Intra Prediction Algorithm in H.264/AVC, Proceedings 7th International Conference on Signal Processing, 2004. Proceedings. ICSP '04. 004., Beijing, 2004, pp. 1191-1194 vol.2, doi: 10.1109/ICOSP.2004.1441537 (“Fu”) |
| 1019 | Pan et al., Fast Mode Decision for Intra Prediction (“JVT-G013” or “Pan”) (Mar. 2003) |
| 1020 | *InterDigital, Inc. et al. v. Amazon.com Services LLC*, No. 2:25-cv-822-AWA-DEM, ECF No. 1 (E.D. Va., Dec. 18, 2025) |

## LISTING OF CHALLENGED CLAIMS

| Reference | Limitation |
|---|---|
| **Claim 1[1]** | |
| 1[pre] | A video encoding apparatus, comprising: |
| 1[a] | a memory and a processor, configured for: |
| 1[b] | encoding picture data for at least a block in a picture, by performing intra prediction with multiple partition types for chroma encoding of the block, the multiple partition types comprising a set of multiple chroma partition types of sizes 16×16, 8×8, 4×4 and a set of multiple luma partition types, the set of multiple chroma partition types being different than the set of multiple luma partition types, and |
| 1[c] | determining a particular chroma partition type using a single chroma intra prediction mode that is different than a luma intra prediction mode, for encoding a partitioned block from the set of multiple chroma partition types in response to a luma partition type utilized to encode the block, the luma partition type being included in the set of multiple luma partition types and only luma partition type is signaled, not the chroma partition type, |
| 1[d] | said encoding comprising: setting a luma partition, |
| 1[e] | setting a chroma partition from the set of multiple chroma partition types; and, |
| 1[f] | setting a luma prediction mode, setting a chroma prediction mode, wherein chroma and luma have different modes; and encoding the block. |

[1] Limitations 1[b] and 1[c] include text as corrected by the September 2, 2025 Certificate of Correction.

| Reference | Limitation |
|---|---|
| **Claim 2** | |
| 2[pre] | A method comprising: |
| 2[a] | encoding picture data for at least a block in a picture, by perform intra prediction with multiple partition types for chroma encoding of the block, the multiple partition types comprising a set of multiple chroma partition types of sizes 16×16, 8×8, 4×4 and a set of multiple luma partition types, the set of multiple chroma partition types being different than the set of multiple luma partition types, and |
| 2[b] | determining a particular chroma partition type using a single chroma intra prediction mode that is different than a luma intra prediction mode, for encoding a partitioned block from the set of multiple chroma partition types in response to a luma parturition type utilized to encode the block, the luma partition type being included in the set of multiple luma partition types and only luma partition type is signaled, not the chroma partition type, |
| 2[c] | said encoding comprising: setting a luma partition, |
| 2[d] | setting a chroma partition from the set of multiple chroma partition types; and, |
| 2[e] | setting a luma prediction mode, setting a chroma prediction mode, wherein chroma and luma have different intra prediction modes; and encoding the block. |
| **Claim 3** | |
| 3 | The method of claim 2, wherein a particular chroma partition type for coding the block is determined from the set of chroma partition types responsive to a luma partition type utilized to code the block or one or more neighboring blocks the luma partition type being included in the set of luma partition types. |

| Reference | Limitation |
|---|---|
| **Claim 4** | |
| 4 | The method of claim 3, wherein for the particular chroma partition type, a largest-size available transform matching the particular chroma partition type is selected from a set of transforms. |
| **Claim 5** | |
| 5 | The method of claim 3, wherein from among a particular luma partition type and a particular chroma partition type selected to code the block only the particular luma partition type is signaled, the particular luma partition type being selected from the set of luma partition types and the particular chroma partition type being selected from the set of chroma partition types. |
| **Claim 6** | |
| 6 | The method of claim 5, wherein the particular luma partition type is absolutely coded or differentially coded from one or more neighboring blocks. |
| **Claim 10** | |
| 10[pre] | A method comprising: |
| 10[a] | decoding picture data for at least a block in a picture, by performing intra prediction with multiple partition types for chroma decoding of the block, the multiple partition types comprising a set of multiple chroma partition types of sizes 16×16, 8×8, 4×4 and a set of multiple luma partition types, the set of multiple chroma partition types being different than the set of multiple luma partition types, and |
| 10[b] | determining a particular chroma partition type using a single chroma intra prediction mode that is different than a luma intra prediction mode, for decoding a partitioned block from the set of multiple chroma partition types in response to a luma partition type utilized to decode the block, the luma partition type being included in the set |

| Reference | Limitation |
|---|---|
| | of multiple luma partition types and only luma partition type is signaled, not the chroma partition type, |
| 10[c] | said decoding comprising: parsing a luma partition, |
| 10[d] | setting a chroma partition from the set of multiple chroma partition types; and, |
| 10[e] | parsing a luma prediction mode, parsing a chroma prediction mode, wherein chroma and luma have different intra prediction modes; and decoding the block. |
| **Claim 11** | |
| 11 | The method of claim 10, wherein for the particular chroma partition type, a largest-size available transform matching the particular chroma partition type is selected from a set of transforms. |
| **Claim 12** | |
| 12 | The method of claim 10, wherein from among a particular luma partition type and a particular chroma partition type selected to decode the block only information indicating the particular luma partition type is received from a corresponding encoder for use in decoding the block, the particular luma partition type being selected from the set of luma partition types and the particular chroma partition type being selected from the set of chroma partition types. |
| **Claim 13** | |
| 13 | The method of claim 12, wherein the particular luma partition type is absolutely decoded or differentially decoded from one or more neighboring blocks. |
| **Claim 14** | |
| 14[pre] | A video decoding apparatus, comprising: |
| 14[a] | a memory and a processor, configured for: |

| Reference | Limitation |
|---|---|
| 14[b] | operating on picture data for at least a block in a picture, |
| 14[c] | by performing intra prediction with multiple partition types for chroma decoding of the block, the multiple partition types comprising a set of multiple chroma partition types of sizes 16×16, 8×8, 4×4 and a set of multiple luma partition the set of multiple chroma partition types being different than the set of multiple luma partition types, and |
| 14[d] | determining a particular chroma partition type using a single chroma intra prediction mode that is different than a luma intra prediction mode, for decoding a partitioned block from the set of multiple chroma partition types in response to a luma partition type utilized to decode the block, the luma partition type being included in the set of multiple luma partition types and only luma partition type is signaled, not the chroma partition type, |
| 14[e] | said decoding comprising: parsing a luma partition, |
| 14[f] | setting a chroma partition from the set of multiple chroma partition types; and, |
| 14[g] | parsing a luma prediction mode, parsing a chroma prediction mode, wherein chroma and luma have different intra prediction modes; and decoding the block. |
| **Claim 15** | |
| 15 | The apparatus of claim 14, wherein for the particular chroma partition type, a largest-size available transform matching the particular chroma partition type is selected from a set of transforms. |
| **Claim 16** | |
| 16 | The apparatus of claim 14, wherein from among a particular luma partition type and a particular chroma partition type selected to decode the block only information indicating the particular luma partition type is received from a corresponding encoder for use in decoding the block, the particular luma partition type being selected |

| Reference | Limitation |
|---|---|
| | from the set of luma partition types and the particular chroma partition type being selected from the set of chroma partition types. |
| **Claim 17** | |
| 17 | The apparatus of claim 14, wherein the particular luma partition type is absolutely decoded or differentially decoded from one or more neighboring blocks. |
| **Claim 18** | |
| 18 | A non-transitory computer readable storage medium comprising data for instruction to implement the method of claim 10. |
| **Claim 19** | |
| 19 | The apparatus of claim 1, wherein a particular chroma partition type for coding the block is determined from the set of chroma partition types responsive to a luma partition type utilized to code the block or one or more neighboring blocks, the luma partition type being included in the set of luma partition types. |
| **Claim 20** | |
| 20 | The apparatus of claim 19, wherein for the particular chroma partition type, a largest-size available transform matching the particular chroma partition type is selected from a set of transforms. |

U.S. Patent No. 12,143,606 ("the '606 patent," EX-1001) generally relates to video encoding technology that converts video signals into compressed data, building upon the H.264 standard. At a high level, the purported invention is directed to determining the size of blocks (called "partitions") for encoding color information (known as "chrominance" or "chroma") based on the size of blocks for encoding brightness information (known as "luminance" or "luma"). But that idea existed in the prior art, at least in the Sekiguchi and Xiong references discussed in this Petition. As explained below, each reference—alone or in combination with VCEG-AJ21 (which disclosed particular sizes of luma partitions recited in the claims) or H.264—rendered obvious every limitation of claims 1-6, 10-20 ("Challenged Claims") of the '606 patent. The inventor of the '606 patent thus claimed someone else's idea, and it is for this reason that Amazon.com Services LLC ("Amazon" or "Petitioner") petitions for *inter partes* review ("IPR") of the Challenged Claims.

## I. GROUNDS FOR STANDING

Petitioner certifies the '606 patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR on the grounds herein. On December 18, 2025, Patent Owner InterDigital, Inc. (hereafter, "PO") filed a complaint for patent infringement against Petitioner in E.D. Va. asserting infringement of, *inter alia*, the '606 patent. EX-1020. As of the filing of this Petition, Petitioner has not yet been served with the complaint.

## II. IDENTIFICATION OF CHALLENGE

### A. Prior Art[2]

Petitioner respectfully requests cancellation of the Challenged Claims over:

| Prior Art |
|---|
| Sekiguchi (U.S. Patent Pub. No. 2008/0170615), published July 17, 2008; prior art at least under §§102(a), 102(b)[3] (EX-1005) |
| VCEG-AJ21; publicly available by October 8, 2008; prior art at least under §102(a) (EX-1006) |
| Xiong (WO2006/026903), published March 16, 2006; prior art at least under §§102(a), 102(b) (EX-1007, certified English translation EX-1008) |
| H.264, titled "Advanced video coding for generic audiovisual services"; publicly available no later than August 12, 2008; prior art under at least §102(b) (EX-1009). |

[2] References herein are prior art based on the earliest priority date on the '606 patent's face: August 12, 2009.

[3] All references to 35 U.S.C. §§102, 103 are to the pre-AIA statutes.

### B. Grounds for Challenge

| Ground | | Claims | Prior Art |
|---|---|---|---|
| 1A | §103 | 1-3, 5, 10, 12, 14, 16, 18-19[4] | Sekiguchi, VCEG-AJ21 |
| 1B | §103 | 4, 6, 11, 13, 15, 17, 20 | Sekiguchi, VCEG-AJ21, H.264 |
| 2A | §103 | 1-3, 5, 10, 12, 14, 16, 18-19 | Xiong, VCEG-AJ21 |
| 2B | §103 | 4, 6, 11, 13, 15, 17, 20 | Xiong, VCEG-AJ21, H.264 |

## III. '606 PATENT OVERVIEW

The '606 patent is titled "Methods and Apparatus for Improved Intra Chroma Encoding and Decoding" and issued November 12, 2024, from Application No. 16/903,819 (filed June 17, 2020). The '606 patent is a continuation of Application No. 13/389,872 (filed August 11, 2010) and claims priority to Provisional Application No. 61/233,310 (filed August 12, 2009). For purposes of this Petition only, Petitioner has assumed August 12, 2009 as the priority date for the '606 patent.

### A. Technology Background

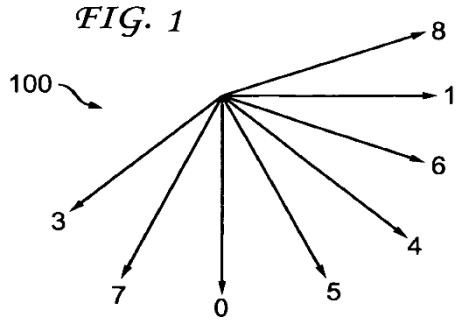
The '606 patent is directed to encoding and decoding video. To store or send digital videos, the video must first be "encoded" into digital data—binary zeros and ones. EX-1003 ("Havlicek"), ¶21. The encoded video data is then provided to a

[4] Petitioner does not challenge claims 7, 8, and 9 in this IPR because they are indefinite as they contradict limitations from claims from which they depend.

decoder (e.g., by transmission over a network). *Id*. The decoder then reconstructs the video sequence from the encoded video data. *Id*.

Because a video sequence is a series of still images played in rapid succession, storing and transmitting each picture (or "frame") separately in native form would require a significant amount of data. For this reason, videos are often "compressed" during encoding to reduce the amount of data needed to store and transmit them to a decoder. In video coding standards such as MPEG-4 AVC (also known as H.264), each frame is partitioned into macroblocks (small rectangular regions) for compression. Havlicek, ¶22. Compression techniques generally include, among others, predicting the values of pixels in a given macroblock that is being processed (i.e., encoded or decoded) based on values of the pixels in previously-processed macroblocks. *Id*. Two main techniques for performing this prediction are referred to as "intra prediction" and "inter prediction." *Id*. Intra prediction exploits spatial redundancy within a frame, predicting macroblocks in the frame based on nearby macroblocks in that same frame that have already been encoded or decoded. *Id.*

For example, intra predictions may be based on directional structure (e.g., directional texture patterns) of spatially-nearby pixels that are most similar to the pixels currently being coded, as shown in '606 Figure 1. EX-1001, Fig. 1, 1:45-65; Havlicek, ¶23.




This figure shows how each direction (or mode) is represented. The "vertical prediction mode" in which the value of the current block is predicted to be similar to the value of the block above it is represented as the arrow labeled 0. EX-1001, 1:50-65; Havlicek ¶24. Similarly, the "horizontal prediction mode"—in which the current block is predicted to be similar to the value of the block to its left—is the arrow labeled 1, and other directions are represented by other numbers. EX-1001, 1:50-65; Havlicek ¶24.

When intra prediction is used for a block of pixels, it is generally applied to all color components, typically including a luma component representing the monochrome signal conveying brightness information (but not color) and two chroma components representing the color information of the pixels. Havlicek, ¶25.

While color television displays and computer displays usually operate on color information in a red/green/blue ("RGB") color space, for coding and transmission it is efficient to represent color images by separating the luma (or

luminance) information from the color information. Havlicek, ¶26 (citing EX-1009 ("Richardson"), 13). This representation includes four components:

- Y – luma or luminance – intuitively, the "brightness" of a pixel – given by a weighted sum of the red, green, and blue information;
- Cr – chroma – the color difference between red (R in the RGB color space) and luminance;
- Cb – chroma – the color difference between blue (B in the RGB color space) and luminance;
- Cg – chroma – the color difference between green (G in the RGB color space) and luminance.

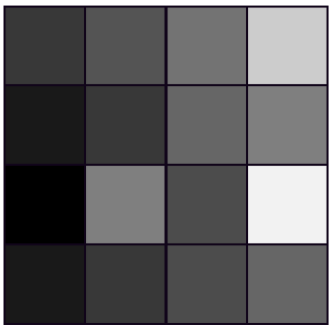
*Id.*

Because Y is a weighted sum of R, G, and B, Cg can always be calculated if Y, Cr, and Cb are known. Thus, only Y, Cr, and Cb need be coded. Havlicek, ¶27 (citing Richardson, 13-14). Further, because human vision is less sensitive to color than to luminance, Cr and Cb may be represented at lower spatial resolution than Y without significantly impacting perceived image quality. *Id.* (citing Richardson, 14). This is called *chroma subsampling*. Havlicek, ¶27.

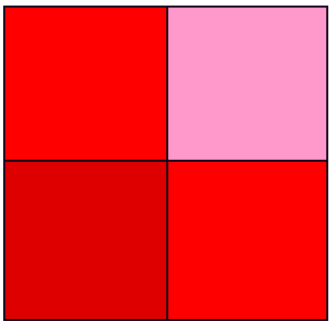
MPEG-4 AVC supports three chroma subsampling formats for video represented in the YCbCr color space, known as 4:2:0, 4:2:2, and 4:4:4. EX-1001, 2:30-3:18, 8:58-9:8; Havlicek, ¶28 (citing Richardson, 14-15). In the 4:4:4 format,

each of the luma and the two chroma components has the same spatial resolution (i.e., the same number of "pixels" or "samples"). EX-1001, 2:31-39; Havlicek, ¶28 (citing Richardson, 14-15). But in the 4:2:2 and 4:2:0 formats, the chroma components are subsampled to a lower spatial resolution, meaning the Cb and Cr chroma components will each comprise a smaller number of "pixels" or "samples" than the luma component. Havlicek, ¶28.

In the 4:2:2 format, the number of chroma samples is reduced by one-half horizontally, but the chroma components maintain full spatial resolution vertically. Havlicek, ¶29. And in the 4:2:0 format (traditionally used for mass market consumer video), each chroma component is subsampled to half the sample rate of the luma component both horizontally and vertically (which halves the resolution of the chroma components), so each chroma sample in the Cb and Cr components provides color information for a block of pixels in the displayed video image that is 2 pixels high by 2 pixels wide. Havlicek, ¶¶30-34.



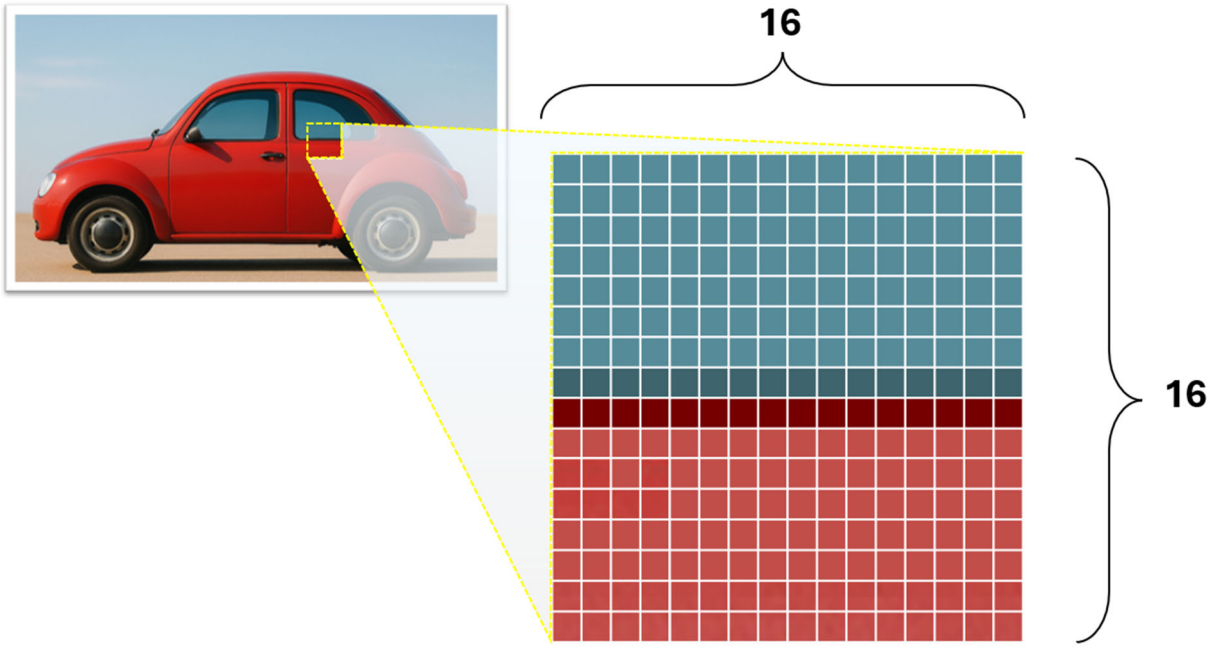
16 pixels (4 pixel by 4 pixel block) showing luma values for each pixel



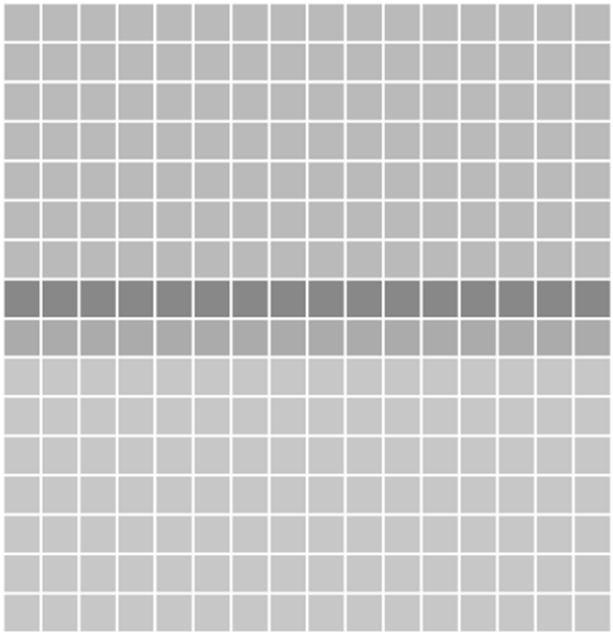
4 chroma samples (in each chroma component), covering 16 pixels (each sample 2 pixels wide and 2 pixels high)

The image below of a red car and a blue sky provides an example of chroma subsampling, particularly subsampling in the 4:2:0 format.[5] Havlicek, ¶35. This image could be a single frame in a video, with a 16x16 pixel section of the image enlarged. *Id*.

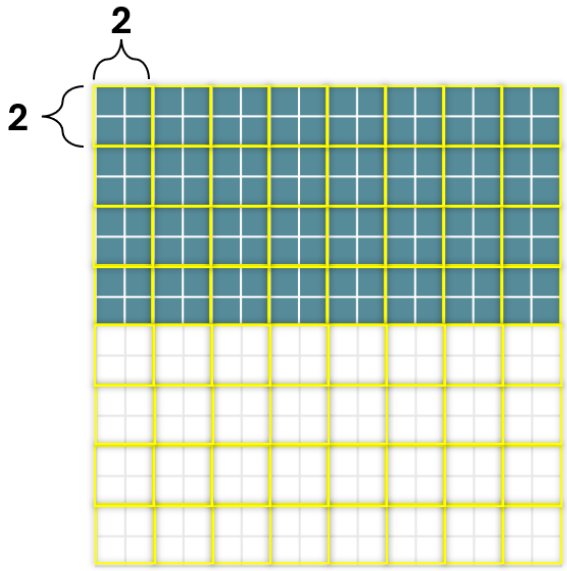
[5] This example is simplified for demonstration purposes. Havlicek, ¶35.



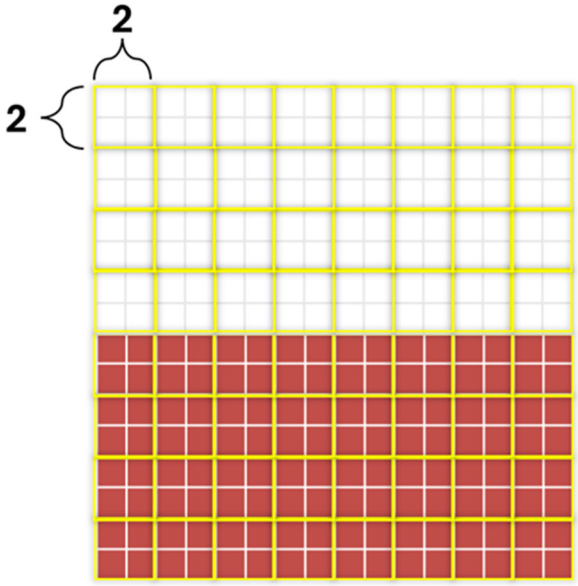

Below is a simplified version of the luma (brightness) values for each pixel in the 16x16 section of the image (Y in the YCbCr format). Havlicek, ¶36.



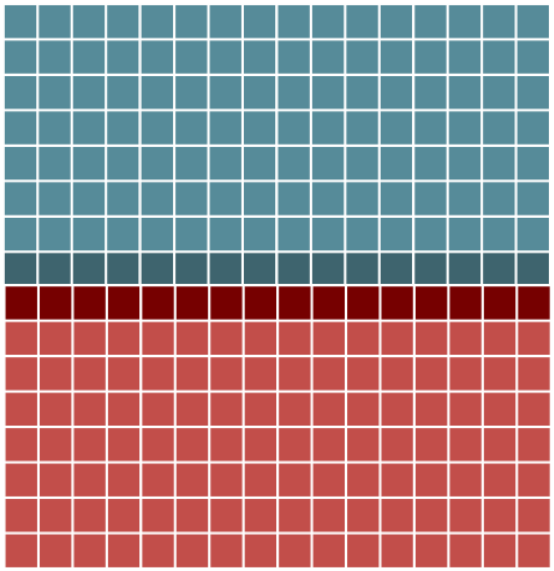
And below is an illustration showing the 2x2 pixel blocks (yellow boxes) for the chroma information for Cb in the 4:2:0 format, within which the chroma information does not change. Havlicek, ¶37.




As with the Cb component, the Cr values are sampled for each 2x2 pixel block, as shown below. Havlicek, ¶38.




The figure below illustrates how the luma (Y), blue values (Cb), and red values (Cr), are combined to create the 16x16 pixel macroblock. Havlicek, ¶39.



Thus, the number of pixels in the luma component of a macroblock may be different from the number of pixels in each chroma component of the same macroblock depending on the chroma subsampling. Havlicek, ¶40.

### B. Purported Invention

For each of the Y (luma) and Cb and Cr (chroma) components of a macroblock, when intra prediction is used it is typically performed on a block or subblock basis within the macroblock. Havlicek, ¶¶41-45. For each component, the ’606 patent refers to the sizes and arrangement of the intra prediction blocks within a macroblock as the “partition” or “partition type.” *Id*.

According to the ’606 patent, the purported invention allows different partition types (i.e., the size and shape of the partition) for intra prediction, including a set of chroma partition types and a set of luma partition types, where the set of chroma partition types is different from the set of luma partition types. EX-1001, 3:27-34.

The ’606 patent discloses two methods for encoding luma and chroma partition types. In “Method 1” (“Embodiment 1”), the chroma partition type for intra prediction is determined by the luma partition type. EX-1001, 9:10-12. The specification distinguishes this method from the prior art by asserting that the chroma partition type is aligned with the luma partition type for a predefined set of partition types. *Id.*, 9:12-15. For example, according to the ’606 patent, if the luma

partition type is 8x8 and the format is 4:2:0, then the chroma partition type will be 4x4. *Id.*, 9:15-18. In this embodiment, since the chroma partition type is decided based on the luma partition type, only the luma partition type is signaled from the encoder to the decoder. *Id.*, 9:28-32.

In "Method 2" ("Embodiment 2") the luma partition type and chroma partition type for intra prediction are independently coded. *Id.*, 11:58-60. The luma partition type, chroma partition type, luma intra prediction mode, and chroma intra prediction mode are all signaled. *Id.*, 12:31-33.

Each of the independent claims of the '606 patent require determining a chroma partition type from a set of multiple chroma partition types in response to a luma partition type used to encode (or decode) a block. *Id.*, claims 1, 2, 10, 14. Further, each independent claim requires that "only luma partition type is signaled, not the chroma partition type." *Id.*, claims 1, 2, 10, 14. The '606 patent thus does not claim Embodiment 2, which performs independent determination of the chroma and luma partition types, and signals both. Havlicek, ¶¶45-46. Instead, to the extent the claims of the '606 patent claim either embodiment of the '606 patent, it would be Embodiment 1, where the chroma partition type is determined from the luma partition type, and only the luma partition type is signaled. *Id*.

## IV. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art ("POSITA") in the field of video encoding and decoding at the time of the purported invention of the '606 patent would have had at least a bachelor's degree in electrical engineering, computer science, computer engineering, or a related field, and approximately three years of experience in design, development, and/or testing of relevant multimedia processing, such as video, and/or image processing or coding. Havlicek, ¶47. Advanced graduate studies with coursework and/or research focusing on topics of video encoding and decoding could substitute for working experience in the field. *Id*.

## V. CLAIM CONSTRUCTION

Claims should be construed "in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." 37 C.F.R. §42.100(b). Petitioner is unaware of any "prior claim construction determination" related to the '606 patent. Petitioner has not proposed any terms for construction because Petitioner does not believe that any constructions are necessary to resolve the issues in this Petition. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); Havlicek, ¶64.

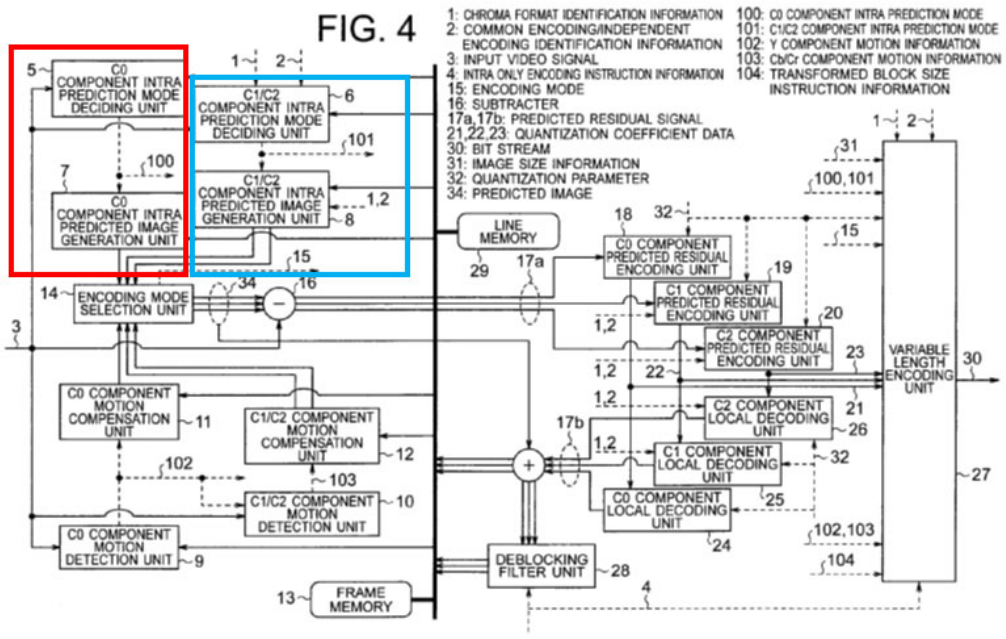
# VI. DETAILED EXPLANATION OF GROUNDS

## A. Ground 1A: Sekiguchi in view of VCEG-AJ21

### 1. Sekiguchi

Sekiguchi (U.S. Patent Pub. No. 2008/0170615) was published on July 17, 2008 and qualifies as prior art under 35 U.S.C. §§102(a), 102(b).

Sekiguchi discusses "'Information Technology Coding of Audio-Visual Objects Part 10: Advanced Video Coding', ISO/IEC 14496-10, 2003," as "related art." Sekiguchi [0004]. That reference is the 2003 version of the H.264 standard, which is the same as MPEG-4 AVC, as discussed above. A POSITA would have understood Sekiguchi as disclosing an encoding and decoding method that was compatible with, and in fact builds upon, the H.264 standard, and in particular the 2003 version of that standard. Havlicek, ¶¶65-66. Sekiguchi discloses using "a first intra prediction mode deciding unit" and "a first intra prediction image generation unit" for luminance and "a second intra prediction mode deciding unit" and "a second intra prediction image generation unit" for chrominance. Sekiguchi, Abstract. The separated luma and chroma mode deciding and image generation units are shown as items 5 and 7 (for luma, outlined in red below) and 6 and 8 (for chroma, outlined in blue below) in Figure 4. Sekiguchi, Fig. 4, [0043], [0045].

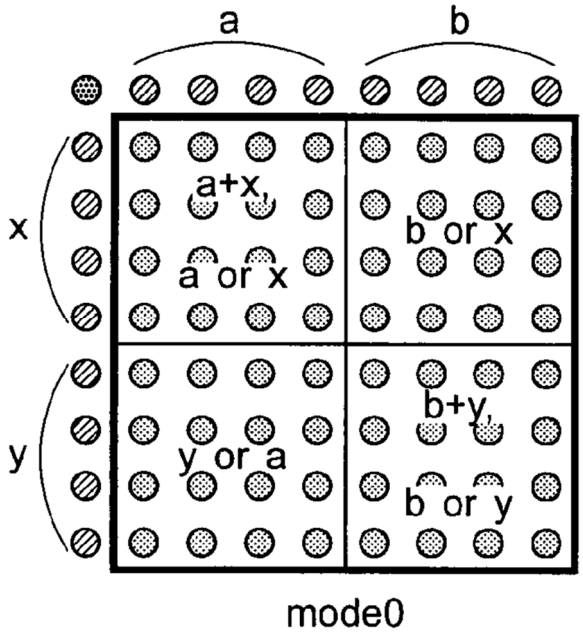



Sekiguchi, Fig. 4[6]

For 4:2:0 and 4:2:2 formats, Sekiguchi provides three available intra prediction mode types for luma: 4x4, 8x8, and 16x16. Sekiguchi, [0043]; Havlicek ¶67. Sekiguchi discloses four different modes for chroma intra prediction. Sekiguchi, [0045]; Havlicek ¶¶68-69. For intra 4:2:0 format, three of these modes (modes 1, 2, and 3) use 8x8 pixel blocks for intra prediction. Sekiguchi, [0045]; Havlicek ¶69. For the other mode (mode 0), the 8x8 pixel block is divided into four 4x4 pixel blocks. Sekiguchi, [0045]; Havlicek ¶69. As shown in Figure 7, a different formula

[6] Annotations to figures have been added throughout this petition unless otherwise noted.

is used for calculating the intra predictions in each of those 4x4 pixel blocks. *Id.*, [0045], Fig. 7 (below, excerpted).




**2. VCEG-AJ21**

VCEG-AJ21 is a printed publication that was publicly available by October 8, 2008, making it prior art to the '606 patent under 35 U.S.C. §102(a). Reader, ¶¶31-48. For example, Dr. Reader explains that VCEG-AJ21 would have been uploaded and made available for download by the public by the beginning of the VCEG October 2008 meeting, where it was scheduled to be discussed. *Id.*, ¶44.

VCEG-AJ21 extended the architecture of the H.264 codec with enlarged macroblock sizes. VCEG-AJ21, 1 (Abstract); Havlicek ¶¶70-71. In particular, VCEG-AJ21 discloses enlarging the H.264 macroblock size of 16x16 to "NxN,"

where N is increased according to powers of 2, and VCEG-AJ21 gives examples of 32x32, 64x64, and 128x128. VCEG-AJ21, 3. Further, VCEG-AJ21 discloses a luma block of 32x32, with each chroma block being 16x16 (for the 4:2:0 format). Havlicek, ¶¶71-73. This is shown in Figure 5 of VCEG-AJ21.

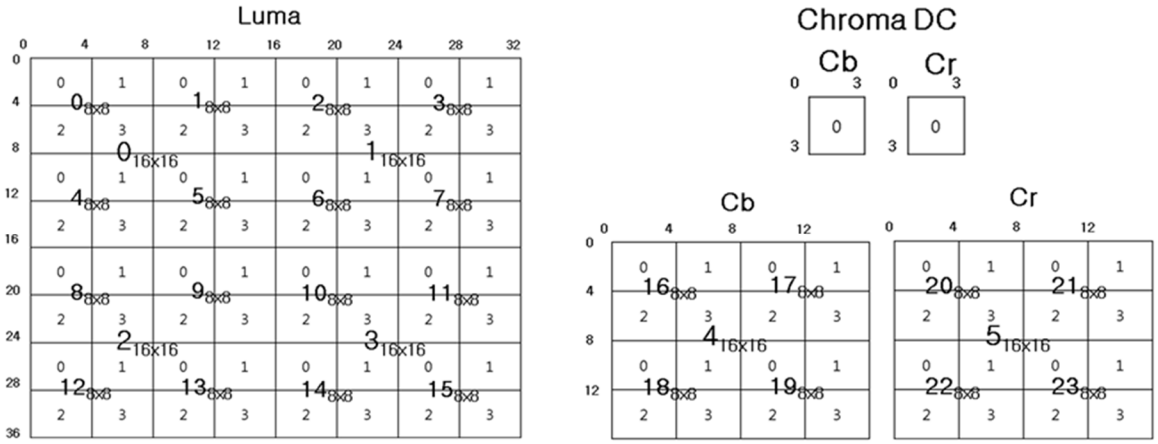



**Fig. 5 Block indexing for 32x32 MB**

### 3. Motivation to Combine Sekiguchi and VCEG-AJ21

A POSITA would have been motivated to combine Sekiguchi and VCEG-AJ21 to extend Sekiguchi's teachings of separating luma and chroma intra prediction to larger block sizes and would have had a reasonable expectation of success in doing so. Havlicek, ¶¶74-75.

Both references build upon H.264. Sekiguchi [0004] (referencing "'Information Technology Coding of Audio-Visual Objects Part 10: Advanced Video Coding', ISO/IEC 14496-10, 2003," which is the 2003 version of H.264); VCEG-AJ21, 1 (Abstract). Both references also disclose macroblock sizes,

luminance components, and chroma components, as well as using the 4:2:0 format. Sekiguchi, [0005]; VCEG-AJ21, 1, 3, 4-5. The references present overlapping, compatible concepts such as enhancing the efficiency of the prior art (H.264) video encoding and decoding process by providing a correspondence between a luma block and a chroma block. Sekiguchi, [0045]; VCEG-AJ21, 1 (Abstract), 6 (Conclusion), 4-5, Figs. 4, 5.

While Sekiguchi focuses on intra prediction of luma and chroma blocks using traditional 16x16 macroblocks—which VCEG-AJ21 also discloses—VCEG-AJ21 discloses larger macroblock sizes for luma and chroma encoding, including 32x32 luma blocks. VCEG-AJ21, 5, Fig. 5; Havlicek, ¶76.

A POSITA would have been motivated to apply Sekiguchi's separate intra prediction for luma and chroma to VCEG-AJ21's larger macroblock sizes, because doing so would benefit the efficiency goals of VCEG-AJ21's enlarged macroblock size. Havlicek, ¶77. This combination would have involved only routine engineering tasks, such as modifying the firmware/software embodying Sekiguchi's system of determining chroma partition type based on luma partition type to incorporate the 32x32 luma partition and 16x16 chroma partition disclosed in VCEG-AJ21. *Id.* This would have been as simple as an additional conditional statement (e.g., if/then, or "switch" statement) to account for VCEG-AJ21's 32x32 luma partition. *Id*. Those routine engineering tasks would have yielded predictable results: a more efficient

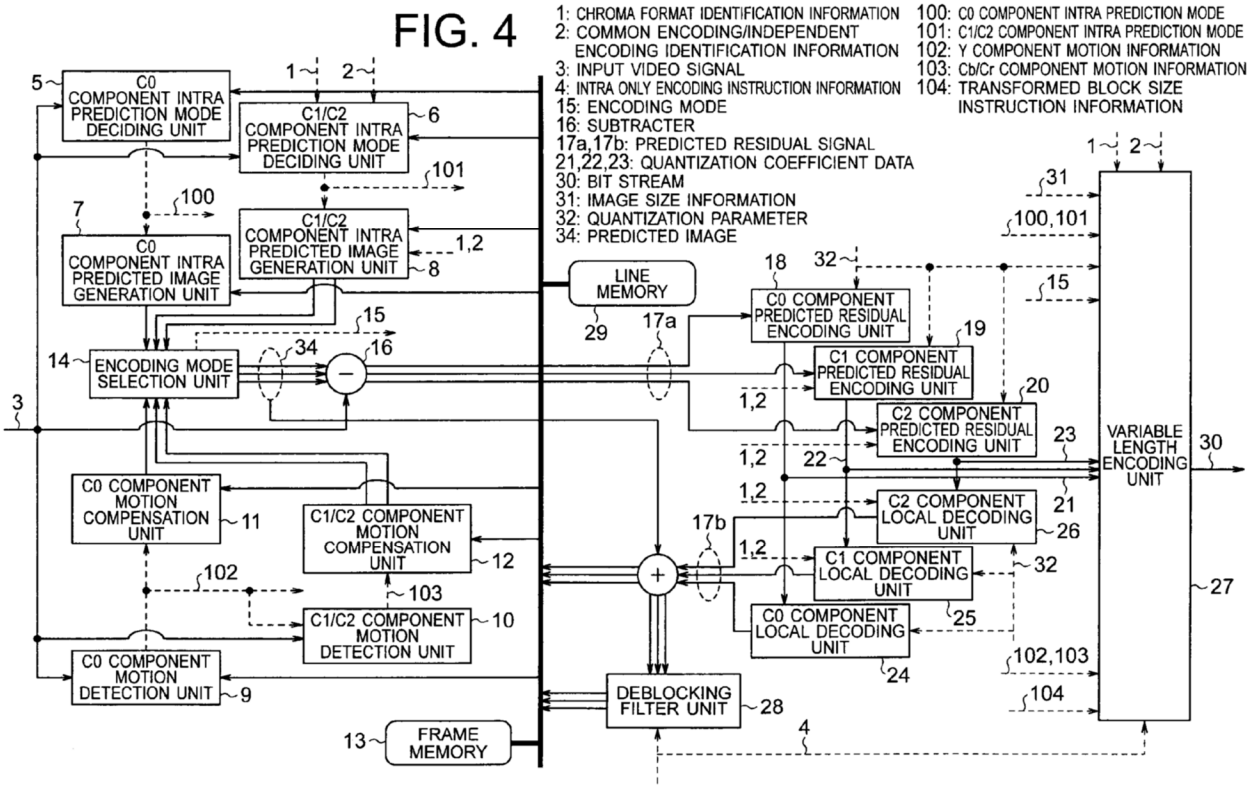
encoding of luma and chroma intra prediction, taking advantage of VCEG-AJ21's larger block sizes, and would not have adversely affected Sekiguchi's system (and in fact would have enhanced it). *Id.* (citing VCEG-AJ21, 1).

**4. Claim 1**

**a. 1[pre]**

If limiting, Sekiguchi discloses/suggests 1[pre]. In particular, Sekiguchi discloses *a video encoding apparatus* that is illustrated in Figure 4. Sekiguchi, [0007] ("moving image encoding device"), Fig. 4;[7] Havlicek, ¶78.

[7] Italicized text is claim text unless otherwise noted.




Sekiguchi, Fig. 4

**b. 1[a]**

Sekiguchi discloses/suggests 1[a]. In particular, a POSITA would have understood that Sekiguchi uses a *memory* and *processor* for encoding video. Sekiguchi, [0041]-[0049], Fig. 4; Havlicek, ¶79. This is shown, for example, in the video encoder of Figure 4, which depicts components such as memory (e.g., "frame memory," item 13) for the video data being encoded. Havlicek, ¶79. A POSITA would also have understood that implementing the software/firmware components

of Figure 4 would require storing machine instructions in a memory. *Id*. And some form of processor would be needed to execute those instructions and operate on the data. *Id*.

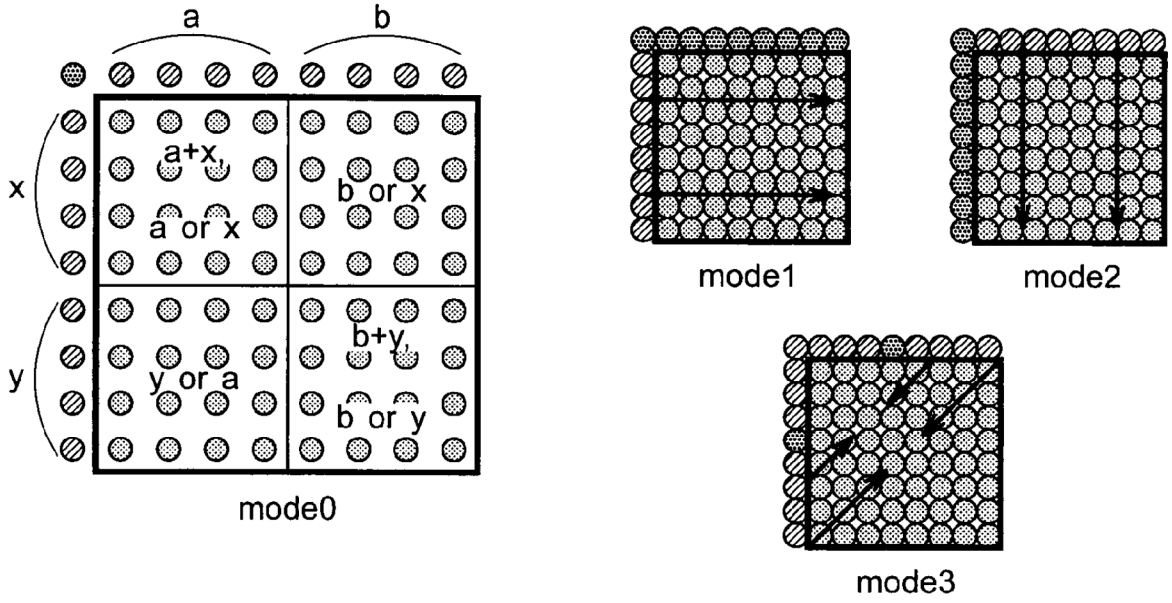
**c. 1[b]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 1[b]. Sekiguchi discloses *encoding picture data* for a macroblock using intra prediction. Sekiguchi, [0041]-[0049]; Havlicek, ¶80. In particular, Sekiguchi discloses that encoding is performed on a block of 4x4, 8x8, or 16x16. Sekiguchi, [0043] ("there are three selectable types of modes, an intra 4x4 prediction mode, an intra 8x8 prediction mode, and an intra 16x16 prediction mode. For the intra 4x4 prediction mode and the intra 8x8 prediction mode, a macroblock is divided into blocks of 4x4 pixels or 8x8 pixels"); *see also id.*, [0010], [0017], [0026], [0034]. Sekiguchi further discloses a set of luma partition types for intra prediction that include 16x16, 8x8, and 4x4. *Id.*, [0043].

VCEG-AJ21 likewise discloses a luma partition of 16x16, as well as a larger partition of 32x32. VCEG-AJ21, 4-5, Figs. 4-5; Havlicek, ¶81. The combination of Sekiguchi and VCEG-AJ21 thus teaches/suggests a set of luma partition types that includes 4x4, 8x8, 16x16, and 32x32 for intra prediction. *See* §VI.A.3; Havlicek, ¶81.

Sekiguchi also discloses chroma partition types of sizes 8x8 and 4x4. Sekiguchi, [0045]; Havlicek, ¶82. For intra prediction in the 4:2:0 format, Sekiguchi discloses three intra prediction modes (modes 1, 2, and 3) using 8x8 pixel blocks, and one intra prediction mode (mode 0) that divides those 8x8 pixel blocks into 4x4 pixel blocks, as shown in Figure 7. Sekiguchi, [0045], Fig. 7.

FIG. 7




4:2:0/4:2:2 Cb/Cr INTRA PREDICTION

VCEG-AJ21 likewise discloses a chroma partition type of 8x8 and further describes a chroma partition type of 16x16, as shown in Figures 4 and 5, respectively. VCEG-AJ21, 4-5, Figs. 4, 5. Havlicek, ¶83.

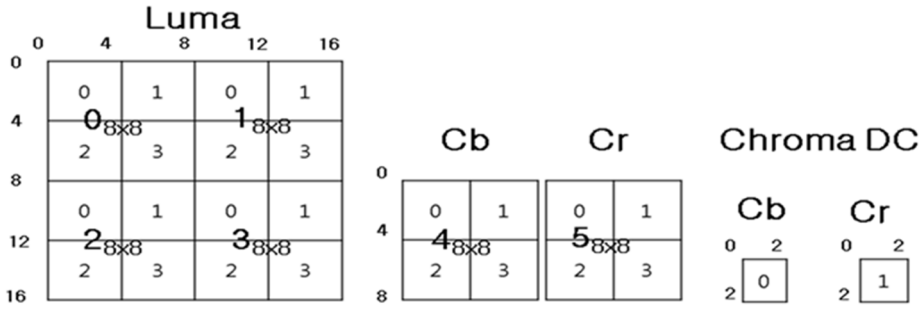



**Fig. 4 Block indexing for 16x16 MB**

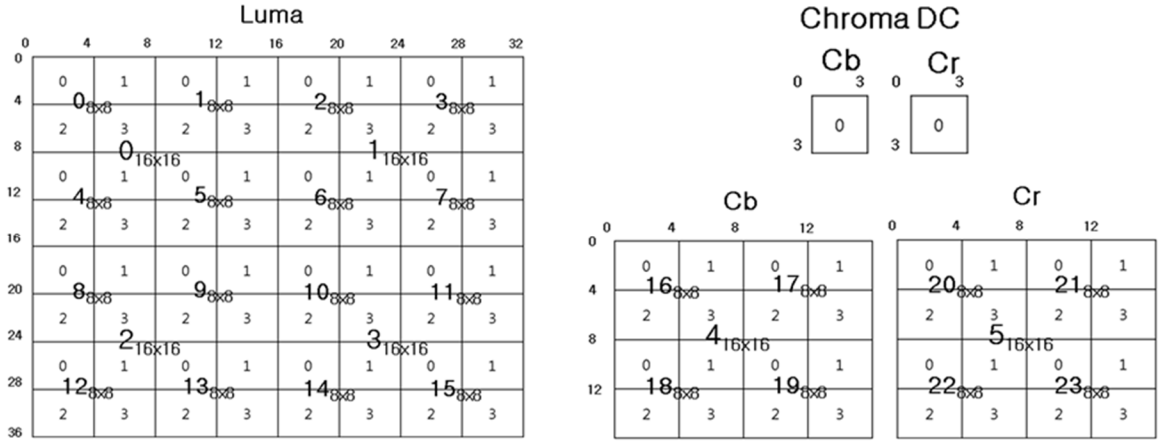



**Fig. 5 Block indexing for 32x32 MB**

If PO argues that Figures 4 and 5 of VCEG-AJ21 do not explicitly disclose 8x8 and 16x16 chroma partitions, a POSITA would have understood this to be disclosed by those VCEG-AJ21 figures in combination with Table 2 of VCEG-AJ21, which includes 32x32 and 16x16 prediction modes usable for both inter and intra prediction. Havlicek, ¶84.

**Table 2. Possible partition block modes (mb_type) for enlarged MB's of 128x128, 64x64 and 32x32**

| | |
|---|---|
| 128x128 MB size | SKIP_128x128(0), 128x128(1), 128x64(2), 64x128(3), SKIP_64x64(4), 64x64(5), 64x32(6), 32x64(7), SKIP_32x32(8), 32x32(9), 32x16(10), 16x32(11), SKIP_16x16(12), 16x16(13), 16x8(14), 8x16(15), 8x8(16), 8x4(17), 4x8(18), 4x4(19), |
| 64x64 MB size | SKIP_64x64(0), 64x64(1), 64x32(2), 32x64(3), SKIP_ 32x32(4), 32x32(5), 32x16(6), 16x32(7), SKIP_16x16(8), 16x16(9), 16x8(10), 8x16(11), 8x8(12), 8x4(13), 4x8(14), 4x4(15), |
| 32x32 MB size | SKIP_32x32(0), 32x32(1), 32x16(2), 16x32(3), SKIP_16x16(4), 16x16(5), 16x8(6), 8x16(7), 8x8(8), 8x4(9), 4x8(10), 4x4(11), |

A POSITA would have understood these prediction modes to use, respectively, 16x16 and 8x8 partitions for luma prediction, because, for the 4:2:0 format, the partitions used for the chroma components could be, at most, one quarter the size of the luma partition. Havlicek, ¶85. So for the 32x32 mode, the chroma partition could be, at most, 16x16, and for the 16x16 mode, the chroma partition could be, at most, 8x8. *Id.*

Therefore, the combination of Sekiguchi and VCEG-AJ21 teaches/suggests 16x16, 8x8, and 4x4 chroma partitions (*multiple partition types comprising a set of multiple chroma partition types of sizes 16×16, 8×8, 4×4*) for *performing intra prediction*. *See* §VI.A.3; Havlicek, ¶86. But because the combination does not teach a set of chroma partition types that includes 32x32, the set of multiple chroma partition types is different than the set of multiple luma partition types (32x32, 16×16, 8×8, 4×4) (*a set of multiple luma partition types, the set of multiple chroma partition types being different than the set of multiple luma partition types*). Havlicek, ¶86.

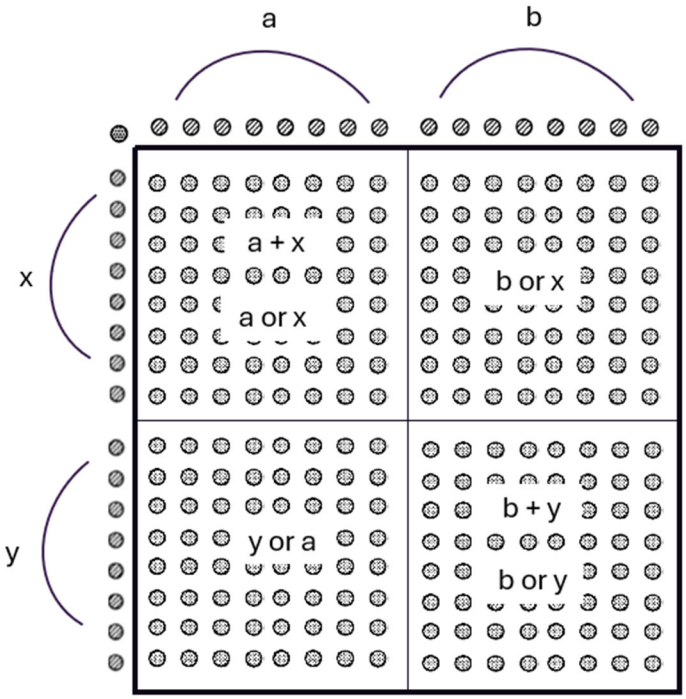
And a POSITA would have been motivated to make the combination of Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

**d. 1[c]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 1[c]. Sekiguchi discloses using an 8x8 chroma partition type in response to a 16x16 luma partition type (for modes 1, 2, and 3), and a 4x4 chroma partition type in response to a 16x16 partition type (for mode 0). Sekiguchi, [0043]-[0045]; Havlicek, ¶87.

As discussed for limitation 1[b], VCEG-AJ21 discloses using an 8x8 chroma partition type with a 16x16 luma partition type, and a 16x16 chroma partition type with a 32x32 luma partition type. VCEG-AJ21, 4-5, Figs. 4-5; §VI.A.4.c. Therefore, Figure 4 shows *determining* an 8x8 chroma partition type *in response to* a 16x16 luma partition type, and Figure 5 shows *determining* a 16x16 chroma partition type *in response to* a 32x32 luma partition type. Havlicek, ¶88.

As also discussed for limitation 1[b], to the extent PO argues Figures 4 and 5 do not show particular partition types, a POSITA would have understood that VCEG-AJ21 discloses, based on Table 2, a luma partition type of 32x32 (for the 32x32 mode) and a luma partition type of 16x16 (for the 16x16 mode). *See* §VI.A.4.c. In the combination of Sekiguchi and VCEG-AJ21, a POSITA would have scaled up mode 0 of Figure 7 below to work with an 8x8 chroma partition type, as illustrated by Dr. Havlicek below. Havlicek, ¶¶89-93.

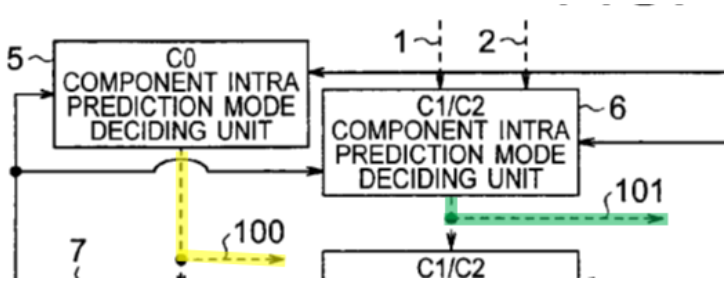



Therefore, Sekiguchi's method would be expanded by *determining* a 16x16 chroma partition type *in response to* a 32x32 luma partition type (for modes 1, 2, and 3) and *determining* an 8x8 chroma partition type *in response to* a 32x32 luma partition type (for mode 0). Havlicek, ¶94.

Thus, each reference (and the combination of references) discloses *determining a particular chroma partition type…for encoding a partitioned block from a set of multiple chroma partition types in response to a luma partition type utilized to encode the block*. Havlicek, ¶95.

In the 4:2:0 and 4:2:2 formats, Sekiguchi uses C0 for the luma component (Y), and C1 and C2 are each one of the chroma components (Cb, Cr). Sekiguchi, [0043], [0045]. As shown in Figure 4 (excerpted below, and annotated), there is a C0

Component Intra Prediction Mode Deciding Unit (item 5) that provides a luma prediction mode (signal 100, highlighted yellow), and a C1/C2 Component Intra Prediction Deciding Unit (item 6) that provides a chroma prediction mode (signal 101, highlighted green). Havlicek, ¶96.

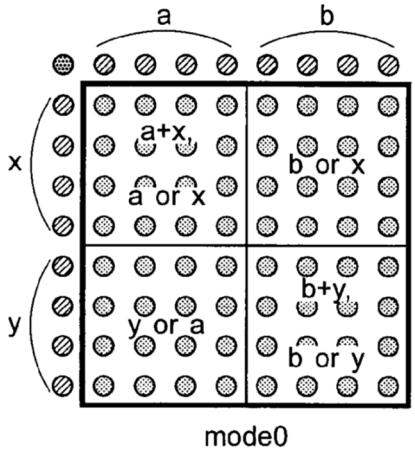



Sekiguchi, Fig. 4 (excerpted)

Sekiguchi discloses that C1/C2 component intra prediction mode is split into 101a and 101b. Sekiguchi, [0045]. But "101*a* and 101*b* are always equal in value in the case of 4:2:0 and 4:2:2, and one of 101*a* and 101*b* is multiplexed on a bit stream" (*a single chroma intra prediction mode*). Sekiguchi, [0045]. Sekiguchi also discloses "a C1/C2 component intra prediction mode 101 [the *single chroma intra prediction mode*] different from the Y component" (*that is different than a luma intra prediction mode*). In other words, Sekiguchi signals only one chroma intra prediction mode, because the intra prediction modes for both chroma components within each chroma partition of a macroblock are the same. Havlicek, ¶97. But Sekiguchi signals both luma intra prediction mode and chroma intra prediction mode, because it recognizes that those may be different modes. *Id.* A POSITA would have recognized

that Sekiguchi's teachings specifically allow for the luma and chroma intra prediction modes to be independently selected and to be different from one another. Otherwise, Sekiguchi's encoder would be wasting both processing capacity (by having separate intra prediction mode deciding units for luma and chroma) and bandwidth (by independently signaling both luma intra prediction mode and chroma intra prediction mode). *Id*.

Furthermore, Sekiguchi provides an example of a chroma intra prediction mode that has no matching luma intra prediction mode. And notably, Sekiguchi refers to different "modes" for luma intra prediction and chroma intra prediction. Sekiguchi, [0045]. For example, "mode 0" for chroma intra prediction—shown in Figure 7 (excerpted below)—includes four modes for chroma intra prediction of 4x4 blocks. Sekiguchi, [0045], Fig. 7; Havlicek, ¶98.



As shown for mode 0, each 4x4 block has intra prediction modes, where "an average value is predicted from the sides" of the 4x4 blocks. Sekiguchi, [0045]. Sekiguchi discloses multiple ways to do this: "for a 4x4 block of the upper left part, all 8 pixels of areas 'a' and 'x' are averaged, or 4 pixels of 'a' or 'x' are averaged, and one of those average values is used as a predicted value." *Id.* Sekiguchi does not disclose any luma intra prediction mode similar to the "a or x," the "b or x," the "y or a," the "b+y," nor the "b or y" chroma intra predictions" used for the 4x4 blocks of mode 0 in Figure 7. Therefore, whenever chroma intra prediction mode is determined to be that of mode 0, it is a different intra prediction mode from any luma intra prediction mode. Havlicek, ¶99.

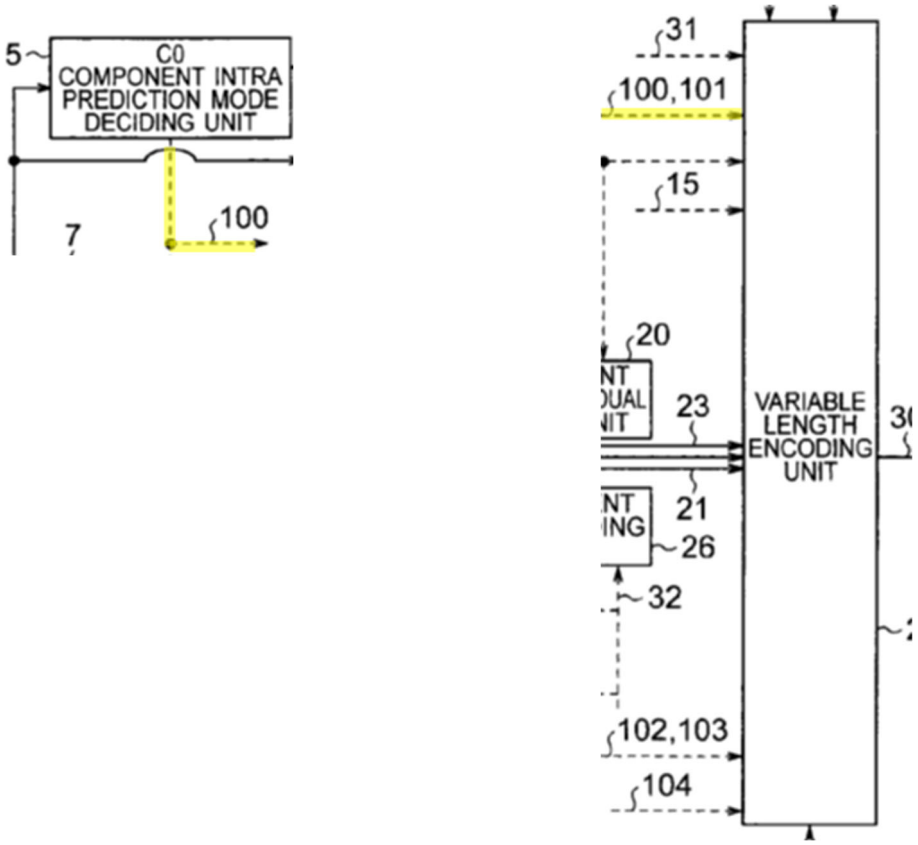
The combination of Sekiguchi and VCEG-AJ21 also teaches/suggests that *only luma partition type is signaled, not the chroma partition type*. Havlicek, ¶100. Sekiguchi discloses three "selectable types of modes," each associated with a particular luma partition type: 4x4, 8x8, and 16x16. Sekiguchi, [0043]. This information is provided as part of signal 100 from the C0 component ("Y" or "luma" component in YCrCb format parlance) intra prediction mode deciding unit. *Id.*, [0043]-[0044]. Unlike luma, Sekiguchi does not disclose including the chroma partition type in signal 101 coming from the C1/C2 component intra prediction mode deciding unit. *Id.*, [0045]. Instead, Sekiguchi only discloses that signal as including whether the chroma components are using mode 0, 1, 2, or 3. *Id.*; Havlicek, ¶100.

Thus, the combination of Sekiguchi and VCEG-AJ21 teaches/suggests using a 16x16 chroma partition type in response to a 32x32 luma partition type (from VCEG-AJ21) and a 4x4 chroma partition type in response to a 16x16 luma partition type (mode 0 from Sekiguchi) (*determining a particular chroma partition type…for encoding a partitioned block from the set of multiple chroma partition types in response to a luma partition type utilized to encode the block*), from the set of luma partition types of 32x32, 16x16, 8x8, and 4x4 (*the luma partition type being included in the set of multiple luma partition types*). *See* §VI.A.3; Havlicek, ¶101. The combination also teaches/suggests independent determination of intra prediction modes for luma and chroma via a separate C0 Component Intra Prediction Mode Deciding Unit (item 5), which provides a luma prediction mode, and C1/C2 Component Intra Prediction Deciding Unit resulting in a C1/C2 component intra prediction mode 101 different from the Y component (*using a single chroma intra prediction mode that is different than a luma intra prediction mode*). *See* §VI.A.3; Havlicek, ¶101. Further, the combination sends luma partition type as part of signal 100, but not chroma partition type as part of signal 101 (*only luma partition type is signaled, not the chroma partition type*). Havlicek, ¶101. And a POSITA would have been motivated to combine Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

**e. 1[d]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 1[d]. Havlicek, ¶102. Sekiguchi discloses setting the luma partition as part of setting the intra prediction mode to either 16x16, 8x8, or 4x4. Sekiguchi, [0043]. And a POSITA reading VCEG-AJ21 would further have understood that the VCEG-AJ21 luma partition could be set to 32x32. VCEG-AJ21, 4, Table 2, Fig. 4-5; Havlicek, ¶102. The combination of Sekiguchi and VCEG-AJ21 thus teaches that the luma partition could be set to 16x16 or 32x32.

Furthermore, Figure 4 of Sekiguchi (excerpted and annotated below) shows this intra prediction mode is part of the encoding as it is output as item 100 (yellow highlighting) by C0 Component Intra Prediction Mode Deciding Unit 5 in FIG. 4 and then input to variable length encoding unit 27 which generates the encoded bitstream 30. Sekiguchi, [0043], Fig. 4; Havlicek, ¶103.



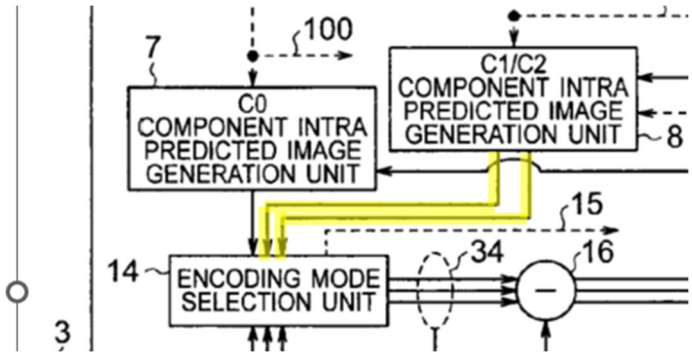

Sekiguchi, Fig. 4 (excerpted)

Thus, the combination of Sekiguchi and VCEG-AJ21 teaches/suggests setting the luma partition to 32x32, 16x16, 8x8, or 4x4 (*encoding comprising: setting a luma partition*). *See* §VI.A.3; Havlicek, ¶104. And a POSITA would have been motivated to combine Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

**f. 1[e]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 1[e]. Havlicek, ¶105. As discussed for limitation 1[c], the combination of Sekiguchi and VCEG-AJ21 determines a chroma partition type in response to a luma partition type. *See* §VI.A.4.d; Havlicek, ¶105. Those chroma partition types include at least 16x16, 8x8,

and 4x4. *See* §VI.A.4.e; Havlicek, ¶105. Therefore, the determined chroma partition type is from *the set of multiple chroma partition types*. Havlicek, ¶105. The combination of Sekiguchi and VCEG-AJ21 also teaches/suggests *setting* that chroma partition to the determined chroma partition type. *See* §VI.A.3; Havlicek, ¶105. In particular, as shown below in relevant part and annotated, the C1/C2 Component Intra Predicted Image Generation Unit generates a chroma intra prediction image (signals highlighted in yellow) by setting a chroma partition based on the determined chroma partition type. Sekiguchi, [0049], Fig. 4; Havlicek, ¶105.



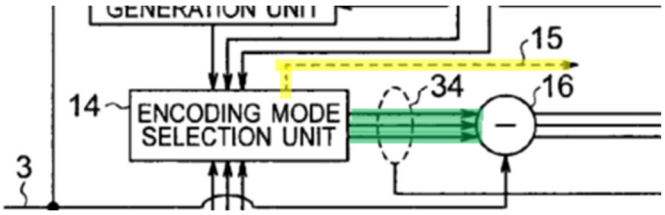

Sekiguchi, Fig. 4 (excerpted)

**g. 1[f]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 1[f]. Havlicek, ¶106.

As discussed for limitation 1[c], Sekiguchi discloses determining a single chroma intra prediction mode that is different from the luma intra prediction mode. *See* §VI.A.4.d. The different luma and chroma intra prediction modes determined

for limitation 1[c] are set by Sekiguchi's encoder. Havlicek, ¶107. In particular, Sekiguchi discloses the encoding mode selection unit 14 outputting signals 15 ("encoding mode," highlighted yellow below) and 34 ("predicted image," highlighted green below) to C0 component predicted residual encoding unit 18, C1 component predicted residual encoding unit 19, and C2 component predicted residual encoding unit 20 and then ultimately to variable length encoding unit 27 which generates the encoded bitstream 30. Sekiguchi, [0048]-[0049], [0061]-[0067], Fig. 4.




Sekiguchi, Fig. 4 (excerpted)

Sekiguchi further discloses "encoded data of the macroblock." Sekiguchi, [0035]; Havlicek, ¶108.

Therefore, the combination of Sekiguchi and VCEG-AJ21 discloses independent determination of intra prediction modes for luma and chroma via a separate C0 Component Intra Prediction Mode Deciding Unit (item 5), which would provide a luma prediction mode, and C1/C2 Component Intra Prediction Deciding Unit resulting in a C1/C2 component intra prediction mode 101 different from the Y component (*setting a luma prediction mode, setting a chroma prediction mode,*

*wherein chroma and luma have different modes*) and *encoding the block*. Havlicek, ¶110. And a POSITA would have been motivated to combine Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

**5. Claim 2**

**a. 2[pre]**

If limiting, Sekiguchi discloses/suggests 2[pre] when it describes "a digital image signal encoding method." Sekiguchi, [0002]; *see also id.*, [0006], claim 9; Havlicek, ¶110.

**b. 2[a]**

Sekiguchi-VCEG-AJ21 teaches/suggests 2[a] for substantially the same reasons as 1[b]. *See* §VI.A.4.c; Havlicek, ¶111.

**c. 2[b]**

Sekiguchi-VCEG-AJ21 teaches/suggests 2[b] for substantially the same reasons as 1[c]. *See* §VI.A.4.d; Havlicek, ¶112.

**d. 2[c]**

Sekiguchi-VCEG-AJ21 teaches/suggests 2[c] for substantially the same reasons as 1[d]. *See* §VI.A.4.e; Havlicek, ¶113.

**e. 2[d]**

Sekiguchi-VCEG-AJ21 teaches/suggests 2[d] for substantially the same reasons as 1[e]. *See* §VI.A.4.f; Havlicek, ¶114.

**f. 2[e]**

Sekiguchi-VCEG-AJ21 teaches/suggests 2[e] for substantially the same reasons as 1[f]. *See* §VI.A.4.g; Havlicek, ¶115.

**6. Claim 3**

Sekiguchi-VCEG-AJ21 teaches/suggests claim 3's additional limitation for substantially the same reasons as 1[c]. *See* §VI.A.4.d; Havlicek, ¶116.

**7. Claim 5**

Sekiguchi-VCEG-AJ21 teaches/suggests claim 5's additional limitation for substantially the same reasons as 1[c] and 2[b]. *See* §§VI.A.4.d, VI.A.5.c; Havlicek, ¶117.

**8. Claim 10**

**a. 10[pre]**

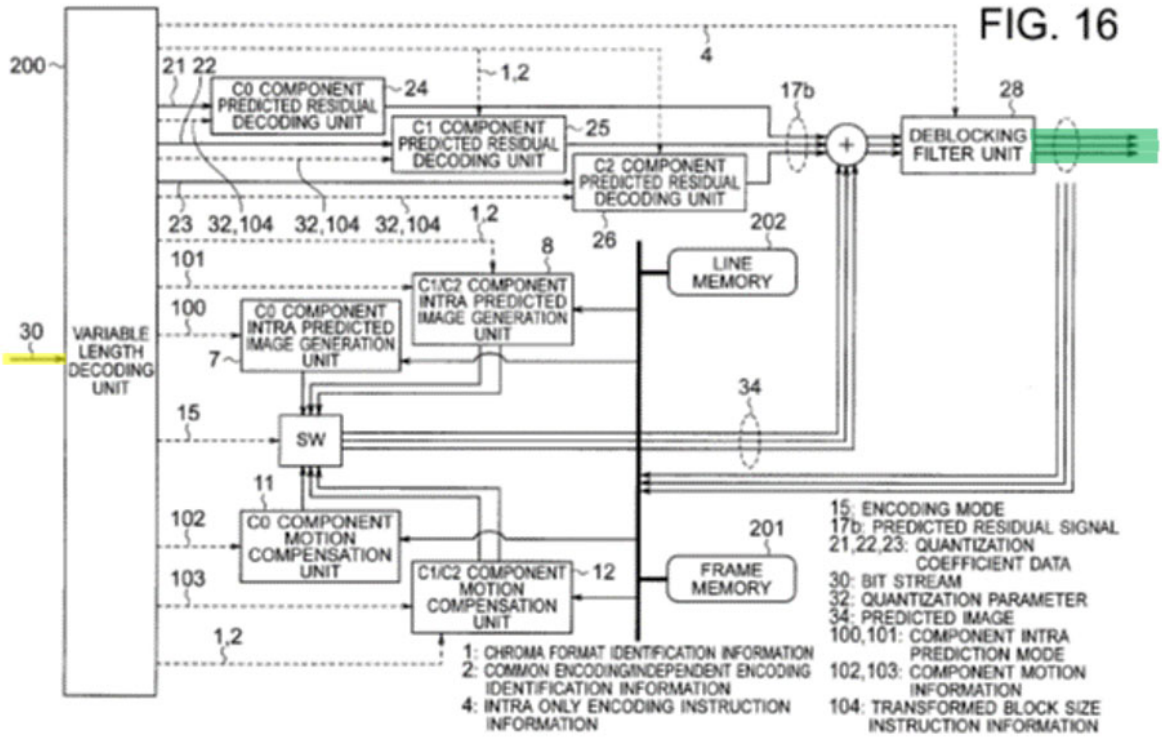
If limiting, Sekiguchi discloses/suggests 10[pre] when it describes "a digital image signal decoding method." Sekiguchi, [0002]; *see also id.*, [0006], claims 6-7; Havlicek, ¶118.

**b. 10[a]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 10[a]. As described for limitation 1[b], the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.A.4.c; Havlicek, ¶119.

And Sekiguchi further discloses a decoding device, shown in Figure 16 (below), where bit stream 30 (highlighted yellow below) is input, and the decoded

video image (highlighted green below) is the output. Sekiguchi, [0025], [0077]-[0078], Fig. 16; Havlicek, ¶120.




Sekiguchi's decoding device decodes the incoming video signal, including "the macroblock structure," "macroblock data," and "macroblock units" (*decoding picture data for at least a block in a picture*). Sekiguchi, [0078]; Havlicek, ¶121.

Figure 16 of Sekiguchi also includes a C0 component intra prediction image generation unit 7, which takes as input component intra prediction mode signal (100)—the same signal 100 generated during encoding. Sekiguchi, [0043], [0078], [0092], Figs. 4, 16. Figure 16 of Sekiguchi also includes C1/C2 component intra prediction image generation unit 8, which takes as input a different component intra

mode signal (101). *Id.*, [0045], [0078], [0092], Figs. 4, 16. Sekiguchi explains that "[w]hen a chroma format is 4:2:0 or 4:2:2, a C0 component intra prediction mode 100 defined by a unit of 4x4 or 8x8 blocks is decoded for the Y component, and an independently encoded C1/C2 component intra prediction mode 101 is decoded for the Cb/Cr component." Sekiguchi, [0092]; *see also id.*, [0100], [0102]. A POSITA would have understood this to describe *decoding* the picture data that was encoded according to the method disclosed in Sekiguchi—as explained above for limitation 1[b]—and the combination of Sekiguchi and VCEG-AJ21 thus teaches/suggests this limitation. Havlicek, ¶122. Furthermore, a POSITA would have been motivated to combine Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

**c. 10[b]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 10[b]. Havlicek, ¶123. As described for limitation 1[c], the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.A.4.d; Havlicek, ¶123. And as described for limitation 10[a], Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b; Havlicek, ¶123. A POSITA would therefore have understood that Sekiguchi discloses *decoding* the picture data that was encoded according to the method described in Sekiguchi—as explained above for limitation 1[c]—such that the combination of Sekiguchi and VCEG-AJ21 teaches/suggests this limitation.

Havlicek, ¶123. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.A.3.

**d. 10[c]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 10[c]. Havlicek, ¶124. As described for limitation 1[d], the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.A.4.e; Havlicek, ¶124. And as described for limitation 10[a], Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b; Havlicek, ¶124. A POSITA would therefore have understood that Sekiguchi discloses *decoding* the picture data that was encoded according to the method disclosed in Sekiguchi—as explained above for limitation 1[d]—such that the combination of Sekiguchi and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶124. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.A.3.

**e. 10[d]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 10[d]. Havlicek, ¶125. As described for limitation 1[e], the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.A.4.f; Havlicek, ¶125. And as described for limitation 10[a], Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b;

Havlicek, ¶125. A POSITA would therefore have understood that Sekiguchi discloses *decoding* the picture data that was encoded according to the method disclosed in Sekiguchi—as explained above for limitation 1[e]—such that the combination of Sekiguchi and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶125. And a POSITA would have been motivated to combine Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

**f. 10[e]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 10[e]. Havlicek, ¶126. As described for limitation 1[f], the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.A.4.g; Havlicek, ¶126. And as described for limitation 10[a], Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b; Havlicek, ¶126. A POSITA would therefore have understood that Sekiguchi discloses *decoding* the picture data that was encoded according to the method disclosed in Sekiguchi—as explained above for limitation 1[f]—such that the combination of Sekiguchi and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶126. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.A.3.

### 9. Claim 12

Sekiguchi-VCEG-AJ21 teaches/suggests claim 12's additional limitation. Havlicek, ¶127.

As described for claim 5, the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this claim. *See* §VI.A.7; Havlicek, ¶128. And as described for 10[a] above, Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b; Havlicek, ¶128. A POSITA would have therefore understood Sekiguchi to disclose *decoding* the picture data that was encoded according to the method described in Sekiguchi—as explained above for claim 5—such that the combination of Sekiguchi and VCEG-AJ21 thus teaches/suggests this claim. Havlicek, ¶128. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.A.3.

### 10. Claim 14

#### a. 14[pre]

If limiting, Sekiguchi discloses/suggests 14[pre]. Sekiguchi describes a video decoding apparatus. Sekiguchi, [0076]-[0077], Fig. 16; Havlicek, ¶129.

#### b. 14[a]

Sekiguchi discloses/suggests 14[a]. Havlicek, ¶130. In particular, a POSITA would have understood that Sekiguchi uses a *memory* and *processor* for decoding video. Sekiguchi, [0076]-[0120], Fig. 16; VCEG-AJ21, 1 (Introduction); §VI.A.3;

Havlicek, ¶130. This is shown, for example, in the video decoder of Figure 16, which depicts components such as memory (e.g., "frame memory," item 201) for the video data being decoded. Havlicek, ¶130. A POSITA would also have understood that implementing the software/firmware components of Figure 16 would require storing machine instructions in a memory. *Id*. And some form of processor is needed to execute those instructions and operate on the data. *Id*.

**c. 14[b]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 14[b] for substantially the same reasons discussed for 1[b] and 10[a]. *See* §§VI.A.3, VI.A.4.c, VI.A.8.b; Havlicek, ¶131.

**d. 14[c]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 14[c] for substantially the same reasons discussed above for 1[b] and 10[a]. *See* §§VI.A.3, VI.A.4.c, VI.A.8.b; Havlicek, ¶132.

**e. 14[d]**

Sekiguchi in combination withVCEG-AJ21 teaches/suggests 14[d] for substantially the same reasons as 1[c] and 10[b]. *See* §§VI.A.3, VI.A.4.d, VI.A.8.c; Havlicek, ¶133.

**f. 14[e]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 14[e] for substantially the same reasons as 1[d] and 10[c]. *See* §§VI.A.3, VI.A.4.e, VI.A.8.d; Havlicek, ¶134.

**a. 14[f]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 14[f] for substantially the same reasons as 1[e] and 10[d]. *See* §§VI.A.3, VI.A.4.f, VI.A.8.e; Havlicek, ¶135.

**a. 14[g]**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests 14[g] for substantially the same reasons as 1[f] and 10[e]. *See* §§VI.A.3, VI.A.4.g, VI.A.8.f; Havlicek, ¶136.

**11. Claim 16**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests claim 16's additional limitations for substantially the same reasons as claim 12. *See* §VI.A.9; Havlicek, ¶137.

**12. Claim 18**

Sekiguchi in combination with VCEG-AJ21 teaches/suggests claim 18's additional limitation. Havlicek, ¶138.

A POSITA would have understood that the methods disclosed in Sekiguchi and VCEG-AJ21 were implemented as software, as prior video decoding standards, such as H.264, had been, and that software was represented as data for instructions to implement the video decoding methods. VCEG-AJ21, 2; Havlicek, ¶139. Therefore, a POSITA would have understood the combination of Sekiguchi and VCEG-AJ21 teaches/suggests implementing the method of claim 10 in a series of instructions stored on a non-transitory computer readable storage medium. Havlicek, ¶139. A POSITA would have been motivated to make the combination of Sekiguchi and VCEG-AJ21 for the reasons stated above. *See* §VI.A.3.

#### 13. Claim 19

Sekiguchi in combination with VCEG-AJ21 teaches/suggests claim 19's additional limitations for substantially the same reasons as claims 1 and 3. *See* §§VI.A.4, VI.A.6; Havlicek, ¶140.

### B. Ground 1B: Sekiguchi in view of VCEG-AJ21 and H.264

#### 1. H.264

H.264 is a standard for "higher compression of moving pictures for various applications such as videoconferencing, digital storage media, television broadcasting, Internet streaming, and communication." H.264, i. The revision of H.264 referenced herein (EX-1010) was approved by the ITU-T Study Group 16 in November 2007 and was publicly available by August 12, 2008, making it prior art

under §102(b). H.264, i; Munford, ¶¶7-36; Havlicek, ¶141.[8] For example, Ms. Munford explained that "the final, approved edition of ITU-T H.264 2007 was posted to the ITU website and made available for purchase no later than May 29, 2008," "and the substance of that document [through amendments to March 2005 version] was publicly available no later than September 2007." Munford, ¶¶35-36.

**2. Motivation to combine Sekiguchi, VCEG-AJ21, and H.264**

A POSITA would have been motivated to combine H.264 with the combination of Sekiguchi and VCEG-AJ21 discussed above (*see* §VI.A.3) to extend H.264's macroblock structure to larger macroblocks, and to separate luma and chroma intra prediction, as taught by Sekiguchi and VCEG-AJ21, and would have had a reasonable expectation of success in doing so. Havlicek, ¶142.

[8] To the extent PO argues that EX-1010 was not publicly available by August 12, 2008, the substance of that reference was available in the form of Amendments 1 and 2 to the 2005 version of H.264, which were publicly available by no later than September 2007. EX-1015 ("H.264 (03/2005)"); Munford, ¶36, Appendices H26402 (EX-1016 ("Amendment 1")), H26403 (EX-1017 ("Amendment 2")). Alternative citations to H.264 (03/2005), Amendment 1, and/or Amendment 2 are provided as footnotes throughout this Petition.

Sekiguchi and VCEG-AJ21 expressly build upon H.264. Sekiguchi, [0004]; VCEG-AJ21, 1 (Abstract); Havlicek, ¶143. Sekiguchi recognized that H.264 used "a macroblock area composed of luminance components 16x16 pixels" and "corresponding chrominance components are 8x8 pixel blocks." Sekiguchi, [0005]. Sekiguchi disclosed enhancements including different intra partition types and intra prediction modes for luma and chroma. *Id.*, [0043], [0045]; Havlicek, ¶144.

VCEG-AJ21 proposed "extend[ing] the architecture of H.264 codec with enlarged MB sizes." VCEG-AJ21, 1. VCEG-AJ21 recognizes the limitation of H.264's 16x16 macroblock and the benefits of larger macroblocks, especially for High Definition ("HD") video. *Id.* ("It may not be efficient for the HD or beyond HD since the MB size of 16x16 pixels is relatively small for high resolution video contents."), 2 ("It implies that relatively large block modes are more advantageous to the high resolution videos in terms of the Rate-distortion optimization."). In particular, VCEG-AJ21 discloses a macroblock using a 32x32 pixel block for a luma partition, and a 16x16 pixel block for a chroma partition. *Id.*, 4-5, Fig. 5; Havlicek, ¶145.

A POSITA would have understood the teachings of Sekiguchi and VCEG-AJ21 to build on the work of H.264 by adding larger block sizes, additional partition types, and additional intra prediction modes using routine engineering. Havlicek, ¶146. In particular, the new intra prediction partition types and modes would be

added to Table 7-11 of H.264, and the macroblock syntax of Section 7.3.5 would be adjusted to include encoding of the different intra partition types and modes. H.264, 51-53, 91[9]; Havlicek, ¶146. Doing so would not adversely affect (and would in fact benefit) the H.264 standard. Havlicek, ¶146.

### 3. Claim 4

Sekiguchi in view of VCEG-AJ21 and H.264 teaches/suggests claim 4's additional limitation. Havlicek, ¶147.

For the 4:2:0 format, H.264 discloses a single transform available to be used for chroma: 4x4. H.264, 172.[10] So for each *particular chroma partition type* (16x16, 8x8, 4x4) in the combination of Sekiguchi, VCEG-AJ21, and H.264, the *largest-size available transform* (4x4) *is selected from a set of transforms* (the set containing the single element: the 4x4 transform). Havlicek, ¶148.

If PO argues that H.264 discloses two *available transforms*—i.e., 8x8 and 4x4—the combination of Sekiguchi, VCEG-AJ21, and H.264 nevertheless still teaches/suggests this limitation. H.264 explains that when an 8x8 chroma partition type is used (for the 4:4:4 format), there is an 8x8 transform available for chroma.

[9] H.264 (03/2005), 50, 87.

[10] H.264 (03/2005), 162; Amendment 2, 29-30.

H.264, 174 (Section 8.5.5).[11] A POSITA would have understood that for the combined system of Sekiguchi and VCEG-AJ21—which includes an 8x8 chroma partition type, as shown for limitation 1[b]—there would be a motivation to use the larger 8x8 chroma partition disclosed in H.264 for the 4:4:4 format because large transforms provide better energy compaction and better preservation of detail than small transforms. Havlicek, ¶149 (citing Wien, 604, 608 ("With ABT, the encoder can trade energy compaction by larger transforms against the size of the region a single prediction direction is applied to.")). So for at least 8x8 and 4x4 chroma partition types, the combination of Sekiguchi, VCEG-AJ21, and H.264 teaches/suggests selecting the *largest-size available transform* (8x8 for an 8x8 chroma partition and 4x4 for a 4x4 chroma partition), from *a set of transforms* (the set consisting of the 8x8 and 4x4 transforms), meeting this limitation. *Id.*

Further, for the 16x16 chroma partition, it would have been "obvious to try" the 8x8 transform. There are a finite number of options available (the 4x4 and 8x8 transforms) described in H.264. As both options are provided in H.264, they are each an identified, predictable solution. Therefore, a POSITA would have had two potential options, and it would have been obvious to try them both to determine which provided better energy compaction and better preservation of detail. Havlicek,

[11] Amendment 2, 30.

¶150; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 402-03 (2007) ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense."). As discussed above, because given the better energy compaction and better preservation of detail available from a larger transform, a POSITA would have had success using the larger (8x8) transform. Havlicek, ¶150 (citing Wien, 604, 608). Therefore, the combination of Sekiguchi, VCEG-AJ21, and H.264 teaches/suggests selecting the *largest-size available transform* (8x8 for a 16x16 chroma partition, 8x8 for an 8x8 chroma partition, and 4x4 for a 4x4 chroma partition), from *a set of transforms* (the set consisting of the 8x8 and 4x4 transforms). Havlicek, ¶150. A POSITA would have been motivated to make the combination of Sekiguchi, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.B.2;

**4. Claim 6**

VCEG-AJ21-H.264 teaches/suggests claim 6's additional limitation. Havlicek, ¶151.

Section 7.3.5 of H.264 provides a syntax for encoding macroblocks, which includes encoding mb_type (outlined in red) and transform_size_8x8_flag (outlined in blue). Havlicek, ¶152.

| macroblock_layer( ) { | C | Descriptor |
|---|---|---|
| **mb_type** | 2 | ue(v) \| ae(v) |
| if( mb_type == I_PCM ) { | | |
| while( !byte_aligned( ) ) | | |
| **pcm_alignment_zero_bit** | 3 | f(1) |
| for( i = 0; i < 256; i++ ) | | |
| **pcm_sample_luma[ i ]** | 3 | u(v) |
| for( i = 0; i < 2 * MbWidthC * MbHeightC; i++ ) | | |
| **pcm_sample_chroma[ i ]** | 3 | u(v) |
| } else { | | |
| noSubMbPartSizeLessThan8x8Flag = 1 | | |
| if( mb_type != I_NxN && MbPartPredMode( mb_type, 0 ) != Intra_16x16 && NumMbPart( mb_type ) == 4 ) { | | |
| sub_mb_pred( mb_type ) | 2 | |
| for( mbPartIdx = 0; mbPartIdx < 4; mbPartIdx++ ) | | |
| if( sub_mb_type[ mbPartIdx ] != B_Direct_8x8 ) { | | |
| if( NumSubMbPart( sub_mb_type[ mbPartIdx ] ) > 1 ) | | |
| noSubMbPartSizeLessThan8x8Flag = 0 | | |
| } else if( !direct_8x8_inference_flag ) | | |
| noSubMbPartSizeLessThan8x8Flag = 0 | | |
| } else { | | |
| if( transform_8x8_mode_flag && mb_type == I_NxN ) | | |
| **transform_size_8x8_flag** | 2 | u(1) \| ae(v) |
| mb_pred( mb_type ) | 2 | |
| } | | |
| if( MbPartPredMode( mb_type, 0 ) != Intra_16x16 ) { | | |
| **coded_block_pattern** | 2 | me(v) \| ae(v) |
| if( CodedBlockPatternLuma > 0 && transform_8x8_mode_flag && mb_type != I_NxN && noSubMbPartSizeLessThan8x8Flag && ( mb_type != B_Direct_16x16 \|\| direct_8x8_inference_flag ) ) | | |
| **transform_size_8x8_flag** | 2 | u(1) \| ae(v) |
| } | | |
| if( CodedBlockPatternLuma > 0 \|\| CodedBlockPatternChroma > 0 \|\| MbPartPredMode( mb_type, 0 ) == Intra_16x16 ) { | | |
| **mb_qp_delta** | 2 | se(v) \| ae(v) |
| residual( 0, 0, 15 ) | 3 \| 4 | |
| } | | |
| } | | |
| } | | |

H.264, 51.[12]

H.264's Table 7-11 includes the allowed macroblock types for intra prediction frames. H.264, 91 [13] ; Havlicek, ¶153. Both mb_type (red) and

[12] H.264 (03/2005), 50.

[13] H.264 (03/2005), 87.

transform_size_8x8_flag (blue) are included in Table 7-11, reproduced in part and annotated below.

| mb_type | Name of mb_type | transform_size_8x8_flag | MbPartPredMode ( mb_type, 0 ) | Intra16x16 PredMode | CodedBlock PatternChroma | CodedBlock PatternLuma |
|---|---|---|---|---|---|---|
| 0 | I_NxN | 0 | Intra_4x4 | na | Equation 7-34 | Equation 7-34 |
| 0 | I_NxN | 1 | Intra_8x8 | na | Equation 7-34 | Equation 7-34 |
| 1 | I_16x16_0_0_0 | na | Intra_16x16 | 0 | 0 | 0 |
| 2 | I_16x16_1_0_0 | na | Intra_16x16 | 1 | 0 | 0 |
| 3 | I_16x16_2_0_0 | na | Intra_16x16 | 2 | 0 | 0 |

H.264, 93 (excerpted)

Also in Table 7-11 is the result of the function MbPartPredMode(mb_type,0) (yellow). As shown, *the particular luma partition type is absolutely coded* by the combination of the syntax elements mb_type and transform_size_8x8_flag. For example, when mb_type is encoded as 0 and transform_size_8x8_flag is encoded as 0, MbPartPredMode(mb_type,0) results in a luma partition type of Intra_4x4. When mb_type is encoded as 0 and transform_size_8x8_flag is encoded as 1, MbPartPredMode(mb_type,0) results in luma partition type of Intra_8x8. When mb_type is set to any value in the range 1-24, then transform_size_8x8_flag is not present in the bitstream, transform_size_8x8_flag is inferred to be equal to 0, and

MbPartPredMode(mb_type,0) results in a luma partition type of Intra_16x16. Havlicek, ¶154. This is summarized by the table below. *Id.*

| **mb_type** | **Name of mb_type** | **transform_size_8x8_flag** | **MbPartPredMode (mb_type,0)** |
|---|---|---|---|
| 0 | I_NxN | 0 | Intra_4x4 |
| 0 | I_NxN | 1 | Intra_8x8 |
| 1-24 | I_16x16_X | N/A | Intra_16x16 |
| 25 | I_PCM | N/A | N/A |

Section 7.3.5.1 of H.264 ("Macroblock prediction syntax") describes a function "mb_pred()" with if/then statements for intra prediction of luma based on the result of MbPartPredMode() discussed above. H.264, 52[14]; Havlicek, ¶155.

[14] H.264 (03/2005), 51; Amendment 2, 13.

| | | |
|---|---|---|
| if( MbPartPredMode( mb_type, 0 ) == Intra_4x4 \|\| MbPartPredMode( mb_type, 0 ) == Intra_8x8 \|\| MbPartPredMode( mb_type, 0 ) == Intra_16x16 ) { | | |
| if( MbPartPredMode( mb_type, 0 ) == Intra_4x4 ) | | |
| for( luma4x4BlkIdx=0; luma4x4BlkIdx<16; luma4x4BlkIdx++ ) { | | |
| **prev_intra4x4_pred_mode_flag[** luma4x4BlkIdx ] | 2 | u(1) \| ae(v) |
| if( !prev_intra4x4_pred_mode_flag[ luma4x4BlkIdx ] ) | | |
| **rem_intra4x4_pred_mode[** luma4x4BlkIdx ] | 2 | u(3) \| ae(v) |
| } | | |
| if( MbPartPredMode( mb_type, 0 ) == Intra_8x8 ) | | |
| for( luma8x8BlkIdx=0; luma8x8BlkIdx<4; luma8x8BlkIdx++ ) { | | |
| **prev_intra8x8_pred_mode_flag[** luma8x8BlkIdx ] | 2 | u(1) \| ae(v) |
| if( !prev_intra8x8_pred_mode_flag[ luma8x8BlkIdx ] ) | | |
| **rem_intra8x8_pred_mode[** luma8x8BlkIdx ] | 2 | u(3) \| ae(v) |
| } | | |
| if( ChromaArrayType == 1 \|\| ChromaArrayType == 2 ) | | |
| **intra_chroma_pred_mode** | 2 | ue(v) \| ae(v) |

H.264, 52 (excerpted)

For example, if the luma intra prediction partition type is set to Intra_4x4, there is a for loop that processes intra prediction for luma for each 4x4 block, as shown below. Havlicek, ¶156.

| | | |
|---|---|---|
| if( MbPartPredMode( mb_type, 0 ) == Intra_4x4 ) | | |
| for( luma4x4BlkIdx=0; luma4x4BlkIdx<16; luma4x4BlkIdx++ ) { | | |
| **prev_intra4x4_pred_mode_flag[** luma4x4BlkIdx ] | 2 | u(1) \| ae(v) |
| if( !prev_intra4x4_pred_mode_flag[ luma4x4BlkIdx ] ) | | |
| **rem_intra4x4_pred_mode[** luma4x4BlkIdx ] | 2 | u(3) \| ae(v) |
| } | | |

H.264, 52 (excerpted)

The H.264 function mb_pred() also defines a similar loop that processes intra prediction modes similarly for luma 8x8 intra prediction blocks, as shown below. Havlicek, ¶157.

| | | |
|---|---|---|
| if( MbPartPredMode( mb_type, 0 ) == Intra_8x8 ) | | |
| for( luma8x8BlkIdx=0; luma8x8BlkIdx<4; luma8x8BlkIdx++ ) { | | |
| **prev_intra8x8_pred_mode_flag[** luma8x8BlkIdx ] | 2 | u(1) \| ae(v) |
| if( !prev_intra8x8_pred_mode_flag[ luma8x8BlkIdx ] ) | | |
| **rem_intra8x8_pred_mode[** luma8x8BlkIdx ] | 2 | u(3) \| ae(v) |
| } | | |

H.264, 52 (excerpted); Havlicek, ¶157.

VCEG-AJ21 adds a 32x32 pixel macroblock to H.264, as illustrated in Figure 5 below. VCEG-AJ21, 4-5, Fig. 5; Havlicek, ¶158.

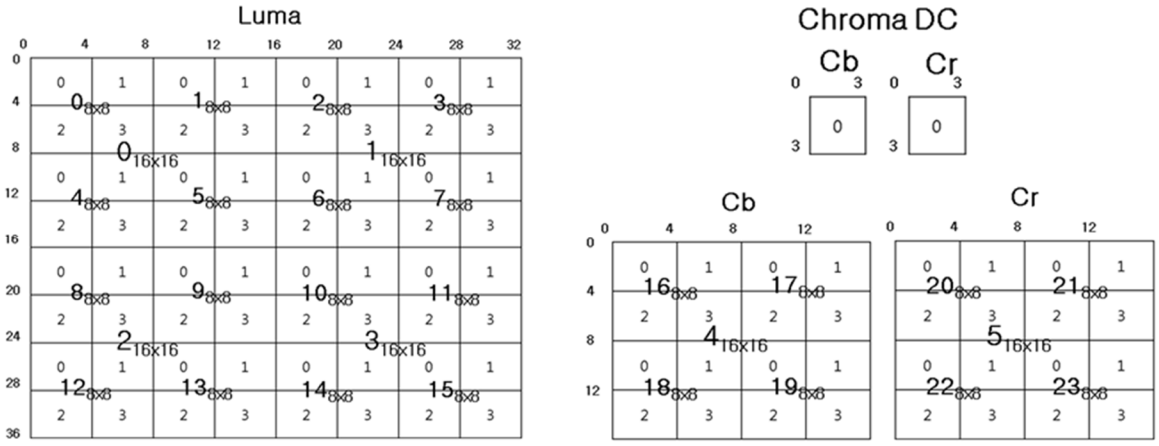



**Fig. 5 Block indexing for 32x32 MB**

The third row of Table 2 lists the possible partition block modes for inter prediction for the 32x32 block. VCEG-AJ21, 4. A POSITA would have understood that any mode using a square partition (e.g., 16x16, 8x8, 4x4) would also apply to intra prediction, because a POSITA would have known that within the context of H.264 (and similar codecs), the set of macroblock partition types available for intra prediction was a subset of the types available for inter prediction—specifically

consisting of the square partition types (and omitting the oblong rectangular partition types). Havlicek, ¶¶73, 159-160. Thus, a POSITA would have understood that while VCEG-AJ21 expressly focuses on inter prediction, it also discloses partition types for 32x32 luma blocks and 16x16 chroma blocks that a POSITA would have found obvious to use for intra prediction. Havlicek, ¶160.

A POSITA would have further understood that using an enlarged 32x32 macroblock would require encoding luma at that partition size, along with 4x4, 8x8, and 16x16 (as is shown in Table 7-11 of H.264). Havlicek, ¶161. In particular, a POSITA would have updated Table 7-11 of H.264 to include additional rows for mb_type values representing intra prediction of luma blocks of size 32x32 (each of which would result in a return value of Intra_32x32 from MbPartPredMode(mb_type,0)). *Id.* The updated table would include the following logic (new rows highlighted yellow), *id.*:

| **mb_type** | **Name of mb_type** | **transform_size_8x8_flag** | **MbPartPredMode** |
|---|---|---|---|
| 0 | I_NxN | 0 | Intra_4x4 |
| 0 | I_NxN | 1 | Intra_8x8 |
| 1-24 | I_16x16_X | N/A | Intra_16x16 |
| 25 | I_PCM | N/A | N/A |

| | | | |
|---|---|---|---|
| 26 | I32EMB_NxN | 0 | Intra_4x4 |
| 26 | I32EMB_NxN | 1 | Intra_8x8 |
| 27 | I32EMB_16x16 | N/A | Intra_16x16 |
| 28-51 | I32EMB_32x32_X | N/A | Intra_32x32 |
| 52 | I32EMB_PCM | N/A | N/A |

In addition, the syntax of H.264 clauses 7.3.5 and 7.3.5.1 would be easily updated to account for the new intra prediction of 32x32 blocks. Havlicek, ¶162.

Thus, the combination of Sekiguchi, VCEG-AJ21, and H.264 teaches/suggests that mb_type and transform_size_8x8_flag encode the partition information for luma intra prediction for each particular 4x4, 8x8, 16x16, and 32x32 block, without reference to any other block (*the particular luma partition type is absolutely coded*). Havlicek, ¶163. A POSITA would have been motivated to make the combination of Sekiguchi, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.B.2.

**5. Claim 11**

Sekiguchi in view of VCEG-AJ21 and H.264 teaches/suggests claim 11's additional limitation. Havlicek, ¶164.

As described for claim 4, the combination of Sekiguchi, VCEG-AJ21, and H.264 teaches/suggests the *encoding* side of this claim. *See* §VI.B.3; Havlicek, ¶165.

As described for limitation 10[a], Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b; Havlicek, ¶165. A POSITA would therefore have understood that Sekiguchi discloses *decoding* the picture data that was encoded according to the method disclosed in Sekiguchi—as explained above for claim 4—and the combination of Sekiguchi, VCEG-AJ21, and H.264 teaches/suggests this claim. Havlicek, ¶165. A POSITA would have been motivated to make the combination of Sekiguchi, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.B.2.

**6. Claim 13**

Sekiguchi in view of VCEG-AJ21 and H.264 teaches/suggests claim 13's additional limitation. Havlicek, ¶166.

As described for claim 6, the combination of Sekiguchi and VCEG-AJ21 teaches/suggests the *encoding* side of this claim. *See* §VI.B.4; Havlicek, ¶167. And as described for limitation 10[a], Sekiguchi discloses decoding the picture data that was encoded according to the method disclosed in Sekiguchi. *See* §VI.A.8.b; Havlicek, ¶167. A POSITA would therefore have understood that Sekiguchi discloses *decoding* the picture data that was encoded according to the method disclosed in Sekiguchi—as explained above for claim 6—and the combination of Sekiguchi, VCEG-AJ21, and H.264 teaches/suggests this claim. Havlicek, ¶167. A

POSITA would have been motivated to make the combination of Sekiguchi, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.B.2.

#### 7. Claim 15

Sekiguchi in view of VCEG-AJ21 and H.264 teaches/suggests claim 15's additional limitation for substantially the same reasons as claims 11 and 14. *See* §§VI.B.5, VI.A.10; Havlicek, ¶168.

#### 8. Claim 17

Sekiguchi in view of VCEG-AJ21 and H.264 teaches/suggests claim 17's additional limitation for substantially the same reasons as claims 13 and 14. *See* §§VI.B.6, VI.A.10; Havlicek, ¶169.

#### 9. Claim 20

Sekiguchi in view of VCEG-AJ21 and H.264 teaches/suggests claim 20's additional limitation for substantially the same reasons as claim 4. *See* §VI.B.3; Havlicek, ¶170.

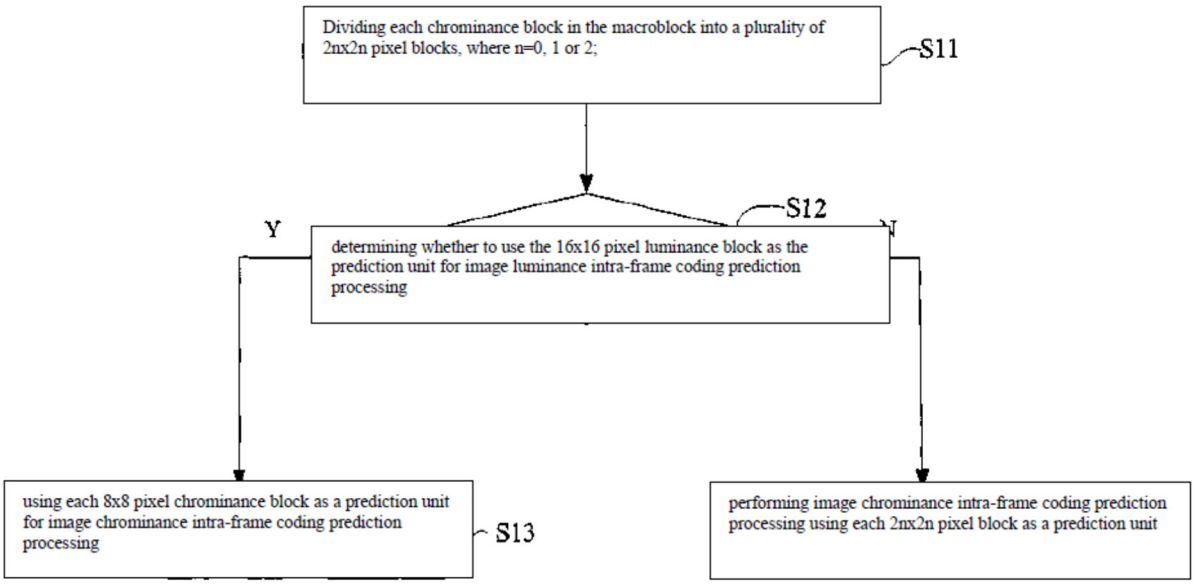
### C. Ground 2A: Xiong in view of VCEG-AJ21

#### 1. Xiong

Xiong (WO2006/026903) was published on March 16, 2006, and qualifies as prior art under 35 U.S.C. §§102(a), 102(b). Havlicek, ¶171.

Xiong discloses a method for intra-frame coding. Xiong, 1 (Abstract).[15] In particular, Xiong proposes a method that improves image chrominance coding efficiency in video coding. Xiong, 5:11-13. Xiong determines the chrominance block based on the size of the luminance block. Xiong, 5:10-6:20; Havlicek, ¶172.

In Xiong's first embodiment—relied on for this petition—when a 16x16 pixel luma block is used, Xiong's method uses an 8x8 pixel block as a prediction unit for chroma intra-frame coding prediction processing. Xiong, 5:20-24; 10:5-9. Or when a different sized luma block is used, Xiong's method uses $2^n$x$2^n$ pixel blocks as a prediction unit for chroma intra-frame coding processing, where n = 0, 1, or 2. *Id.*, 5:15-24, 9:26-10:9. This is shown in Figure 6. Xiong, Fig. 6; Havlicek, ¶173.




[15] Citations to Xiong refer to the English translation of WO2006/026903, EX-1008.

The determination of whether n = 0, 1, or 2 is made for each implementation of Xiong's method (applicable to each of Xiong's disclosed embodiments). Havlicek, ¶174. Xiong describes "n=2, i.e., dividing each chrominance block into four 4x4 pixel blocks, as the most preferred implementation." Xiong, 9:5-11. Therefore, in Xiong's "most preferred implementation," Xiong uses either 8x8 or 4x4 pixel blocks for intra-frame chroma prediction. Havlicek, ¶174.

### 2. Motivation to Combine Xiong and VCEG-AJ21

A POSITA would have been motivated to combine Xiong and VCEG-AJ21 to extend Xiong's teachings of determining chroma block sizes based on luma block sizes to include larger block sizes, and a POSITA would have had a reasonable expectation of success in doing so. Havlicek, ¶175.

Both references build upon H.264. Xiong, 3:8-15; VCEG-AJ21, 1 (Abstract). Both references also disclose macroblock sizes, luminance components, and chroma components and use the 4:2:0 format. Xiong, 3:16-20, 5:10-23, 8:18-24; VCEG-AJ21, 1, 3, 4-5. The references present overlapping, compatible concepts such as enhancing the efficiency of the prior art (H.264) video encoding and decoding process by providing a correspondence between a luma block and a chroma block. Xiong, 5:10-22; VCEG-AJ21, 1 (Abstract), 6 (Conclusion), 4-5, Figs. 4, 5. Havlicek, ¶176.

While Xiong focuses on intra prediction of luma and chroma blocks using traditional 16x16 macroblocks—which VCEG-AJ21 also discloses—VCEG-AJ21 discloses larger macroblock sizes for luma and chroma encoding, including 32x32 luma blocks. VCEG-AJ21, 5, Fig. 5. A POSITA would have been motivated to apply Xiong's separate intra prediction for luma and chroma to VCEG-AJ21's larger macroblock size because doing so would allow for more efficient encoding of luma and chroma intra prediction by taking advantage of VCEG-AJ21's larger block sizes, and it would not have adversely affected Xiong's system (and in fact would have enhanced it). Havlicek, ¶177. This combination would have involved only routine engineering tasks, such as modifying the firmware/software of Xiong's system to incorporate the 32x32 luma partition and 16x16 chroma partition disclosed in VCEG-AJ21. *Id.* This would have been as simple as an additional conditional statement (e.g., if/then, or "switch" statement) to account for VCEG-AJ21's 32x32 luma partition. *Id.*

**3. Claim 1**

**a. 1[pre]**

If limiting, Xiong discloses/suggests 1[pre]. Xiong discloses intra-frame coding implementations that could be used in, for example, "conference television, videophone, streaming media, high-definition laser video disc (HD DVD, High-

definition digital video disc) and video surveillance." Xiong, 3:8-15. Each of these would be a *video encoding apparatus* for Xiong's disclosed method. Havlicek, ¶178.

**b. 1[a]**

Xiong discloses/suggests 1[a]. As discussed above, Xiong discloses intra-frame coding in, for example, "conference television, videophone, streaming media, high-definition laser video disc (HD DVD, High-definition digital video disc) and video surveillance." Xiong, 3:8-15. A POSITA would have understood such devices include a memory for storing the software/firmware instructions corresponding to Xiong's method as well as a processor to execute those instructions. Havlicek, ¶¶179-180.

**c. 1[b]**

Xiong in combination with VCEG-AJ21 teaches/suggests 1[b]. Xiong discloses encoding picture data for a block of a picture, using intra prediction. Xiong, 5:10-24, 10:5-9, Fig. 6. In particular, Xiong discloses luma partition types that include at least 16x16 pixel blocks, and chroma partition types that include at least 8x8 and 4x4 pixel blocks. Xiong, 5:10-24 (("determining whether to use the 16x16 pixel luminance block as the prediction unit for image luminance intra-frame coding prediction"), ("using each 8 x 8-pixel chrominance block as a prediction unit for image chrominance intra-frame coding prediction"), ("performing image chrominance intra-frame coding prediction using each $2^n$x$2^n$ pixel block as a

prediction unit")), 9:5-11, 10:5-9, Fig. 6 (S13 ("8x8 pixel chrominance block"), S14 ("$2^{[n]}$x$2^{[n]}$ pixel block"); Havlicek, ¶181.

VCEG-AJ21 likewise discloses a luma partition of 16x16 but adds 32x32, 8x8, and 4x4. VCEG-AJ21, 4-5, Figs. 4-5, Table 2; Havlicek, ¶182. The combination of Xiong and VCEG-AJ21 thus teaches/suggests *a set of multiple luma partition types* that includes 4x4, 8x8, 16x16, and 32x32. *See* §VI.C.2; Havlicek, ¶182.

VCEG-AJ21 additionally discloses chroma partition types of 8x8 and 16x16, as shown in Figures 4 and 5, respectively. VCEG-AJ21, 4-5, Figs. 4, 5; Havlicek, ¶¶183-185.

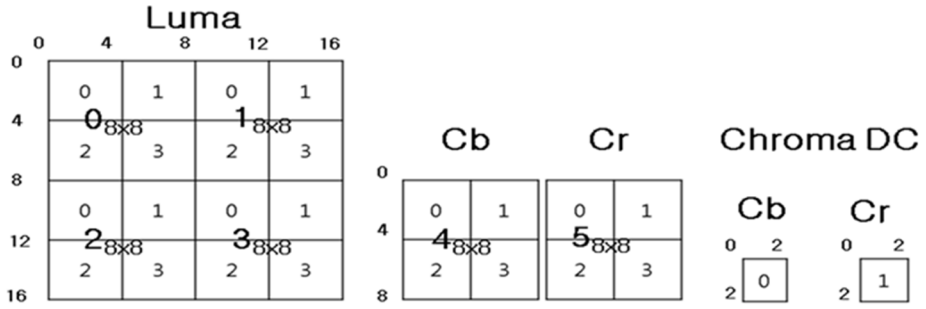



**Fig. 4 Block indexing for 16x16 MB**

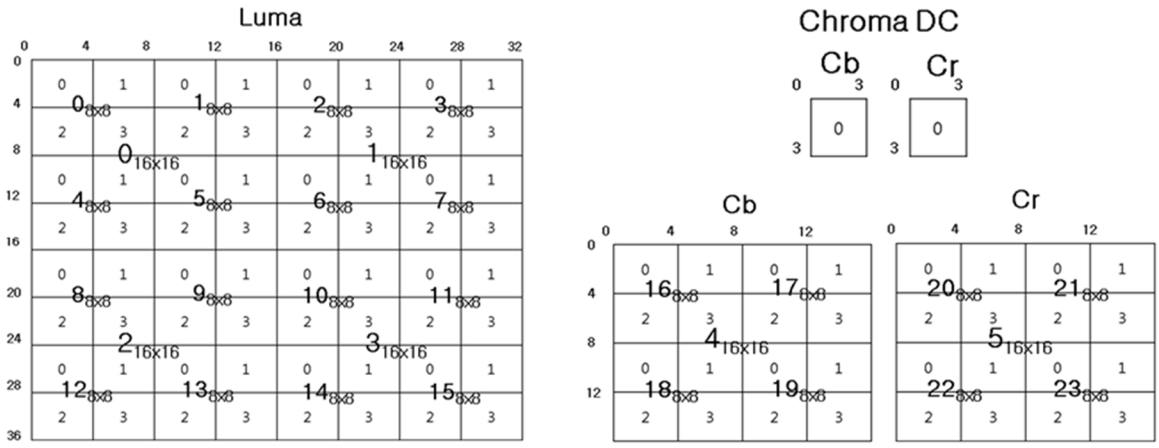



**Fig. 5 Block indexing for 32x32 MB**

The combination of Xiong and VCEG-AJ21 thus also teaches/suggests *multiple partition types comprising a set of multiple chroma partition types of sizes 16×16, 8×8, 4×4*. *See* §VI.C.2; Havlicek, ¶186. And because the combination of Xiong and VCEG-AJ21 does not teach a set of chroma partition types that includes 32x32, the *set of multiple chroma partition types* is *different than the set of multiple luma partition types*. Havlicek, ¶186. A POSITA would have been motivated to make the combination of Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.C.2.

**d. 1[c]**

Xiong in combination with VCEG-AJ21 teaches/suggests 1[c]. For the 4:2:0 format, VCEG-AJ21 discloses using an 8x8 chroma partition type in response to a 16x16 luma partition type, and a 16x16 chroma partition type in response to a 32x32 luma partition type (*determining a particular chroma partition type…in response to*

*a luma partition type utilized to encode the block, the luma partition type being included in the set of multiple luma partition types*). VCEG-AJ21, 4-5, Figs. 4-5; Havlicek, ¶187.

Further, Xiong discloses that if a 16x16 luma partition is used for intra-picture prediction, then an 8x8 chroma partition is used. Xiong, 5:10-24 ((“determining whether to use the 16x16 pixel luminance block as the prediction unit for image luminance intra-frame coding prediction, and if yes, go to step (A1-2) [which is] using each 8 x 8-pixel chrominance block as a prediction unit for image chrominance intra-frame coding prediction”)), 9:5-11, 10:5-9, Fig. 6 (S13); Havlicek, ¶188. And in the “most preferred implementation” as applied to the first embodiment, Xiong discloses using a 4x4 chroma block if a luma block other than 16x16 pixels is used. Xiong, 5:10-24, 9:5-11, 10:5-9, Fig. 6 (S14 (“$2^{[n]}$x$2^{[n]}$ pixel block”)). Xiong thus *determin[es] a particular chroma partition type…for encoding a partitioned block from the set of multiple chroma partition types in response to a luma partition type utilized to encode the block* (8x8 chroma block *in response to* 16x16 luma block; 4x4 chroma block *in response to* non-16x16 luma block). Havlicek, ¶188.

In addition, Xiong discloses *using a single chroma intra prediction mode that is different than a luma intra prediction mode*. Havlicek, ¶189. Xiong discloses ways of determining the chroma intra prediction mode. Xiong, 6:20-7:8 (“calculating respectively the coding efficiency of image chrominance intra-frame coding

prediction in various prediction modes with each 8x8 [or $2^n \times 2^n$] pixel chrominance block as a prediction unit, and taking the prediction mode corresponding to the highest coding efficiency as the same prediction mode based on rate-distortion optimization"). But Xiong does not describe the details of how to determine luma intra prediction mode. Havlicek, ¶190. However, a POSITA would have understood that rate-distortion optimization (RDO) was a widely accepted and widely used method for selecting the best luma and chroma intra prediction modes for encoding a block. Havlicek, ¶¶190-195. And a POSITA would have further understood that RDO would be expected to choose different optimal intra-prediction modes for luma and chroma. *Id.* (citing EX-1018, EX-1019).

Thus, a POSITA would have understood that determining the chroma intra prediction mode based on RDO will often result in a luma intra prediction mode that is different from the chroma intra prediction mode (*a single chroma intra prediction mode that is different than a luma intra prediction mode*). Havlicek, ¶195. To the extent a POSITA used a different calculation (other than rate-distortion optimization) to determine the luma intra prediction mode, it would also be expected to often be the case that the resulting luma intra prediction mode would be different from the chroma intra prediction mode for at least the reason that luma and chroma are expected to generally have different characteristics on which the prediction modes are based. *Id.*

Furthermore, Xiong's disclosures indicate that the single chroma intra prediction mode is different than a luma intra prediction mode through its disclosure and use of mapping tables. For example, Xiong discloses determining chroma intra prediction modes using two mapping relationship tables: a "first mapping relationship table" between a prediction mode for 16x16 luminance blocks and the prediction mode adopted and the image chrominance intra-frame coding prediction process for $2^n \times 2^n$ pixel blocks; and a "second mapping relationship table" between a prediction mode for 4x4 luminance blocks and the prediction mode adopted and the image chrominance intra-frame coding prediction process for $2^n \times 2^n$ pixel blocks. Xiong, 6:27-7:5; Havlicek ¶196. Either the first or second mapping relationship table is used "to determine the corresponding prediction mode as the same prediction mode according to the prediction mode or prediction mode combination adopted by the luminance block in the image luminance intra-frame coding prediction." Xiong, 7:6-13. Notably, the reference to "the same prediction mode" relates to the same chroma prediction mode for each of the $2^n \times 2^n$ pixel blocks. *Id.*, 6:8-9 ("The plurality of $2^n \times 2^n$ pixel blocks divided from each macroblock adopt the same prediction mode to perform image chrominance intra-frame coding prediction"). A POSITA would have understood that a mapping table is necessary because the chroma intra prediction mode corresponding to each luma intra prediction mode is generally different from the luma intra prediction mode. Havlicek, ¶196. Providing such a

mapping table saves both processing power (because the chroma prediction mode is looked up based on luma prediction mode rather than being independently calculated) and bandwidth (because only the luma prediction mode for the larger block need be encoded). If the inputs to the mapping table matched the outputs of the mapping table, there would be no need for the mapping table at all. *Id.* Therefore, the fact that Xiong uses mapping tables indicates *a single chroma intra prediction mode that is different than a luma intra prediction mode*. *Id*.

The combination of Xiong and VCEG-AJ21 also teaches/suggests that *only luma partition type is signaled, not the chroma partition type* because the determination of chroma partition type is made by information available to both the encoder and decoder (i.e., the luma partition type), so Xiong would not need to signal the chroma partition type—which would improve system efficiency. Havlicek, ¶197. A POSITA would have understood that where there is a one-to-one relationship between two items of data, such as the luma intra prediction partition type and the chroma intra prediction partition type in this case, transmitting both items of data is essentially redundant. *Id*. A POSITA would have further understood that transmitting such redundant information would be a waste of bandwidth and storing such redundant information in an encoded video signal would be a counterproductive waste of storage capacity. *Id.*

Therefore, the combination of Xiong and VCEG-AJ21 teaches/suggests using a 16x16 chroma partition type in response to a 32x32 luma partition type (from VCEG-AJ21) and an 8x8 chroma partition type in response to a 16x16 luma partition type (from Xiong) (*determining a particular chroma partition type…for encoding a partitioned block from the set of multiple chroma partition types in response to a luma partition type utilized to encode the block*), from the set of luma partition types of 32x32, 16x16, 8x8, and 4x4 (*the luma partition type being included in the set of multiple luma partition types*). Havlicek, ¶198. The combination also teaches/suggests determining the chroma intra prediction mode that is different from a luma intra prediction mode, either because each mode is determined independently (resulting in different RDO, for example), or based on a mapping between a luma intra prediction mode and a chroma intra prediction mode (*using a single chroma intra prediction mode that is different than a luma intra prediction mode*). *See* §VI.C.2; Havlicek, ¶198. Further, a POSITA would have understood that the combined system signals only the luma partition for efficiency (*only luma partition type is signaled, not the chroma partition type*). Havlicek, ¶198. And a POSITA would have been motivated to combine Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.C.2.

**e. 1[d]**

Xiong in combination with VCEG-AJ21 teaches/suggests 1[d]. As discussed for limitation 1[c], Xiong discloses determining the chroma partition type based on whether the luma partition type is 16x16 or otherwise. *See* §VI.C.3.d; Havlicek, ¶199. Xiong also discloses that in H.264, upon which Xiong builds, "the image luminance prediction process includes two prediction units: 16x16 block prediction and 4x4 block prediction." Xiong, 4:1-3. In addition, a POSITA reading VCEG-AJ21 would have further found it obvious to set the luma partition to 32x32 or to 8x8. VCEG-AJ21, 4-5, Fig. 4, Fig. 5; Havlicek ¶199.

Therefore, the combination of Xiong and VCEG-AJ21 teaches/suggests setting the luma partition to 32x32, 16x16, 8x8 or 4x4 (*encoding comprising: setting a luma partition*). Havlicek, ¶200. A POSITA would have been motivated to make the combination of Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.C.2.

**f. 1[e]**

Xiong in combination with VCEG-AJ21 teaches/suggests 1[e]. As discussed for limitation 1[c], the combination of Xiong and VCEG-AJ21 determines a chroma partition type in response to a luma partition type. *See* §VI.C.3.d. The combination of Xiong and VCEG-AJ21 discloses chroma partition types that include, at least 16x16, 8x8, and 4x4. *See* §VI.C.3.d; Havlicek, ¶201. Therefore, the determined chroma partition type is *from the set of multiple chroma partition types*. Havlicek,

¶201. The combination of Xiong and VCEG-AJ21 also teaches/suggests *setting a chroma partition* to the determined chroma partition type. *Id*. And a POSITA would have been motivated to combine Xiong and VCEG-AJ21 in this way for the reasons stated above. *See* §VI.C.2.

**g. 1[f]**

Xiong in combination with VCEG-AJ21 teaches/suggests 1[f]. Xiong discloses luma prediction modes and chroma prediction modes for different sized partitions. Xiong, 4:5-6:9; Figs. 2-3. As discussed for limitation 1[c], the combination of Xiong and VCEG-AJ21 discloses *using a single chroma intra prediction mode that is different than a luma intra prediction mode* because Xiong determines the chroma prediction mode independently from the luma prediction mode. *See* §§VI.C.2, VI.C.3.d; Havlicek, ¶202. For substantially the same reasons, the combination of Xiong and VCEG-AJ21 discloses *setting a luma prediction mode, setting a chroma prediction mode, wherein chroma and luma have different modes*. Havlicek, ¶202.

Xiong further discloses thereafter encoding the block. Xiong, 3:16-23, Fig. 1. Havlicek ¶203.

The combination of Xiong and VCEG-AJ21 thus discloses independent determination of intra prediction modes for luma and chroma (*setting a luma prediction mode, setting a chroma prediction mode, wherein chroma and luma have*

*different modes*) and *encoding the block*. Havlicek, ¶204. And a POSITA would have been motivated to combine Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.C.2.

**4. Claim 2**

**a. 2[pre]**

If limiting, Xiong discloses/suggests 2[pre] when it describes "a method for image chrominance based on intra-frame coding." Xiong, 5:10-13. Further, Xiong is built as an improvement on H.264 video encoding and decoding methods. *Id.*, 3:16-23, Fig. 1; Havlicek, ¶205.

**b. 2[a]**

Xiong in combination with VCEG-AJ21 teaches/suggests 2[a] for substantially the same reasons as 1[b]. *See* §VI.C.3.c; Havlicek, ¶206.

**c. 2[b]**

Xiong in combination with VCEG-AJ21 teaches/suggests 2[b] for substantially the same reasons as 1[c]. *See* §VI.C.3.d; Havlicek, ¶207.

**d. 2[c]**

Xiong in combination with VCEG-AJ21 teaches/suggests 2[c] for substantially the same reasons as 1[d]. *See* §VI.C.3.e; Havlicek, ¶208.

**e. 2[d]**

Xiong in combination with VCEG-AJ21 teaches/suggests 2[d] for substantially the same reasons as 1[e]. *See* §VI.C.3.f; Havlicek, ¶209.

**f. 2[e]**

Xiong in combination with VCEG-AJ21 teaches/suggests 2[e] for substantially the same reasons as 1[f]. *See* §VI.C.3.g; Havlicek, ¶210.

**5. Claim 3**

The combination of Xiong and VCEG-AJ21 teaches/suggests claim 3's additional limitation for substantially the same reasons discussed above for 1[c]. *See* §VI.C.3.d.; Havlicek, ¶211.

**6. Claim 5**

Xiong in combination with VCEG-AJ21 teaches/suggests claim 5's additional limitation for substantially the same reasons as 1[c] and 2[b]. *See* §§VI.C.3.d, VI.C.4.c; Havlicek, ¶212.

**7. Claim 10**

**a. 10[pre]**

If limiting, Xiong discloses/suggests 10[pre] when it describes "a method for image chrominance based on intra-frame coding." Xiong, 5:10-13. Further, Xiong is built as an improvement on H.264's methods of video encoding and decoding. *Id.*, 3:16-23, Fig. 1; Havlicek, ¶213.

**b. 10[a]**

Xiong in combination with VCEG-AJ21 teaches/suggests 10[a]. As described for limitation 1[b], the combination of Xiong and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.C.3.c; Havlicek, ¶214.

And although Xiong discloses an encoder in detail, a POSITA would have understood that Xiong also describes—at least implicitly—a decoder and the process by which the decoder would decode a bitstream into video. Xiong, 3:6-7 ("The present invention relates to the technical field of video coding and decoding, and further to a method for method for image chrominance prediction based on intra-frame coding."), 7:9-13 (referring to a "reconstructed pixel value"); Fig. 1 ("Decoder"); Havlicek ¶215. Xiong further discloses that its method is implemented in devices (e.g., "conference television, videophone, streaming media, high-definition laser video disc (HD DVD, High-definition digital video disc) and video surveillance") that include decoders. Xiong, 3:8-15. A POSITA would have understood that H.264—upon which Xiong builds—provides for both encoding and associated decoding. *Id.*, 3:8-23; Havlicek, ¶215. To the extent Xiong's encoded video data could not be decoded using H.264, a POSITA would have understood that the decoding of Xiong's disclosed encoding method would be the inverse of the encoding method. Havlicek, ¶215.

**c. 10[b]**

Xiong in combination with VCEG-AJ21 teaches/suggests 10[b]. As described for limitation 1[c], the combination of Xiong and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.C.3.d; Havlicek, ¶216. And as described for limitation 10[a], Xiong discloses decoding the picture data that was encoded

according to Xiong's method. *See* §VI.C.7.b; Havlicek, ¶216. A POSITA would therefore have understood that Xiong discloses *decoding* the picture data that was encoded according to the method disclosed in Xiong—as explained above for limitation 1[c]—such that the combination of Xiong and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶216. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.C.2.

**d. 10[c]**

Xiong in combination with VCEG-AJ21 teaches/suggests 10[c]. As described for limitation 1[d], the combination of Xiong and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.C.3.e; Havlicek, ¶217. And as described for limitation 10[a], Xiong discloses decoding the picture data that was encoded according to the method disclosed in Xiong. *See* §VI.C.7.b; Havlicek, ¶217. A POSITA would therefore have understood that Xiong discloses *decoding* the picture data that was encoded according to the method disclosed in Xiong—as explained above for limitation 1[d]—and the combination of Xiong and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶217. A POSITA would have been motivated to make the combination of Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.C.2.

**e. 10[d]**

Xiong in combination with VCEG-AJ21 teaches/suggests 10[d]. As described for limitation 1[e], the combination of Xiong and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.C.3.f; Havlicek, ¶218. And as described for limitation 10[a], Xiong discloses decoding the picture data that was encoded according to the method disclosed in Xiong. *See* §VI.C.7.b; Havlicek, ¶218. A POSITA would therefore have understood that Xiong discloses *decoding* the picture data that was encoded according to the method disclosed in Xiong—as explained above for limitation 1[e]—such that the combination of Xiong and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶218. And a POSITA would have been motivated to combine Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.C.2.

**f. 10[e]**

Xiong in combination with VCEG-AJ21 teaches/suggests 10[e]. As described for limitation 1[f], the combination of Xiong and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.C.3.g; Havlicek, ¶219. And as described for limitation 10[a], Xiong discloses decoding the picture data that was encoded according to the method disclosed in Xiong. *See* §VI.C.7.b; Havlicek, ¶219. A POSITA would therefore have understood that Xiong discloses *decoding* the picture data that was encoded according to the method disclosed in Xiong—as explained

above for limitation 1[f]—such that the combination of Xiong and VCEG-AJ21 teaches/suggests this limitation. Havlicek, ¶219. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.C.2.

**8. Claim 12**

Xiong in combination with VCEG-AJ21 teaches/suggests claim 12's additional limitation. As described for claim 5, the combination of Xiong and VCEG-AJ21 teaches/suggests the *encoding* side of this limitation. *See* §VI.C.6; Havlicek, ¶¶220-221. And as described for limitation 10[a], Xiong discloses decoding the picture data that was encoded according to the method disclosed in Xiong. *See* §VI.C.7.b; Havlicek, ¶221. A POSITA would therefore have understood that Xiong discloses *decoding* the picture data that was encoded according to the method disclosed in Xiong—as explained above for claim 5—such that the combination of Xiong and VCEG-AJ21 teaches/suggests this claim. Havlicek, ¶221. And a POSITA would have been motivated to make the combination for the reasons stated above. *See* §VI.C.2.

**9. Claim 14**

**a. 14[pre]**

If limiting, Xiong discloses/suggests 14[pre]. Xiong's intra-frame coding is implemented in, for example, "conference television, videophone, streaming media, high-definition laser video disc (HD DVD, High-definition digital video disc) and

video surveillance." Xiong, 3:8-15. Each of these would include *a video decoding apparatus*. Havlicek, ¶222.

**b. 14[a]**

Xiong discloses/suggests 14[a]. As discussed above, Xiong's intra-frame coding is implemented in, for example, "conference television, videophone, streaming media, high-definition laser video disc (HD DVD, High-definition digital video disc) and video surveillance." Xiong, 3:8-15. A POSITA would have understood such devices would include a memory and a processor for storing the software/firmware instructions corresponding to Xiong's method as well as a processor to execute those instructions. Havlicek, ¶¶223-224.

**c. 14[b]**

Xiong in combination with VCEG-AJ21 teaches/suggests 14[b] for substantially the same reasons discussed for 1[b] and 10[a]. *See* §§VI.C.2, VI.C.3.c, VI.C.7.b; Havlicek, ¶225.

**d. 14[c]**

Xiong in combination with VCEG-AJ21 teaches/suggests 14[c] for substantially the same reasons discussed for 1[b] and 10[a]. *See* §§VI.C.2, VI.C.3.c, VI.C.7.b; Havlicek, ¶226.

**e. 14[d]**

Xiong in combination with VCEG-AJ21 teaches/suggests 14[d] for substantially the same reasons as 1[c] and 10[b]. *See* §§VI.C.2, VI.C.3.d, VI.C.7.c; Havlicek, ¶227.

**f. 14[e]**

Xiong in combination with VCEG-AJ21 teaches/suggests 14[e] for substantially the same reasons as 1[d] and 10[c]. *See* §§VI.C.2, VI.C.3.e, VI.C.7.d; Havlicek, ¶228.

**g. 14[f]**

Xiong in combination with VCEG-AJ21 teaches/suggests 14[f] for substantially the same reasons as 1[e] and 10[d]. *See* §§VI.C.2, VI.C.3.f, VI.C.7.e; Havlicek, ¶229.

**h. 14[g]**

Xiong in combination with VCEG-AJ21 teaches/suggests 14[g] for substantially the same reasons as 1[f] and 10[e]. *See* §§VI.C.2, VI.C.3.g, VI.C.7.f; Havlicek, ¶230.

**10. Claim 16**

Xiong in combination with VCEG-AJ21 teaches/suggests claim 16 for substantially the same reasons as claim 12. *See* §VI.C.8; Havlicek, ¶231.

### 11. Claim 18

Xiong in combination with VCEG-AJ21 teaches/suggests claim 18's additional limitation. Havlicek ¶232.

A POSITA would have understood that the methods disclosed in Xiong and VCEG-AJ21 would have been implemented as software, as prior video decoding standards (e.g., H.264) had been, and that software would have been represented as data for instructions to implement the video decoding methods. VCEG-AJ21, 2 ("In this contribution, we attempt to extend with enlarged MB sizes the JM reference software architecture."); Havlicek, ¶233. Therefore, a POSITA would have understood the combination of Xiong and VCEG-AJ21 teaches/suggests implementing the method of claim 10 in a series of instructions stored on a non-transitory computer readable storage medium. Havlicek, ¶233. A POSITA would have been motivated to make the combination of Xiong and VCEG-AJ21 for the reasons stated above. *See* §VI.B.2.

### 12. Claim 19

Xiong in combination with VCEG-AJ21 teaches/suggests claim 19 for substantially the same reasons as claims 1 and 3. *See* §§VI.C.3, VI.C.5; Havlicek, ¶234.

### D. Ground 2B: Xiong in view of VCEG-AJ21 and H.264

#### 1. Motivation to combine Xiong, VCEG-AJ21, and H.264

A POSITA would have been motivated to combine H.264 with the combination of Xiong and VCEG-AJ21 discussed above (*see* §VI.C.2) to extend H.264's macroblock structure to larger macroblocks with separate luma and chroma intra prediction (as taught by Xiong and VCEG-AJ21), and a POSITA would have had a reasonable expectation of success in doing so. Havlicek, ¶235.

Each of Xiong and VCEG-AJ21 expressly build upon H.264. Xiong, 3:8-26; VCEG-AJ21, 1 (Abstract); Havlicek ¶236. Xiong recognizes that for H.264, "image chrominance prediction is only carried out with 8x8 blocks as prediction units, but there is no further consideration of using 4x4 blocks as prediction units for intra-frame coding prediction, as in the luminance prediction." Xiong, 5:5-8. According to Xiong, "[t]his results in the defect the image chrominance coding having low efficiency in the H.264 intra-frame coding prediction technology." *Id.*, 5:8-10. To address this problem, Xiong proposes "a method for image chrominance based on intra-frame coding which can effectively improve the image chrominance coding efficiency in video image coding technology" using different sized luma and chroma blocks for intra prediction. *Id.*, 5:10-6:20; *see* §VI.C.1.

VCEG-AJ21 likewise proposes "extend[ing] the architecture of H.264 codec with enlarged MB sizes." VCEG-AJ21, 1. VCEG-AJ21 recognizes the limitation of

H.264's 16x16 macroblock and the benefits of larger macroblocks, especially for High Definition ("HD") video. *Id.* ("It may not be efficient for the HD or beyond HD since the MB size of 16x16 pixels is relatively small for high resolution video contents."), 2 ("It implies that relatively large block modes are more advantageous to the high[-]resolution videos in terms of the Rate-distortion optimization."). VCEG-AJ21 therefore discloses a macroblock using a 32x32 pixel block for a luma partition and 16x16 pixel blocks for a chroma partition. VCEG-AJ21, 4-5, Fig. 5; Havlicek ¶237.

A POSITA would have understood the teachings of Xiong and VCEG-AJ21 supplement H.264 by adding larger block sizes, additional partition types, and additional intra prediction modes using routine engineering. Havlicek, ¶238. In particular, the new intra prediction partition types and modes would be added to Table 7-11 of H.264, and the macroblock syntax of Section 7.3.5 would be adjusted to include encoding of the different intra partition types and modes. H.264, 51, 91; Havlicek, ¶238. Doing so would not adversely affect (and would in fact benefit) the H.264 standard. Havlicek, ¶238.

**2. Claim 4**

VCEG-AJ21-H.264 teaches/suggests claim 4's additional limitation for substantially the same reasons as discussed for that limitation in Ground 1B. *See* §VI.B.3; Havlicek ¶239. A POSITA would have been motivated to make the

combination of Xiong, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.D.1.

**3. Claim 6**

VCEG-AJ21-H.264 teaches/suggests claim 6's additional limitation for substantially the same reasons as discussed for this limitation in Ground 1B. *See* §VI.B.4; Havlicek ¶240. A POSITA would have been motivated to make the combination of Xiong, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.D.1.

**4. Claim 11**

Xiong in view of VCEG-AJ21 and H.264 teaches/suggests claim 11's additional limitation. Havlicek ¶241.

As described for claim 4, the combination of Xiong, VCEG-AJ21, and H.264 teaches/suggests the *encoding* side of this limitation. *See* §VI.D.2; Havlicek, ¶242. And as described for limitation 10[a], Xiong discloses decoding the picture data that was encoded according to the method disclosed in Xiong. *See* §VI.C.7.b; Havlicek, ¶242. A POSITA would therefore have understood that Xiong discloses *decoding* the picture data that was encoded according to the method disclosed in Xiong—as explained above for claim 4—such that the combination of Xiong, VCEG-AJ21, and H.264 teaches/suggests this claim. Havlicek, ¶242. And a POSITA would have been

motivated to combine Xiong, VCEG-AJ21, and H.264 for the reasons stated above. *See* §VI.D.1.

**5. Claim 13**

Xiong in view of VCEG-AJ21 and H.264 teaches/suggests claim 13's additional limitation. Havlicek ¶243.

As described for claim 6, the combination of Xiong, VCEG-AJ21, and H.264 teaches/suggests *wherein the particular luma partition type is absolutely coded or differentially coded from one or more neighboring blocks*. *See* §0; Havlicek, ¶244.

As described for limitation 10[a], Xiong discloses decoding the picture data that was encoded according to Xiong's method. *See* §VI.C.7.b; Havlicek, ¶245.

**6. Claim 15**

Xiong in view of VCEG-AJ21 and H.264 teaches/suggests claim 15 for substantially the same reasons as claims 11 and 14. *See* §§0, VI.C.9; Havlicek, ¶246.

**7. Claim 17**

Xiong in view of VCEG-AJ21 and H.264 teaches/suggests claim 17 for substantially the same reasons as claims 13 and 14. *See* §§VI.D.5, VI.C.9; Havlicek, ¶247.

### 8. Claim 20

Xiong in view of VCEG-AJ21 and H.264 teaches/suggests claim 20 for substantially the same reasons as claims 1 and 4. *See* §§VI.C.3, VI.D.2; Havlicek, ¶248.

## VII. CONCLUSION

*Inter Partes* Review of the Challenged Claims is respectfully requested.

## VIII. MANDATORY NOTICES

### A. Real Party in Interest

Petitioner identifies itself as real party in interest. Out of an abundance of caution, Petitioner discloses Amazon.com, Inc., as a potential real party in interest.

### B. Related Matters

To the best of Petitioner's knowledge, the '606 patent has been involved in the following matters:

- *InterDigital, Inc. et al. v. Amazon.com Services LLC*, No. 2:25-cv-822-AWA-DEM (E.D. Va.)

### C. Notice of Counsel and Service Information

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Petitioner consents to electronic service. All services and communications to the attorneys listed above may be sent to:

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**D. Power of Attorney**

A power of attorney is filed herewith according to 37 C.F.R. §42.10(b).

Respectfully submitted,

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Date: January 5, 2026

**CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(D)**

Pursuant to 37 C.F.R. §42.24(a), Petitioner hereby certifies that portions of the above-captioned Petition for *inter partes* review of U.S. Patent No. 12,143,606, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,802. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

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**CERTIFICATE OF SERVICE**

The undersigned hereby certifies that true copies of the Petition for *inter partes* review of U.S. Patent No. 12,143,606 and supporting materials (Exhibits and Power of Attorney) were served via overnight delivery on the Patent Owner at the correspondence address of record as listed on Patent Center:

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A courtesy copy was also sent via electronic mail to Patent Owner's litigation counsel listed below:

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