

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LENOVO (UNITED STATES), INC.,
Petitioner,

v.

TELEFONAKTIEBOLAGET LM ERICSSON,
Patent Owner.

Case IPR2025-00177
U.S. Patent No. 10,708,618
Issued: July 7, 2020
Application No. 16/440,274
Filed: June 13, 2019

Title: REFERENCE PICTURE SIGNALING

PETITION FOR
INTER PARTES REVIEW OF U.S. PATENT NO. 10,708,618

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No.	Description
1001	U.S. Patent No. 10,708,618 (“ 618 patent ”)
1002	File History of U.S. Patent No. 10,708,618
1003	Declaration of Dr. Charles D. Creusere, dated December 10, 2024 (“ Creusere Decl. ” or “ Creusere ”)
1004	U.S. Patent Pub. No. 2009/0052531 (“ Mulroy ”)
1005	ITU-T Recommendation H.264 (Nov. 2007) <i>SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS Infrastructure of audiovisual services – Coding of moving video - Advanced video coding for generic audiovisual services</i> (“ H.264/AVC ”)
1006	U.S. Patent Application Pub. No. 2006/0165176 (“ Raveendran ”)
1007	Order in <i>Telefonaktiebolaget LM Ericsson, v. Lenovo (U.S.), Inc.</i> 5:23-cv-00714-M-KS (E.D.N.C.), ECF No. 20 (Feb. 16, 2024)
1008	ITU-T Recommendation H.263 (Nov. 2000), <i>Annex U: Enhanced reference picture selection mode</i> , International Telecommunication Union (prepared by ITU-T Study Group 16 (2001-2004) and approved under the WTSA Resolution 1 procedure on Nov. 17, 2000)
1009	File History of U.S. Patent Application No. 15/299,997, which issued as U.S. Patent No. 9,807,418
1010	Comparison of Challenged Claims
1011	ITU-T Recommendation H.263 (Feb. 1998) <i>SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS Infrastructure of audiovisual services – Coding of moving video – Video coding for low bit rate communication</i>
1012	Updated Joint Claim Construction Chart in the Matter of <i>Certain Electronic Computing Devices, and Components and Modules Thereof</i> , ITC-337-TA-1387 (June 6, 2024)
1013	ITU-T Recommendation H.263 (Jan. 2005) <i>SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS Infrastructure of</i>

No.	Description
	<i>audiovisual services – Coding of moving video – Video coding for low bit rate communication (“H.263”)</i>
1014	Recommendation ITU-T H.265 (Apr. 2013) <i>SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS Infrastructure of audiovisual services – Coding of moving video – High efficiency video coding (“H.265”)</i>
1015	Stephan Wenger, <i>H.264/AVC Over IP</i> , IEEE Transactions on Circuits and Systems for Video Tech., Vol. 13, No. 7 (July 2003) (“Wenger”)
1016	Thomas Wiegand et al., <i>Overview of the H.264/AVC Video Coding Standard</i> , IEEE Transactions on Circuits and Systems for Video Tech., Vol. 13, No. 7 (July 2003) (“Wiegand”)

MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

1. Real Party-In-Interest

The real parties-in-interest are Lenovo (United States), Inc., Lenovo (Shanghai) Electronics Technology Co. Ltd., Lenovo Beijing Co., Ltd., Lenovo PC HK Ltd., Lenovo Information Productions (Shenzhen) Co. Ltd.

2. Related Matters

The '618 patent (EX1001) has been asserted in the following litigations:

- *Telefonaktiebolaget LM Ericsson v. Lenovo (United States), Inc. et al.*, Case No. 5:23-cv-00714 (E.D.N.C.), filed December 12, 2023; and
- *Certain Electronic Computing Devices, and Components and Modules Thereof*; Inv. No. 337-TA-1387 ITC, filed December 12, 2023.

The following pending patent applications allege priority to the '618 patent or its alleged priority application: U.S. Patent App. No. 18/458,256.

3. Lead And Back-Up Counsel, And Service Information

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Petitioner consents to service via email at the above email addresses and the email address of Lenovo-EricssonIPR@klarquist.com.

Pursuant to 37 C.F.R. § 42.10(b), concurrently filed with this Petition is a Power of Attorney executed by Petitioner and appointing the above counsel.

Petitioner authorizes Account No. 02-4550 to be charged for any fees, including those enumerated in 37 C.F.R. § 42.15.

I. INTRODUCTION

Lenovo (United States), Inc. (“Petitioner”) respectfully requests *inter partes* review (“IPR”) of claims 1-19 of U.S. Patent No. 10,708,618 (EX1001, “’618 patent”), allegedly assigned to Telefonaktiebolaget LM Ericsson (“Patent Owner”).

The challenged claims of the ’618 patent relate to video encoding and decoding. More specifically, the ’618 patent purports to disclose a new way to encode video to indicate more reliably which already-decoded pictures a decoder needs to store for later use. But as discussed below, none of these ideas were new: several years earlier, a U.S. patent publication identified the same issues with the industry-standard coding methods and proposed the same solution, rendering the ’618 patent’s claimed method obvious.

During prosecution of the application that led to the ’618 patent, the Applicant alleged two advances over the prior art cited by the Examiner. EX1002, 134-37¹. First, the ’618 patent’s method uses “buffer description information” to regularly restate the picture number of each picture that should be in the buffer of the decoder at any given time, in an effort to eliminate some types of decoding errors that can arise from data loss during transmission. Second, instead of listing the full picture number each time, which can grow quite large over time and thus would use more

¹ EX1002 citations are to page numbering added by Petitioner.

bits and reduce compression efficiency, the '618 patent uses a “delta identifier”—the difference between the current frame’s number and the number of the picture being described.

However, several years before the '618 patent’s claimed priority date, Mulroy (EX1004) proposed implementing the same solution to the same problem using the toolkit provided by the then-current H.264/AVC standard. Mulroy proposed using information “informing the decoder as to exactly which frames should be in the decoder buffer at that time” (i.e., buffer description information) to avoid the “mismatch between the contents of the encoder and decoder buffers” that would arise “[i]f the decoder loses a set of MMCO commands.” EX1004, ¶27. To accomplish this in Mulroy’s “modified version” of H.264/AVC, Mulroy taught using the existing “‘reference picture list reordering’ commands defined by H.264.” EX1004, ¶27. As known and defined in H.264/AVC (EX1005), these standard reordering commands included a syntax element specifying an “absolute difference” (i.e., a delta identifier) between a picture number identifying a reference picture and a picture number for the current picture being decoded. EX1005, 47, 86.

The obvious implementation of Mulroy using H.264/AVC, along with additional art detailing embodiments in hardware and software, renders all challenged claims obvious.

II. GROUND(S) FOR STANDING PER 37 C.F.R. § 42.104(a)

Petitioner certifies that the '618 patent is available for IPR and that Petitioner is not barred or estopped from requesting an IPR challenging the patent claims on the grounds identified in this petition.

III. IDENTIFICATION OF CHALLENGE

A. Statement Of the Precise Relief Requested / Statutory Grounds

Petitioner requests *inter partes* review of claims 1-19 (the “challenged claims”) of the '618 patent, on the following statutory grounds:

	Reference(s)	Basis	Claims
Ground 1	U.S. Patent Publication No. 2009/0052531 (“Mulroy,” EX1004) in view of the H.264/AVC standard (“H.264/AVC,” EX1005)	35 U.S.C. § 103	1-7
Ground 2	Mulroy in view of H.264/AVC and further in view of U.S. Patent Application Publication No. 2006/0165176 (“Raveendran,” EX1006).	35 U.S.C. § 103	8-19

For each ground, in §§VIII and IX below, the petition presents evidence of unpatentability and establishes a reasonable likelihood that the Petitioner will prevail in establishing that each Challenged Claim is unpatentable.

B. No Examiner Addressed These Unpatentability Grounds

Neither “the same [n]or substantially the same prior art or arguments previously were presented to the Office.” 35 U.S.C. § 325(d).

Neither Mulroy nor Raveendran were cited or discussed during prosecution, and neither is referenced in the '618 patent. Mulroy provides express teachings on using buffer information, in encoded data for a current picture, defining reference pictures to store for use in decoding of the current picture. These teachings were not considered by the Examiner and help show that the challenged claims were obvious.

While the Examiner considered aspects of H.264/AVC, nothing in the record indicates that the Examiner considered Mulroy in view of H.264/AVC, much less the specific teachings and disclosures relied on by this Petition or the supporting expert testimony explaining how these teachings and disclosures render the claims obvious. Thus, the Petition should not be denied under Section 325(d).

C. The Board Should Institute Despite Parallel Litigation

The Board should not discretionarily deny under Section 314(a) because the parallel district court litigation has been stayed from the outset in its entirety pending the parallel ITC proceeding, with no schedule or trial date. EX1007, 3; *Beckman Coulter, Inc. v. Sirigen II Ltd.*, IPR2022-01203, Paper 12 at 18 (PTAB Jan. 6, 2023) (instituting IPR and finding that, “[w]ithout a trial date, we see no need to engage in a full analysis of the *Fintiv* factors”). As to the ITC proceeding, “[t]he PTAB will not discretionarily deny petitions based on applying *Fintiv* to a parallel ITC proceeding.” USPTO Memorandum to PTAB, Interim Procedure for Discretionary

Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation at 6-7 (June 21, 2022).

IV. STATE OF THE ART

A. Video Coding Exploits Spatial (Intra-frame) And Temporal (Inter-frame) Redundancies In Pictures To Compress Video

Video is made up of a series of pictures that are shown in rapid succession so that humans perceive them as motion. EX1003, ¶39; *see generally id.*, ¶¶39-55 (describing the development of video compression techniques). The pictures in that series are usually very similar, both within areas of a picture and from one picture to the next. EX1003, ¶44. Video coding standards compress digital video by leveraging those similarities within a single frame² (spatial redundancy) and across frames (temporal redundancy). EX1003, ¶¶40-41; EX1013, 2; EX1005, 3. This allows video files to be much smaller, making storage and transmission more efficient for uses such as streaming, broadcasting, or video conferencing. *E.g.*, EX1016, 560.

Video coding relies on two main compression techniques: intra-frame and inter-frame compression. EX1003, ¶48.

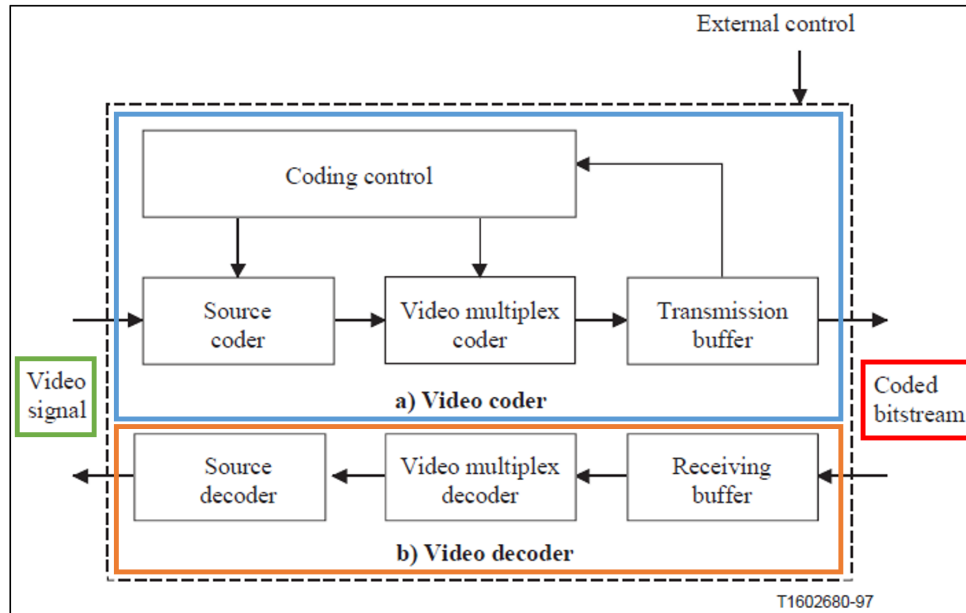
Intra-frame compression focuses on redundancy within a single frame, such as repeated patterns or areas with similar pixel values, and uses techniques like intra-

² The terms “frame” and “picture” are used interchangeably both in the ’618 patent’s specification. (EX1001, 5:45-47) and in this Petition.

prediction to predict the values of the pixels in the frame and transform coding to otherwise exploit this spatial redundancy. *E.g.*, EX1005, 4 (describing “spatial redundancy removal”); EX1013, i (using “transform coding ... to reduce spatial redundancy”), 2 (same); EX1003, ¶¶40-41, 48.

Inter-frame compression, on the other hand, uses redundancy between frames to predict regions of new frames using regions of previously decoded ones. *E.g.*, EX1005, 3-4 (describing use of macroblocks for inter prediction in H.264), 189 (noting “use of Inter predictive coding to exploit temporal redundancy in the sequence”); EX1013, i (“inter-picture prediction to utilize temporal redundancy” in H.263). Using inter-frame prediction avoids the need to completely encode every frame, further improving compression efficiency. EX1003, ¶¶40-41, 48.

Video compression and decompression are typically performed by a video codec (coder-decoder). A codec compresses and decompresses digital video according to a video coding standard. A **coder** (or encoder) compresses an input **video** signal by applying techniques to reduce the data size, resulting in an encoded **bitstream** of the compressed video. A **decoder** performs the inverse operations on the bitstream to reconstruct the original video signal. EX1003, ¶42.



EX1013, 2 (depicting a block diagram of the H.263 video codec) (annotated);
EX1003, ¶42.

**B. Inter Prediction Uses Previously Decoded Pictures
In A Decoded Picture Buffer (DPB) As Reference Pictures**

For inter prediction to work, an encoder and decoder need to have access to previously decoded pictures. Thus, an encoder and decoder typically include a buffer referred to as the “Decoded Picture Buffer” or simply “DPB.” EX1005, 297; EX1008, 1; EX1013, 149 (describing a “memory buffer of reference pictures” in H.263). A DPB can be managed by simple rules (e.g., only store the most recently decoded picture). But to fully harness the advantages of inter prediction, the reference pictures sometimes must be actively managed. EX1003, ¶50.

Some ways that reference pictures were managed was to allow storage of multiple reference pictures in the DPB, to allow storage of long-term reference

pictures in the DPB and reordering of reference pictures. *E.g.*, EX1013, 173-74 (§U.4.5); EX1003, ¶51. Storing multiple reference pictures enables selection between multiple candidates for which reference picture to use. Storing a long-term reference picture allows retention of a reference picture that is especially useful for prediction. Reordering reference pictures allows the encoder to use the lowest number for a reference picture index value to identify the most-used reference frame in a section of a picture to reduce the total number of bits required to encode a picture. EX1003, ¶51.

**C. H.264/AVC, The State-of-The-Art Video Coding Standard
In 2010, Used Reordering of Reference Pictures And Memory
Management Of Its DPB To Perform Efficient Inter Prediction**

To promote interoperability of various software and hardware, international organizations regularly establish standards for how to decode video, and the '618 patent describes H.264/AVC as the “state of the art video coding standard” at the time. EX1001, 1:31-35. H.264/AVC was first published in May 2003 and remains in common use today. EX1003, ¶¶56-57.

In H.264/AVC each picture has a frame number (*frame_num*) indicating its position in decoding order and a picture order count (*pic_order_cnt*) indicating its position in display order. EX1005, 79-85 (§7.4.3). Each picture is subdivided into macroblocks and slices, to efficiently encode the various pieces of the picture. EX1005, 23-24 (§6.3); EX1003, ¶58.

H.264/AVC uses inter-prediction as one of its techniques to encode video (EX1003, ¶59) and manages the ordering of reference pictures (for signaling with reference picture index values) with reordering commands (EX1005, 47 (§7.3.3.1); EX1003, ¶59). These commands are part of a reference picture list reordering syntax structure named “ref_pic_list_reordering()”. EX1005, 47 (§7.3.3.1). When present, this syntax structure contains instructions on how the decoder should update the reference picture list, compared to a default (according to rules) ordering and constituents of the reference picture list. Pictures that are available in the DPB can be removed from or inserted into the reference picture list, so that the reference picture list includes reference pictures that are effective for inter-frame prediction and excludes non-used reference pictures. Reference pictures can be swapped (in order) in the reference picture list, so that lower numbered reference picture index values identify more commonly used reference pictures. According to H.264/AVC, that reordering happens before decoding of macroblocks or blocks of the current picture (or slice of the current picture). EX1003, ¶¶58-69.

To manage buffer memory use, H.264/AVC uses two methods. The first is known as the “sliding window” approach, where the oldest short-term reference picture in the DPB is removed, if the DPB is full, after each new picture is decoded. EX1013, 151. The other method is to use Memory Management Control Operations (“MMCO”) commands indicating which pictures should be saved in the DPB for

later use and which should be removed. EX1013, 151, 173. The H.264/AVC MMCO commands affect which reference pictures are retained in the DPB, the default ordering when reference pictures in the DPB are put in a reference picture list before possible reordering later, and how the reference pictures may be used as “short-term” reference pictures or “long-term” reference pictures. Because of how these MMCO commands function, encoded data for previous pictures includes information that indicates which pictures should be saved in the DPB for use in decoding the current picture. EX1003, ¶¶70-73. In H.264/AVC, when MMCO commands are used, MMCO values are signaled in the bitstream for every slice of a picture that will be stored as a reference picture, to control how reference pictures in the DPB are managed. EX1005, 86-89 (§7.4.3.3). These commands are identical in each slice of a given picture. *Id.*; EX1003, ¶¶51-55.

Despite redundancy in the MMCO commands, occasionally this data is lost for a picture, including information indicating which pictures to store in the DPB and how to store them. EX1001, 2:56-3:6. If the MMCO commands are lost, the DPB may have the wrong pictures in it when decoding subsequent pictures. Because inter prediction relies on the pictures in the DPB, this may result in incorrect decoding. *Id.*; EX1003, ¶74. This alleged weakness in H.264/AVC had been recognized for years prior to the filing of the ’618 patent: for example, Mulroy, which was filed in 2007, recognized that “[i]f the decoder loses a set of MMCO

commands, there will be mismatch between the contents of the encoder and decoder buffers” and proposes strategies to mitigate that weakness. EX1004, ¶27. EX1003, ¶75.

V. THE ’618 PATENT

The ’618 patent issued July 7, 2020, from an application filed on June 13, 2019, and alleges priority to a provisional application filed June 30, 2011. EX1001, Cover, 1:6-20; EX1003, ¶¶39, 79.

A. The ’618 Patent’s Specification

The ’618 patent’s specification states that its “general objective” is “to provide an efficient reference picture signaling and buffer management in connection with video encoding and decoding.” EX1001, 3:20-22. EX1003, ¶81. The problem its specification alleges was solved is the loss of information indicating which reference pictures to retain for decoding of a current picture and how those reference pictures should be identified when encoded data for the current picture is received. *See, e.g.*, EX1001, 6:1-4. EX1003, ¶82. But as discussed in §IV.C above, and as further discussed in §VIII.A below, these criticisms of the MMCO and sliding window systems in H.264/AVC were not new in the art but had been recognized and raised by Mulroy in 2007. EX1003, ¶83.

To address the alleged deficiencies of H.264/AVC, the ’618 patent discloses that it “instead specif[ies] which decoded pictures to be used for reference pictures

in an absolute or explicit way instead of a relative or implicit way,” i.e., by including numbers that indicate the exact picture order counts of the reference pictures in the DPB. EX1001, 6:41-43. The benefit of this is that it is not “dependent on that previously encoded pictures have been correctly received and decoded.” EX1001, 4:39-42. Instead, the ’618 patent discloses signaling the “buffer description information that is used for reference pictures in an absolute and explicit way instead of a relative or implicit way.” EX1001, 4:42-44. EX1003, ¶84.

The ’618 patent alleges that by using absolute signaling, “the encoded representation of a picture contains the information about which reference pictures to use for reference during decoding independent of the encoded representations of previous pictures in the video stream.” EX1001, 4:45-48. EX1003, ¶84. The alleged benefit of this “absolute” signaling approach is that the decoder uses information included in encoded data for the current picture itself to identify reference pictures used when decoding the current picture, instead of requiring that the information in the previous pictures also be present. *See* EX1001, 6:38-56. EX1003, ¶¶80, 85.

The other benefit the ’618 patent alleges is more narrowly focused on reducing the number of bits needed to encode the absolute identifiers of reference pictures to use. The ’618 suggests “signal[ing] the reference picture properties, i.e. picture identifiers, relative to the value of these properties as signaled for the current picture.” EX1001, 9:34-36. “For instance, if the current picture has a picture

identifier 7 the list of reference pictures with identifiers 3, 5 and 6 could be defined as -1 , -2 , and -4 , which typically can be represented by fewer bits as compared to 3, 5 and 6, in particular if variable length coding is employed for the picture identifiers.” EX1001, 9:32-42; EX1003, ¶86 (explaining that the value -4 indicates the reference picture with identifier 3 since $7 - 4 = 3$, and so on). In the terminology of the ’618 patent, using a differential value to identify a reference picture relative to the picture identifier of the current picture is still “absolute” signaling, since the differential value and picture identifier of the current picture are part of the encoded data for the current picture. According to the ’618 patent, a picture identifier can be a Picture Order Count (“POC”) value, frame number, or POC value and additional identifier. EX1001, 7:54-56. EX1003, ¶86.

As discussed below, however, solutions to the issues identified in the ’618 patent were addressed by the technology disclosed in Mulroy that predates the ’618 patent’s earliest priority date by more than two years. EX1003, ¶87.

B. The Challenged Claims

The challenged claims are recited in their entireties in EX1010. Challenged claim 1 is representative and listed here, with element numbering added in the lefthand column for ease of reference:

[1.1]	A method of decoding an encoded representation of a picture in a video stream of multiple pictures, the method comprising:
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[1.2]	retrieving, from the encoded representation of the picture, buffer description information defining a plurality of reference pictures;
[1.3]	determining, based on the buffer description information, a reference picture identifier that identifies a respective reference picture among the plurality of reference pictures, the respective reference picture comprising a decoding reference for the picture, wherein determining the reference picture identifier comprises:
[1.4]	(i) retrieving, based on the buffer description information, a delta identifier comprising a difference between the reference picture identifier and a picture identifier identifying the picture; and
[1.5]	(ii) calculating the reference picture identifier based on the picture identifier and the delta identifier; and
[1.6]	updating a decoded picture buffer based on the reference picture identifier.

The other independent claims recite similar limitations, and the dependent claims add additional details about handling the reference pictures, such as how to handle missing reference pictures. EX1010; EX1003, ¶88.

**C. The Relevant Prosecution History
Of The '618 Patent And Its Family Members**

The '618 patent claims priority to U.S. Patent Application No. 16/048,556, filed on Jul. 30, 2018, now U.S. Pat. No. 10,368,088; which is a continuation of U.S. Pat. Application No. 15/718,374, filed on Sep. 28, 2017, now U.S. Pat. No. 10,063,882; which is a continuation of U.S. Pat. Application No. 15/299,997, filed on Oct. 21, 2016, now U.S. Pat. No. 9,807,418; which is a continuation of U.S. Pat. Application No. 13/508,442, filed on Apr. 25, 2013, now U.S. Pat. No. 9,706,223; which is a national stage application of P.C.T. International Application No. PCT/SE2012/050439, filed on Apr. 26, 2012, which claims the benefit of U.S.

Provisional Application No. 61/503,019, filed Jun. 30, 2011. EX1001, Cover, 1:6-20. EX1003, ¶89.

The claims in the '618 patent's ancestor applications are similar to the claims of the '618 patent. In particular, U.S. Pat. App. No. 15/299,997 (the "'997 application") contained a claim that was amended in an April 24, 2017, response to a Non-final Rejection to claim elements such as a retrieving buffer description information and determining a reference picture identifier based on the buffer description information and a delta identifier. The Examiner rejected the original form of that claim as obvious over Borgwardt et al. ("Multi-Picture Buffer Semantics for Interlace," JVT-C049, May 10, 2002) in view of two other patent publications (U.S. Publication No. 2010/0208828 to Lu et al. and U.S. Publication No. 2010/0238822 to Koyabu et al.). EX1009, 309. EX1003, ¶90.

In response to that rejection, the Applicant amended the claim (EX1009, 335-36) and argued that the amended claim was distinct from Borgwardt, because "[e]mbodiments represented by Claim 1 avoid this problem by including, within the encoded picture itself, buffer description information that identifies the reference picture(s) needed to decode the picture" (EX1009, 345). The Applicant further argued that "[i]n this way, each encoded picture may itself include sufficient information to identify the reference pictures needed for decoding the encoded picture." *Id.* (emphasis omitted.) Other aspects that Applicant contended were not

disclosed in the combination of references include buffer description information that defines a plurality of reference pictures and either a delta identifier, a picture identifier, or a calculation of a reference picture identifier. *Id.*, 346-49. EX1003, ¶91. EX1003, ¶92.

During prosecution of the '618 patent, the same Examiner rejected claims for non-statutory double patenting over claims of the ancestor patents, including U.S. Patent No. 9,807,418 which issued from the '997 application, noting that the claims are not patentably distinct from each other because the claims “perform the same function” despite the use of “different terminology” in the claims. EX1002, 100. In the same Office action, the Examiner rejected claims 1-3 as obvious over Borgwardt and Lu, similar to the rejection of the claims in the '997 application. EX1002, 104-05. EX1003, ¶93.

In response, the Applicant repeated the arguments against Borgwardt and Lu used during prosecution of the '997 application, namely that Borgwardt and Lu do not disclose or suggest values that “define buffer description information that define a plurality of reference pictures,” “a delta identifier...identifying the picture, a picture identifier identifying a picture, or calculation of a reference picture identifier.” EX1002, 134-37. Notably, while the Applicant argued that MMCO commands in Borgwardt do not disclose those elements, Applicant did not argue that

the claimed method must not use any MMCO commands. *Id.* The Examiner then allowed the claims. *Id.*, 147-48. EX1003, ¶94.

VI. PERSON OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art in June 2011 (“POSITA”) would have had at least a bachelor’s degree in electrical engineering, computer engineering, or a related field, with about two years of experience in video decoding or encoding technologies. More work or practical experience may qualify one not having the requisite education as a person with ordinary skill in the art while a higher level of education could offset less experience. EX1003, ¶¶35-38.

VII. CLAIM CONSTRUCTION

For *inter partes* review, claim terms should be given the ordinary meaning that the terms would have to a person of ordinary skill in the art on the earliest effective filing date, in view of the specification and file history. 83 Fed. Reg. 51340; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-1313 (Fed. Cir. 2005) (*en banc*). EX1003, ¶95.

For this IPR, Petitioner applies the plain and ordinary meaning of all claim terms and contends that no claim terms require specific construction to resolve the unpatentability issues presented herein. *See, e.g., Aurobindo Pharma USA, Inc. v. Andrx Corp. et al.*, IPR2017-01648, Paper 34 at 11 (PTAB Dec. 28, 2018) (“We address the construction of only certain claim terms raised by the parties, and we do so only to the extent necessary to determine whether Petitioner has demonstrated

unpatentability by a preponderance of the evidence.”) (citing *Nidec Motor Corp. v. Zhongshan Borad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017)).

Both Petitioner and PO have proposed claim constructions before the International Trade Commission for the term “circuit,” as reflected in the Joint Claim Chart (EX1012, 5). That agency has not issued any claim construction to date. For the purposes of this Petition, the Board need not construe that term and should apply its plain and ordinary meaning of that term.

Construction of this and other claim terms may be relevant to issues in district court litigation, e.g., as part of resolving non-infringement disputes or to “clarify and when necessary to explain” terms for “determination of infringement” by the factfinder—typically non-technologist judges and/or jurors. *O2 Micro Int’l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1362 (Fed. Cir. 2008) (citation omitted). Therefore, Lenovo does not waive its right to raise additional issues of claim construction in any litigation, nor does it waive any argument in any litigation that claim terms are indefinite or otherwise invalid.

As noted above, the terms “frame” and “picture” are used interchangeably in the ’618 patent’s specification. ’618, 5:45-47. While this usage does not directly affect the construction of any claim because no claim uses the term “frame,” it does relate to the understanding that one of skill in the art would have of the specification. EX1003, ¶96.

**VIII. GROUND 1: CLAIMS 1-7 ARE
OBVIOUS OVER MULROY IN VIEW OF H.264/AVC**

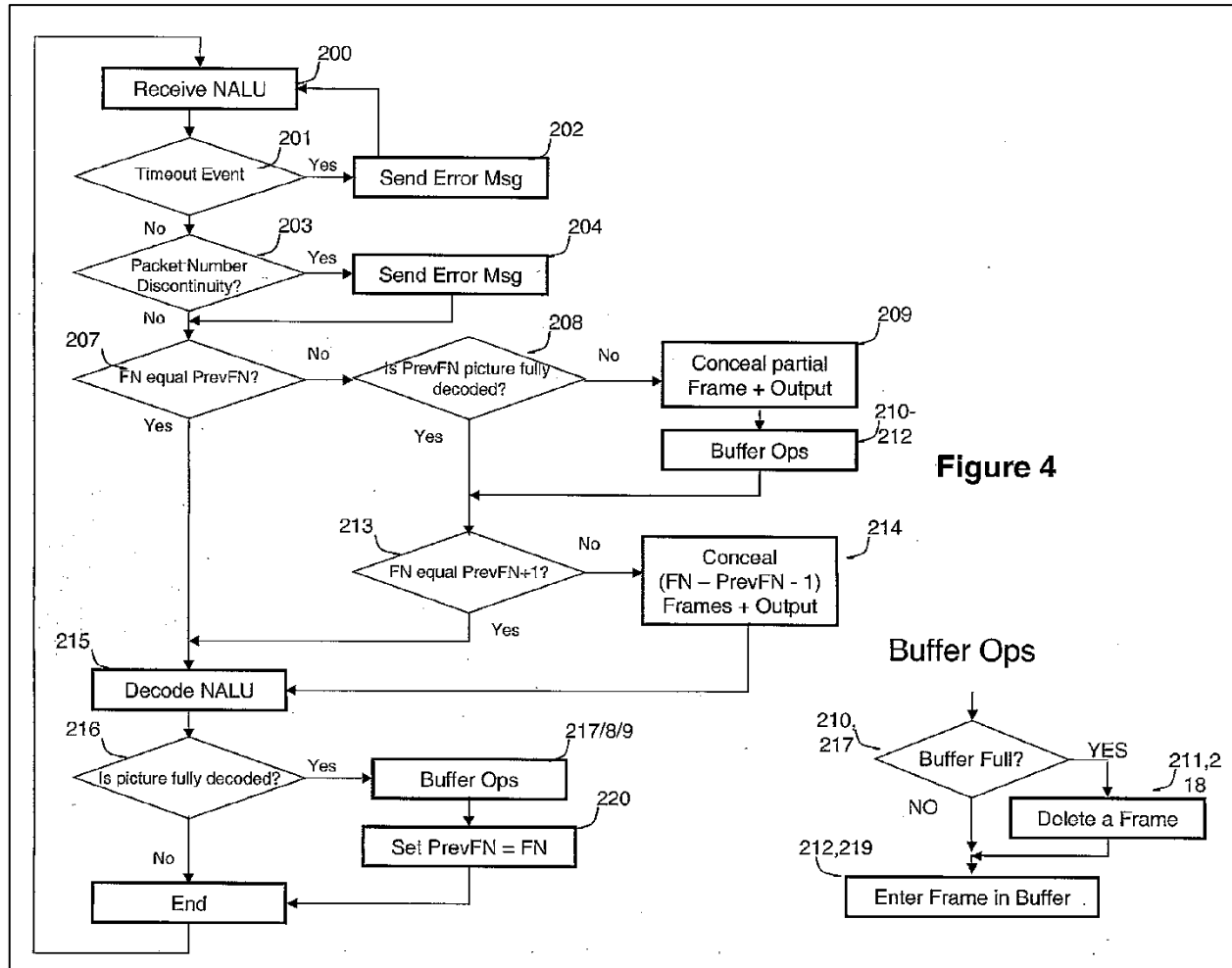
As explained below, claims 1-7 are obvious over Mulroy in view of H.264/AVC. EX1003, ¶97.

A. Mulroy (U.S. 2009/0052531; EX1004)

Mulroy is a U.S. patent application publication that published February 26, 2009, and is thus prior art under at least pre-AIA³ Sections 102(a-b). EX1004, Cover. Mulroy is analogous art to the '618 patent because they are in the same field of endeavor of video coding. EX1001, 1:24-27; EX1004, ¶1; EX1003, ¶98.

Mulroy discloses methods to improve encoding and decoding video streams and uses the toolkit set out in H.264/AVC to implement the method it describes. EX1004, ¶¶8-10. Mulroy's Figure 4 shows at a high level all the video decoding operations that satisfy each element of claim 1 of the '618 patent. EX1003, ¶¶99-100.

³ For purposes of this Petition, Petitioner assumes that the pre-AIA version of the Patent Statute applies to the challenged claims, without conceding that those claims are entitled to a pre-AIA priority date.



EX1004, FIG. 4. EX1003, ¶100.

Mulroy teaches managing the reference pictures in the decoded picture buffer before, during, and after decoding a current picture to maintain the proper reference pictures in the buffer. EX1004, ¶¶30-32, FIG. 4. In doing this, Mulroy teaches, by using the existing H.264 coding tools, including in the encoded data for the current picture, the reference picture identifiers for reference pictures to be used for decoding a current picture, which together define a plurality of reference pictures, instead of relying solely on MMCO commands (in encoded data for one or more

previous pictures) that can be lost. Mulroy, ¶¶21-22, 27. According to H.264/AVC, a picture is organized as multiple slices, and encoded data for a slice is received as a network abstraction layer unit (“NALU”). EX1005, 23-24 (§6.3), 58-61 (§7.4.1). Mulroy makes use of the H.264/AVC tools, such as MMCO commands to delete pictures from the decoder’s reference picture buffer that the encoder has deleted (EX1004, ¶25), and “sets” of MMCO messages, i.e., buffer description information (EX1004, ¶26). For its additions to H.264/AVC, Mulroy indicates “every slice contains a message informing the decoder as to exactly which frames should be in the decoder buffer at that time.” EX1004, ¶27. Mulroy also states that “[o]ne way of doing this is to make use of the ‘reference picture list reordering’ commands defined by H.264.” *Id.* EX1003, ¶¶100-03.

Thus, the decoder in Mulroy uses the “remapping instructions” in the encoded data for the current picture to determine which frames should be in its buffer. EX1004, ¶27. The decoder can delete a reference picture that is not supposed to be in its buffer. EX1004, ¶28. The decoder can also determine that a reference picture is missing from its buffer and instead use an alternative reference picture. EX1004, ¶33. EX1003, ¶104.

B. H.264/AVC (EX1005)

H.264/AVC is a publication titled *Advanced video coding for generic audiovisual services*, ITU-T Recommendation H.264, that details a third version of

the H.264/AVC standard approved in November 2007. EX1005, (a), i, 2; EX1003, ¶105. The Board has previously found H.264/AVC to constitute a printed publication published no later than May 29, 2008. *Unified Patents Inc. v. Velos Media, LLC*, IPR2019-00763, Paper 48 at 13-14 (PTAB Sept. 29, 2020). As Dr. Creusere explains, H.264/AVC was publicly accessible no later than May 29, 2008, and could be located and accessed by a POSITA exercising reasonable diligence at that time, well over one year before June 30, 2011. EX1003, ¶105; *Kyocera Wireless Corp. v. Int’l Trade Comm’n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008) (citation omitted) (a reference is considered publicly accessible if it was “disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it”). H.264/AVC thus qualifies as prior art at least under pre-AIA Sections 102(a-b). EX1003, ¶105.

The H.264/AVC standard was the leading video codec standard at the time Mulroy was filed, and the November 2007 version was widely known at the time as a state-of-the-art video compression standard. *E.g.*, EX1001, 1:31-33; EX1003, ¶105. An H.264 codec system, as referenced in Mulroy and described in H.264/AVC, uses syntax elements in reference picture list reordering information to identify reference pictures. EX1005, 47, 85-86; EX1004, ¶27, EX1003, ¶106. As discussed in §IV.C above, Reference picture list reordering information is signaled

as part of a `ref_pic_list_reordering()` syntax structure, which is in turn signaled as part of a `slice_header()` syntax structure for a slice. The slice header syntax is shown in Section 7.3.3 of H.264/AVC as follows:

7.3.3 Slice header syntax		
<code>slice_header() {</code>	C	Descriptor
<code>first_mb_in_slice</code>	2	ue(v)
<code>slice_type</code>	2	ue(v)
...		
<code>ref_pic_list_reordering()</code>	2	
<code>if((weighted_pred_flag && (slice_type == P slice_type == SP)) </code> <code>(weighted_bipred_idc == 1 && slice_type == B))</code>		
<code>pred_weight_table()</code>	2	

EX1005, 46 (§7.3.3) (excerpt) (highlighting added). The reference picture list reordering syntax (`ref_pic_list_reordering()`) is laid out in H.264/AVC as follows:

7.3.3.1 Reference picture list reordering syntax

ref_pic_list_reordering() {	C	Descriptor
if(slice_type % 5 != 2 && slice_type % 5 != 4) {		
ref_pic_list_reordering_flag_l0	2	u(1)
if(ref_pic_list_reordering_flag_l0)		
do {		
reordering_of_pic_nums_idc	2	ue(v)
if(reordering_of_pic_nums_idc == 0 reordering_of_pic_nums_idc == 1)		
abs_diff_pic_num_minus1	2	ue(v)
else if(reordering_of_pic_nums_idc == 2)		
long_term_pic_num	2	ue(v)
} while(reordering_of_pic_nums_idc != 3)		
}		
if(slice_type % 5 == 1) {		
ref_pic_list_reordering_flag_l1	2	u(1)
if(ref_pic_list_reordering_flag_l1)		
do {		
reordering_of_pic_nums_idc	2	ue(v)
if(reordering_of_pic_nums_idc == 0 reordering_of_pic_nums_idc == 1)		
abs_diff_pic_num_minus1	2	ue(v)
else if(reordering_of_pic_nums_idc == 2)		
long_term_pic_num	2	ue(v)
} while(reordering_of_pic_nums_idc != 3)		
}		
}		

EX1005, 47 (§7.3.3.1) (highlighting added); EX1003, ¶106.

One of the elements that the reference picture list reordering syntax signals is the abs_diff_pic_num_minus1, which indicates the difference (minus 1) between the picture number of a reference picture and a prediction value. By signaling the picture number of a reference picture as a difference value compared to CurrPicNum, the

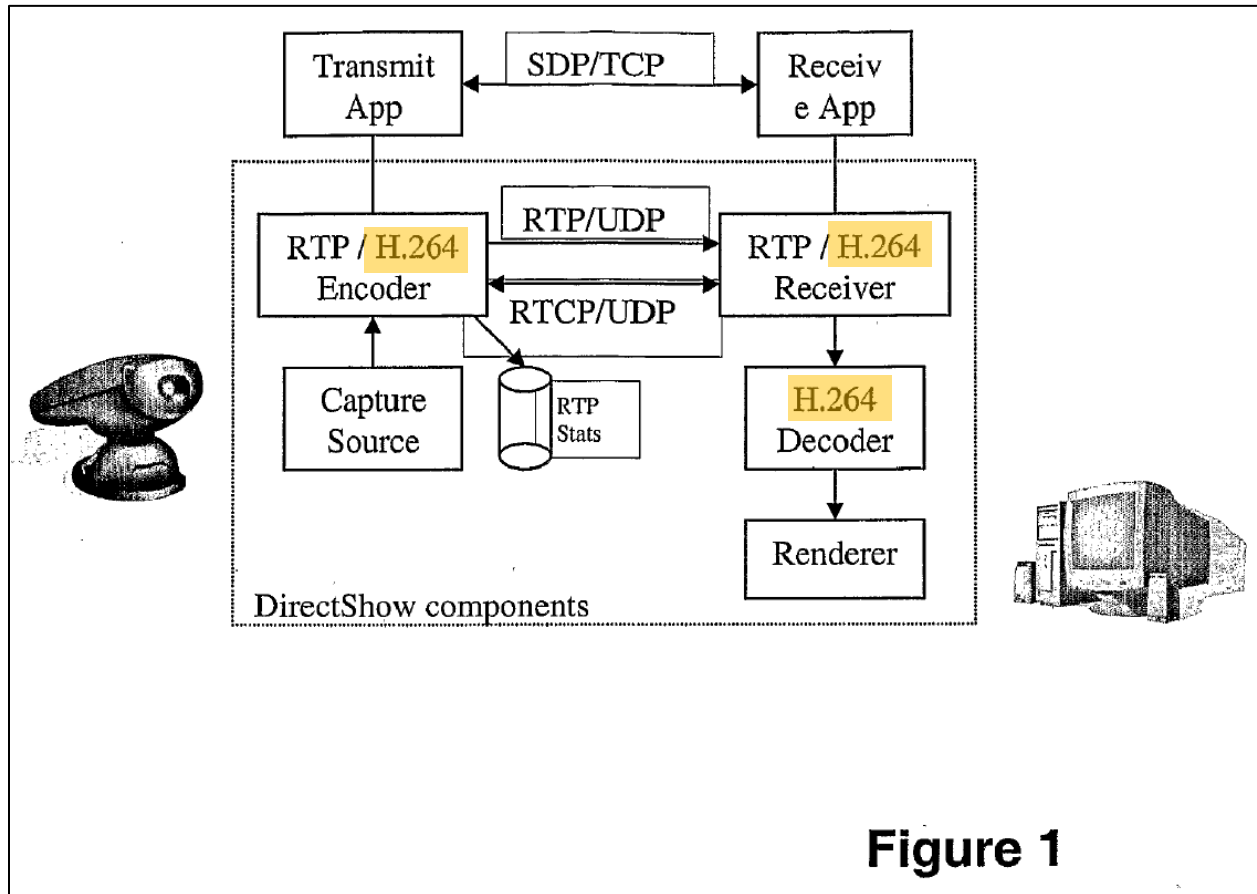
number of bits used to signal the reference picture is typically reduced. *Id.* EX1003, ¶106.

Every time this syntax is used, the prediction value is the picture number (`frame_num`) of the current picture (`CurrPicNum`) for the first picture in the buffer. EX1005, 86 (“**abs_diff_pic_num_minus1** plus 1 specifies the absolute difference between the picture number of the picture being moved to the current index in the list and the picture number prediction value.”), 80 (“**frame_num** is used as an identifier for pictures”), 82 (“`CurrPicNum` is set equal to `frame_num`”), 79-85, 85-86 (describing reference picture list reordering semantics), 117-18 (describing “[r]eordering process of reference picture lists for short-term reference pictures”). In decoding, the value (`abs_diff_pic_num_minus1 + 1`) is combined with (added to or subtracted from) the prediction value `picNumLXPred`. EX1005, 80, 117-18. The first time the reordering syntax is invoked for a given slice, “`picNumL0Pred` and `picNumL1Pred`,” these prediction values, “are initially set equal to `CurrPicNum`.” EX1005, 117-18 (§8.2.4.3.1). After each step, the prediction values for the next frame in the reference picture list is identified using the frame number of the previous frame in the list, plus or minus `abs_diff_pic_num_minus1 + 1`. *Id.* Thus, the frame numbers of each picture in the reference picture list are specified using only information in the current picture, not any prior information. EX1003, ¶108.

According to H.264/AVC, a decoder should infer loss of a picture when an entry in reference picture list reordering information refers (by frame number) to a short-term reference picture that does not exist. EX1005, 120 (§8.2.5.2) (“The decoding process should infer an unintentional picture loss when any of these values of frame_num pertaining to ‘non-existing’ pictures is referred to ... in the reordering commands for reference picture lists for short-term reference pictures”). For a non-existing picture, the decoder generates a picture having samples that “may be set to any value,” and marks the generated picture “as ‘non-existing’ and ‘used for short-term reference.’” *Id.*, 119 (§8.2.5.2). In some cases (when pic_order_cnt_type is not equal to 0), the decoder also generates picture order count values (TopFieldOrderCnt and BottomFieldOrderCnt) for the non-existing picture. *Id.*, 120 (§8.2.5.2). EX1003, ¶107.

C. Combining Mulroy And H.264/AVC

A POSITA would have been motivated to combine the video coding methods of Mulroy with the teachings of H.264/AVC and would have had a reasonable expectation of success in doing so, because Mulroy’s teachings are expressly designed to be used with the “architecture of a real-time multi-reference H.264 encoder and decoder.” EX1004, ¶8. FIG. 1 of Mulroy shows “a video transmission system incorporating apparatus according to embodiments of the invention,” and expressly depicts H.264 elements such as an H.264 encoder and H.264 decoder:



EX1004, FIG. 1 (annotated), ¶4; *id.*, ¶¶9-13. Mulroy further describes the “[en]coder of FIG. 1” with regard to FIG. 2A and “the decoder of FIG. 1” with regard to FIG. 2B. EX1004, ¶¶5-6, 17-18. EX1003, ¶109.

Mulroy describes its teachings as a “modified version” of the H.264 encoder and decoder that “alleviate[s]” the scenario where “[i]f the decoder loses a set of MMCO commands, there will be a mismatch between the contents of the encoder and decoder buffers.” EX1004, ¶27. That is, Mulroy discloses the same problem and the same solution claimed in the ’618 patent, and relies on the H.264/AVC standard for certain aspects of the implementation. Given that H.264/AVC was the state-of-

the-art version of the H.264/AVC standard at the time Mulroy was filed, a POSITA implementing Mulroy would have naturally turned to H.264/AVC for the relevant implementation details. H.264/AVC, in turn, discloses such implementation details as: methods for the retrieval and use of a delta identifier to calculate a reference picture identifier, the identification of reference pictures for subsequent pictures in the video stream, the setting of a picture order count of a non-existing picture, and the marking of non-existing pictures as non-existing. *Infra* §VIII.D.3; EX1003, ¶¶110-11.

Mulroy's reliance on the structures and implementation of H.264/AVC is explicit. For example, Mulroy states that a way of compensating for the loss of MMCO commands in encoded data for a previous picture, which is a stated goal of the '618 patent (EX1001, 6:34-37), would be "to make use of the 'reference picture list reordering' commands defined by H.264" in "every slice...informing the decoder as to exactly which frames should be in the decoder buffer at that time." EX1004, ¶27. By doing this, Mulroy-H.264/AVC can determine that a reference picture is missing from the decoder buffer and use an alternative reference picture instead of proceeding with a "mismatch between the contents of the encoder and decoder buffers" (EX1004, ¶¶27, 33), which in some scenarios can be "severe to the decoding process" (EX1001, 2:43-45). EX1003, ¶112.

Elsewhere, Mulroy describes that the decoder in its codec system should receive encoded data for a slice of a current picture in a NALU syntax structure of H.264/AVC, and some types of NALUs contain slice data for a current picture. EX1004, ¶¶28, 30. A POSITA would have particularly recognized that Mulroy's descriptions of how to employ specific syntax structures from H.264/AVC (e.g., EX1004, ¶¶27-30) and to use specific types of syntax structures and syntax elements (e.g., EX1004, ¶¶26-28) to provide a roadmap for an implementation of Mulroy with H.264/AVC, "in which every slice contains a message informing the decoder as to exactly which frames should be in the decoder buffer at that time." EX1004, ¶27. Furthermore, Mulroy explicitly notes that "[f]urther information can be found" in two IEEE articles about H.264/AVC and implementations thereof for network delivery of encoded data. EX1004, ¶¶80-81 (citing EX1015, EX1016). A POSITA thus would have understood Mulroy as providing an explicit teaching, suggestion, and/or motivation to combine Mulroy with H.264/AVC. EX1003, ¶113.

A POSITA thus would have been motivated to use the elements of H.264/AVC described above when implementing Mulroy and would have had a reasonable expectation of success in doing so, because of the express directions in Mulroy to use the syntax structures and syntax elements of H.264/AVC. EX1003, ¶114. Mulroy specifically gives directions "to make use of the 'reference picture list reordering' commands defined by H.264," which includes the

ref_pic_list_reordering() syntax structure and abs_diff_pic_num_minus1 syntax element discussed in §VIII.B above. EX1004, ¶27. Examples of how a POSITA would implement the method of Mulroy using these syntax structures are laid out by Dr. Creusere in his declaration. EX1003, ¶¶114, 116-44.

So implemented, the “modified version” of H.264/AVC proposed by Mulroy, which encodes every slice with “a message informing the decoder as to exactly which frames should be in the decoder buffer at that time” (EX1004, ¶27), provided improved error resilience due to redundancy in buffer management. EX1003, ¶115.

D. The Mulroy-H.264/AVC Combination

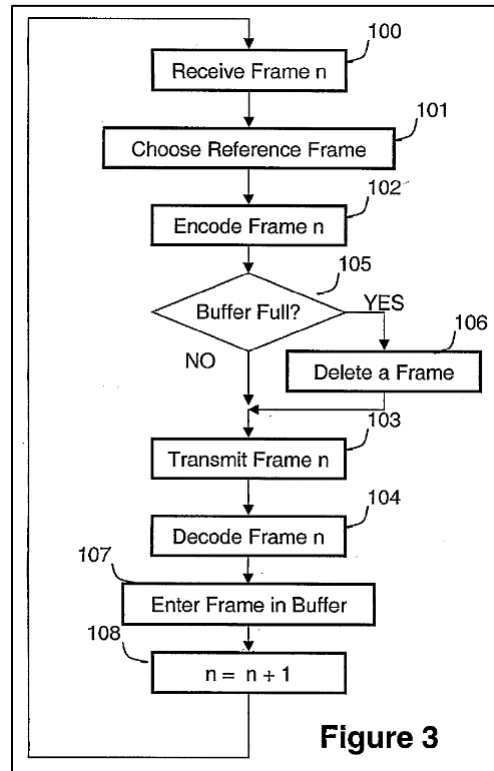
Thus implemented, the resulting Mulroy-H.264/AVC combination (“Mulroy-H.264/AVC”) discloses each element of the challenged claims, including those that allegedly distinguished the claims from the prior art, including buffer description information defining a plurality of reference pictures and a delta identifier, a picture identifier, and calculation of a reference picture identifier. EX1004, ¶¶22-33; EX1005, 1, 3, 18, 47 (§7.3.3.1), 79-85 (§7.4.3), 85-86 (§7.4.3.1), 117-20 (§§8.2.4.3.1 and 8.2.5.2); EX1003, ¶116.

1. **Claim 1**

[1.1] A method of decoding an encoded representation of a picture in a video stream of multiple pictures, the method comprising:

To the extent the preamble is limiting, Mulroy-H.264/AVC discloses it. Mulroy is titled “Video Coding” and describes “[v]ideo frame capture and H.264 real-time encode” (an encoded representation of a picture in a video stream of multiple pictures) and “H.264 real-time decode and display” (decoding an encoded representation of a picture in a video stream of multiple pictures). EX1004, ¶¶8-10; *id.*, ¶1 (“present invention concerns video coding”); EX1005, 18 (“The video source that is represented by the bitstream is a sequence of either or both frames or fields (called collectively pictures) in decoding order.”). Further, a POSITA understood that a video stream comprises multiple pictures, and that video coding involved the decoding of an encoded representation of a picture in a video stream of multiple pictures. *Supra* §IV.A; EX1003, ¶145.

For example, with respect to encoding, Mulroy describes encoding a number of pictures. EX1004, ¶22. The method of encoding described in Mulroy is summarized in the flowchart of FIG. 3, shown below.



EX1004, FIG. 3; *id.*, ¶22 (“FIG. 3 shows the operation of the encoder.”). With respect to decoding, Mulroy also discloses a method of decoding an encoded representation of a picture in a video stream of multiple pictures. *E.g.*, EX1004, Abstract (describing that encoded pictures are decoded by a decoder at a remote receiver). The decoding method of Mulroy is illustrated in Figure 4, shown below.

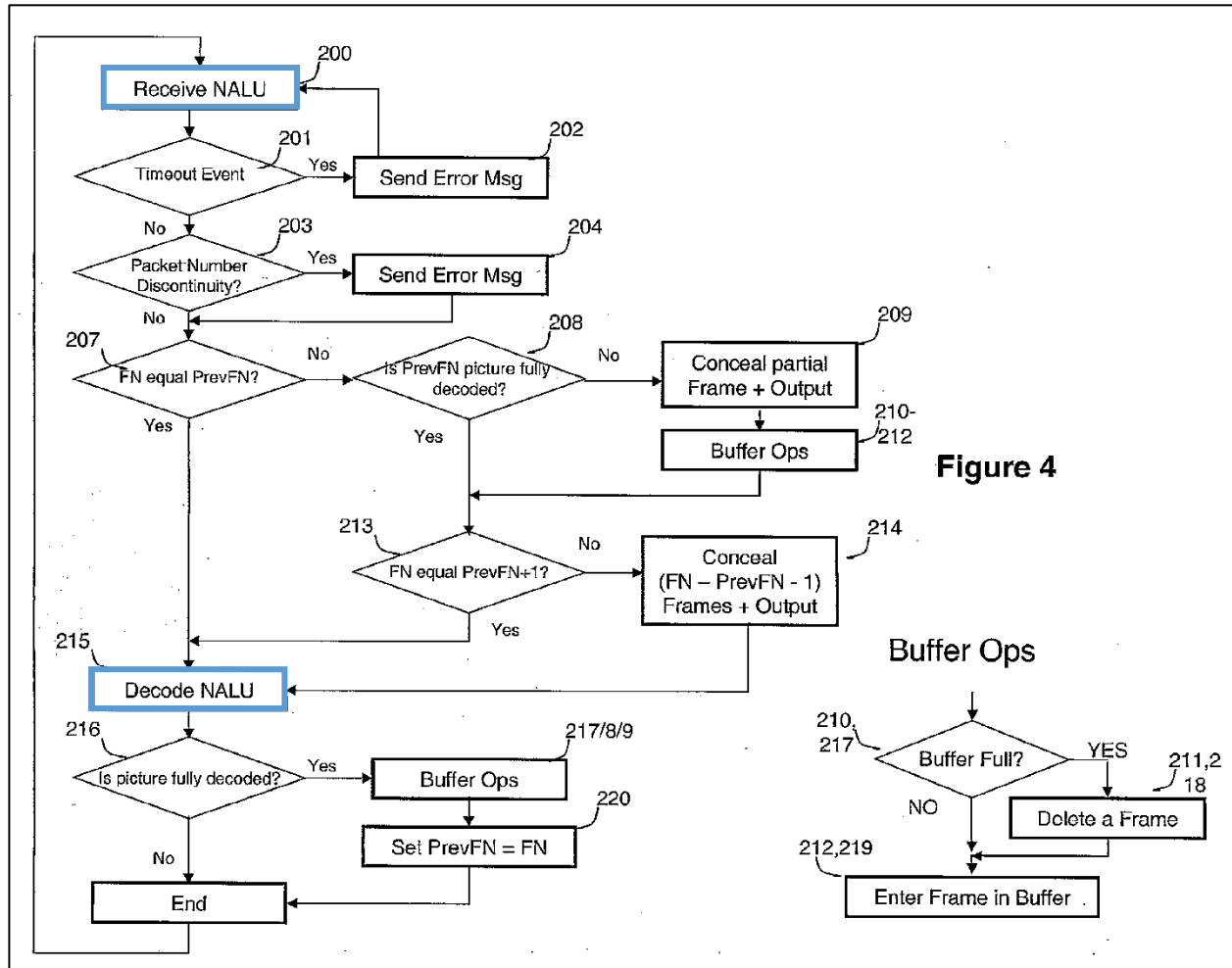


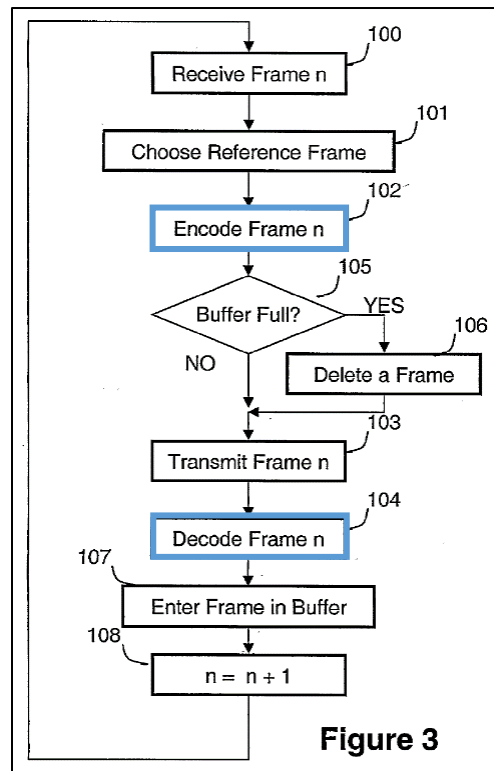
Figure 4

EX1004, FIG. 4 (annotated). A decoder receives encoded data for a slice in a NALU at step 200 (EX1004, ¶30) and decodes the encoded data for the slice at step 215 (EX1004, ¶32). The decoder repeats the operations of receiving and decoding encoded data in NALUs for slices of a current picture. EX1004, ¶32. EX1003, ¶146.

[1.2] retrieving, from the encoded representation of the picture, buffer description information defining a plurality of reference pictures;

Mulroy-H.264/AVC renders this element obvious because Mulroy discloses it. EX1003, ¶147.

Mulroy discloses “retrieving, from the encoded representation of the picture,...” the information recited in this element. Mulroy shows operations of an encoder in FIG. 3 (below) that “insert[s] remapping instructions in every slice (NAL unit) that reference all frames in its buffer.” EX1004, ¶28. These remapping instructions are added to the encoded representation of the picture based on reference pictures in a buffer. EX1004, ¶¶21-22.



EX1004, FIG. 3 (annotated). EX1003, ¶148.

The buffer description information would then be decoded, and thus retrieved, from the encoded frame. EX1003, ¶149. When the decoder receives encoded data in NALUs for slices of a picture and decodes the encoded data, the decoder retrieves

remapping instructions from the encoded data and “use[s] these to determine which frame to remove from its buffer when it otherwise does not have the required knowledge.” EX1004, ¶28. Mulroy thus discloses “retrieving, from the encoded representation of the picture.” EX1003, ¶149.

Mulroy further discloses that what is retrieved is “...*buffer description information....*” Mulroy describes a “modified version [of H.264] in which every slice contains a message informing the decoder as to *exactly which frames should be in the decoder buffer at that time.*” EX1004, ¶27 (emphasis added). EX1003, ¶150.

According to Mulroy, the encoder can change which reference pictures are stored in the buffer, for example, by adding a newly decoded picture or deleting an existing reference picture. EX1004, ¶¶23-26. Mulroy describes sending a “message” in every slice “informing the decoder as to exactly which frames should be in the decoder buffer at that time.” EX1004, ¶27. To do this, the message can use “‘reference picture list reordering’ commands defined by H.264” as “remapping instructions,” where the “remapping instructions can be made use of in the present context for indicating to the decoder which frames (by their frame numbers) should be in its buffer.” *Id.* These commands can be used to maintain the order of the pictures in the reference picture list, remove pictures from the list, or rearrange pictures identified by it, and specific examples of each of these operations are laid out in Dr. Creusere’s declaration. EX1003, ¶151.

Because this “message” in Mulroy states the frames that should be in the decoder buffer, i.e., describes the contents of the buffer, a POSITA would have understood it to be “buffer description information.” EX1003, ¶152.

Mulroy further discloses that its buffer description information “...*defin[es] a plurality of reference pictures.*” Mulroy describes that “the transmitted information includes the reference indices of the predictor, or all the predictors, used so that the decoder can use the correct one(s) for decoding,” which indicates identification of reference pictures in the encoder buffer (and decoder buffer) by the reference indices. EX1004, ¶22. Mulroy states this process for decoding was “known.” *Id.* EX1003, ¶153.

A POSITA would have understood that Mulroy discloses an unambiguous identification in the message that informs “the decoder as to exactly which frames should be in the decoder buffer at that time.” EX1004, ¶27. According to Mulroy, the message can use reference picture list reordering commands as in H.264/AVC to indicate the frames in a decoder buffer. *Id.* Mulroy does not require using reference picture list reordering commands to indicate the frames in the decoder buffer, but instead describes “‘reference picture list reordering’ commands defined by H.264” as “[o]ne way of doing this.” *Id.* Reference picture list reordering commands, used even when reference pictures are not reordered, provide another way to indicate the frames in the decoder buffer. EX1003, ¶154.

A POSITA would have understood that a way to implement this buffer description information would be to use a series of H.264/AVC reference picture list reordering commands. EX1003, ¶155 (discussing detailed examples of such implementation). By including the set of commands in the slice header, the buffer description information indicates the contents of the DPB.

[1.3] determining, based on the buffer description information, a reference picture identifier that identifies a respective reference picture among the plurality of reference pictures, the respective reference picture comprising a decoding reference for the picture, wherein determining the reference picture identifier comprises:

Mulroy-H.264/AVC renders this element obvious because Mulroy discloses a decoder determining, based on reordering commands in encoded data for a slice of a current picture, a reference picture identifier (frame number of a reference picture) that identifies a reference picture among the reference pictures usable to decode the current picture. EX1004, ¶27; EX1003, ¶156.

Mulroy describes that “every slice contains a message informing the decoder as to exactly which frames should be in the decoder buffer at that time. One way of doing this is to make use of the ‘reference picture list reordering’ commands defined by H.264.” EX1004, ¶27; EX1003, ¶157.

Importantly, Mulroy also describes that the encoder should “insert remapping instructions in every slice (NAL unit) that reference all frames in its buffer (there is not necessarily any changing of the default order)” and that the decoder then should

“use these to determine which frame to remove from its buffer when it otherwise does not have the required knowledge.” EX1004, ¶28; EX1003, ¶158.

[1.4] (i) retrieving, based on the buffer description information, a delta identifier comprising a difference between the reference picture identifier and a picture identifier identifying the picture; and

Mulroy-H.264/AVC renders this element obvious because H.264/AVC discloses it. EX1003, ¶159.

H.264/AVC teaches retrieving an `abs_diff_pic_num_minus1` syntax element from a reference picture list reordering syntax structure (`ref_pic_list_reordering()`) in a slice header. *See* EX1005, 47 (§7.3.3.1, laying out the “[r]eference picture list reordering syntax” structure), 85-86 (§7.4.3.1, explaining the “[r]eference picture list reordering semantics”).

As defined, the `abs_diff_pic_num_minus1` syntax element indicates a difference between the picture number (`frame_num`) of a reference picture and a picture number prediction value. *Id.*; *see also id.*, 79-85 (§7.4.3), 85-86 (§7.4.3.1), 117-18 (§8.2.4.3.1). For the first reordering command in each slice header for which the `reordering_of_pic_nums_idc` syntax elements is equal to 0 or 1, the picture number prediction value is “a picture identifier identifying the picture,” i.e., the picture number (`frame_num`) of the current picture (`CurrPicNum`). *Id.* In other words, the `abs_diff_pic_num_minus1` syntax element associated with the first reordering command is “a delta identifier comprising a difference between the

reference picture identifier and a picture identifier identifying the picture.” EX1003, ¶160.

Sections 7.4.3, 7.4.3.1, and 8.2.4.3.1 of H.264/AVC describe a structure for reordering a “plurality of reference pictures” for efficient coding. EX1005, 79-85 (§7.4.3), 85-86 (§7.4.3.1), 117-118 (§8.2.4.3.1). Mulroy describes using the same reference picture list reordering information to reiterate which reference pictures should be in a decoder buffer. EX1004, ¶¶27-28. Thus, the `abs_diff_pic_num_minus1` syntax element of Mulroy-H.264/AVC is an example of a “delta identifier” in claim 1, which is “a difference or delta identifier or value” as described in the ’618 patent. EX1001, 9:48; EX1003, ¶161.

[1.5] (ii) calculating the reference picture identifier based on the picture identifier and the delta identifier; and

Mulroy-H.264/AVC renders this element obvious because H.264/AVC teaches calculating the reference picture identifier based on the picture identifier and the delta identifier. For example, H.264/AVC describes using a delta identifier, its `abs_diff_pic_num_minus1` syntax element, from a reference picture list reordering syntax structure (`ref_pic_list_reordering()`) in a slice header, to determine the picture number of a reference picture. EX1005, 47 (§7.3.3.1). The decoder combines the value (`abs_diff_pic_num_minus1 + 1`) with the prediction value `picNumLXPred`, which when the reordering process is “invoked the first time for a slice,” it is

“initially set equal to CurrPicNum” to determine a variable picNumLXNoWrap indicating the picture number of the reference picture. EX1005, 117-18 (§8.2.4.3.1). Thus, Mulroy-H.264/AVC discloses a delta identifier or at least renders it obvious. EX1003, ¶162.

The delta identifier is used to calculate the reference picture identifier as follows. If the value of the reordering_of_pic_nums_idc syntax element is 0, the decoder subtracts the value $(\text{abs_diff_pic_num_minus1} + 1)$ from the variable picNumLXPred. EX1005, 117 (§8.2.4.3.1 (equation 8-35)). If the value of the reordering_of_pic_nums_idc syntax element is 1, the decoder adds the value $(\text{abs_diff_pic_num_minus1} + 1)$ to the variable picNumLXPred. *Id* (equation 8-36). When reordering_of_pic_nums_idc is 0 or 1 for the first time in a reference picture list reordering syntax structure, the variable picNumLXPred is equal to CurrPicNum, which is the frame number (frame_num) of the current picture, i.e., the picture identifier. EX1005, 79-85 (§7.4.3), 117-18 (§8.2.4.3.1). EX1003, ¶163. Thus, Mulroy-H.264/AVC discloses “calculating the reference picture identifier based on the picture identifier and the delta identifier” once for each slice that has a reordering_of_pic_nums_idc syntax element of 0 or 1. *See also* EX1003, ¶163 (laying out examples of how the abs_diff_pic_num_minus1 syntax element would be used in the Mulroy-H.264/AVC method).

[1.6] updating a decoded picture buffer based on the reference picture identifier.

Mulroy-H.264/AVC renders this element obvious because Mulroy discloses the decoder using the picture number of the reference picture (determined using “remapping instructions” in the encoded data for the current picture) to update its buffer. EX1004, ¶¶28, 33. Mulroy discloses “using the same algorithm as used at the coder for selecting pictures to be deleted” (EX1004, ¶29) as an alternative, instead of using, for example, the “rules for the reference buffer management” that Mulroy lays out at ¶¶47-51 to manage the DPB. EX1003, ¶164. Mulroy further discloses that when the decoder “does not have the required knowledge,” the decoder can use the “remapping instructions in every slice (NAL unit) that reference all frames in its buffer” to “determine which frame to remove from its buffer,” thus providing redundancy if, for example, the MMCO commands are lost. EX1004, ¶28. EX1003, ¶164.

2. Claim 2

[2.1] The method according to claim 1, wherein:

Mulroy-H.264/AVC renders claim 1 obvious. *Supra* §VIII.D (claim 1); EX1003, ¶165.

[2.2] determining the reference picture identifier comprises determining, based on the buffer description information,

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (elements 1.3, 1.4, and 1.5); EX1003, ¶166.

[2.3] i) a picture identifier identifying a respective reference picture among the plurality of reference pictures as the decoding reference for the picture and

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (element 1.3); EX1003, ¶167.

[2.4] ii) a picture identifier identifying a respective reference picture among the plurality of reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in the video stream.

Mulroy-H.264/AVC renders this element obvious because H.264/AVC teaches a picture identifier identifying a respective reference picture among the plurality of reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in the video stream. It would have also been natural and obvious to implement Mulroy with H.264/AVC because Mulroy was explicitly designed to be implemented with H.264/AVC. *Supra* §VIII.C; EX1003, ¶168.

H.264/AVC describes signaling reference picture list reordering information in the `ref_pic_list_reordering()` syntax structure, which is part of the `slice_header()` syntax structure for a slice. EX1005, 47 (§7.3.3.1). This reordering information can include one or more `abs_diff_pic_num_minus1` syntax elements, each identifying a

picture number of a short-term reference picture. EX1005, 47 (§7.3.3.1), 85-86 (§7.4.3.1). This reordering information can include `long_term_pic_num` syntax elements, identifying the picture number of a long-term reference picture. *Id.* EX1003, ¶169.

A POSITA would have understood that some reference pictures identified as long-term reference pictures are used during decoding of a subsequent picture in the decoding order. In some cases, a given long-term reference picture is used for decoding both the current picture and a subsequent picture in Mulroy-H.264/AVC, while in other cases, a given long-term reference picture is used for decoding a subsequent picture but not the current picture in Mulroy-H.264/AVC. *Compare* EX1001, 8:32-38 (“the encoded picture therefore carries the buffer description information that can be used at the decoder to define and identify the reference pictures that are needed to decode the current picture and/or any subsequent picture of the video stream.”); *see also id.*, 15:35-43, 15:44-53, 22:11-30. EX1003, ¶170.

3. Claim 3

[3.1] The method according to claim 1, further comprising:

As discussed above, Mulroy-H.264/AVC satisfies the elements of claim 1. *Supra* §VIII.D (claim 1); EX1003, ¶171.

[3.2] determining whether the reference picture identified by the reference picture identifier is one of missing or non-existing; and

Mulroy-H.264/AVC renders this element obvious because Mulroy teaches that its decoder determines that a reference picture is missing from its buffer and instead uses an alternative reference picture. EX1004, ¶33; EX1003, ¶172.

[3.3] responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, generating a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier.

Mulroy-H.264/AVC renders this element obvious because Mulroy discloses generating a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier, responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, in view of the teachings of H.264/AVC as discussed below. EX1003, ¶173.

According to the H.264/AVC standard, a decoder should infer loss of a picture when an entry in reference picture list reordering information refers to a reference picture that does not exist in the DPB. EX1005, 119-20 (§8.2.5.2). For a non-existing picture, according to the H.264/AVC standard, the decoder generates a picture with samples that “may be set to any value,” and marks the generated picture “as ‘non-existing’ and ‘used for short-term reference.’” *Id.*, 119; EX1003, ¶174.

According to Mulroy, its decoder can determine that a reference picture is missing from the decoder buffer and instead use an alternative reference picture. EX1004, ¶33. A POSITA, reading this description in Mulroy, would have understood that one way to provide an “alternative frame” would be to generate a non-existing reference picture as specified in the H.264/AVC standard—with samples that “may be set to any value” and marking the generated picture “as ‘non-existing’ and ‘used for short-term reference.’” *Id.* Although error concealment operations using a generated, non-existing reference picture are outside the scope of the H.264/AVC standard, Mulroy describes options for setting the values of the samples of the generated picture. EX1004, ¶¶30, 36.; EX1003, ¶175.

4. Claim 4

[4.1] The method according to claim 3, wherein generating the non-existing picture with parameters comprises at least one of:

Mulroy-H.264/AVC renders claim 3 obvious. *Supra* §VIII.D (claim 3); EX1003, ¶176.

For Mulroy-H.264/AVC to render this claim obvious, it need only disclose or render obvious one of the four options for generating the non-existing picture. The language “at least one of ... and ...” in this context could not indicate “one or more” because it is describing method steps, not objects. *Cf. Micropairing Techs. LLC v. Toyota Motor Mfg. Texas Inc.*, No. SA-21-CV-00940-XR, 2022 WL 62540, at *19

(W.D. Tex. Jan. 5, 2022) (finding that the claim language “at least one of...and...” describes choosing a step from a list). Mulroy-H.264/AVC discloses at least limitations [4.2] and [4.5], and thus renders claim 4 obvious. EX1003, ¶177.

[4.2] setting a picture order count (POC) of the non-existing picture to a POC of the reference picture;

Mulroy-H.264/AVC renders this element obvious because H.264/AVC teaches setting a picture order count (POC) of the non-existing picture to a POC of the reference picture. According to H.264/AVC, a decoder should infer loss of a picture when an entry in reference picture list reordering information refers to a reference picture that does not exist in the DPB. EX1005, 119-20 (§8.2.5.2). In some cases (when `pic_order_cnt_type` is not equal to 0), the decoder generates picture order count values (`TopFieldOrderCnt` and `BottomFieldOrderCnt`) for the non-existing picture. *Id.*; EX1003, ¶178.

According to Mulroy, its decoder can determine that a reference picture is missing from the decoder buffer and instead use an alternative reference picture. EX1004, ¶33. A POSITA, reading this description in paragraph 33 of Mulroy, would have understood that one way to provide an “alternative frame” would be to generate a non-existing reference picture as specified in H.264/AVC – with picture order count values generated for the non-existing reference picture as specified in H.264/AVC. EX1003, ¶179.

[4.3] setting an `additional_picture_id` of the non-existing picture to an `additional_picture_id` of the reference picture;

Mulroy-H.264/AVC discloses at least elements [4.2] and [4.5], and thus renders claim 4 obvious. Element [4.3] is not addressed at this time. EX1003, ¶180.

[4.4] setting a `temporal_id` of the non-existing picture to a `temporal_id` of the reference picture; and

Mulroy-H.264/AVC discloses at least elements [4.2] and [4.5], and thus renders claim 4 obvious. Element [4.4] is not addressed at this time. EX1003, ¶181.

[4.5] marking the non-existing picture with a non-existing mark and used for reference mark.

Mulroy-H.264/AVC renders this element obvious because H.264/AVC teaches marking the non-existing picture with a non-existing mark and used for reference mark. According to H.264/AVC, a decoder should infer loss of a picture when an entry in reference picture list reordering information refers to a reference picture that does not exist in the DPB. EX1005, 119-20 (§8.2.5.2). For a non-existing picture, according to H.264/AVC, the decoder generates a picture and marks the generated picture “as ‘non-existing’ and ‘used for short-term reference.’” *Id.*, 119; EX1003, ¶182.

According to Mulroy, its decoder can determine that a reference picture is missing from the decoder buffer and instead use an alternative reference picture. “It can occur that a frame is received without errors, but cannot be decoded correctly

because its reference frame is absent from the buffer. This can be dealt with by decoding the NAL unit in box 215, using an alternative frame that is present in the decoder.” EX1004, ¶33. A POSITA, reading this description in Mulroy, would have understood that one way to provide an “alternative frame” would be to generate a non-existing reference picture as specified in H.264/AVC – including marking the generated picture “as ‘non-existing’ and ‘used for short-term reference.’” EX1005, 119; EX1003, ¶183.

5. Claim 5

[5.1] A method of decoding an encoded representation of a picture in a video stream of multiple pictures, the method comprising:

Mulroy-H.264/AVC renders this obvious. *Supra* §VIII.D (element 1.1); EX1003, ¶184.

[5.2] retrieving, from the encoded representation of the picture, buffer description information defining a plurality of reference pictures;

Mulroy-H.264/AVC renders this element obvious. *Supra* §IX.E (element 1.2); EX1003, ¶185.

[5.3] determining, based on the buffer description information, a reference picture identifier that identifies a reference picture among the plurality of reference pictures that comprises a decoding reference for the picture;

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (element 1.3); EX1003, ¶186.

[5.4] determining whether the reference picture identified by the reference picture identifier is one of missing or non-existing;

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (element 3.2); EX1003, ¶187.

[5.5] responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, generating a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier; and

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (element 3.3); EX1003, ¶188.

[5.6] updating a decoded picture buffer based on the reference picture identifier.

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (element 1.6); EX1003, ¶189.

6. Claim 6

[6.1] The method according to claim 5, wherein generating the non-existing picture with parameters comprises at least one of:

Mulroy-H.264/AVC renders claim 5 obvious. *Supra* §VIII.D (claim 5). For Mulroy-H.264/AVC to render this claim obvious, it need only disclose or render obvious one of the four options for generating the non-existing picture. *Supra* §VIII.D (element 4.1); EX1003, ¶190.

[6.2] setting a picture order count (POC) of the non-existing picture to a POC of the reference picture;

Mulroy-H.264/AVC renders this element obvious. *Supra* §VIII.D (element 4.2); EX1003, ¶191.

[6.3] setting an additional_picture_id of the non-existing picture to an additional_picture_id of the reference picture;

Mulroy-H.264/AVC discloses at least elements 6.2 and 6.5. Element 6.3 is not addressed at this time. EX1003, ¶192.

[6.4] setting a temporal_id of the non-existing picture to a temporal_id of the reference picture; and

Mulroy-H.264/AVC discloses at least elements 6.2 and 6.5. Element 6.4 is not addressed at this time. EX1003, ¶193.

[6.5] marking the non-existing picture with a non-existing mark and used for reference mark.

Mulroy-H.264/AVC renders this element obvious, as discussed above. *Supra* §VIII.D (element 4.5); EX1003, ¶194.

7. Claim 7

[7.1] The method according to claim 5, wherein determining the reference picture identifier comprises:

As discussed above, Mulroy-H.264/AVC satisfies the elements of claim 5. *Supra* §VIII.D (claim 5); EX1003, ¶195.

[7.2] (i) retrieving, based on the buffer description information, a delta identifier comprising a difference between the reference picture identifier and a picture identifier identifying the picture; and

Mulroy-H.264/AVC renders this element obvious, as discussed above. *Supra* §VIII.D (element 1.4); EX1003, ¶196.

[7.3] (ii) calculating the reference picture identifier based on the picture identifier and the delta identifier.

Mulroy-H.264/AVC renders this element obvious, as discussed above. *Supra* §VIII.D (element 1.5); EX1003, ¶197.

IX. GROUND 2: CLAIMS 8-19 ARE OBVIOUS OVER MULROY IN VIEW OF H.264/AVC AND RAVEENDRAN

A. Raveendran (U.S. 2006/0165176; EX1006)

Raveendran is a U.S. patent application publication that was published on July 27, 2006, and thus is prior art under at least Sections 102(a-b). EX1006, Cover. Raveendran is analogous art to the '618 patent because they are both in the same field of endeavor of video coding. EX1006, ¶¶4, 14; EX1003, ¶198.

Raveendran discloses a method and apparatus to perform frame rate up conversion for video compression. Specifically, Raveendran discusses performing operations on bitstreams that are defined by video coding standards and discusses aspects of H.264/AVC. EX1006, ¶¶65-66, 70-71, 73, 75-76. Raveendran also discloses the use of the logic it describes in “a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field

programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein.” EX1006, ¶84. It further discusses implementation of video compression algorithms in an access point in a network. EX1006, ¶¶77-81; EX1003, ¶199.

The disclosures that Raveendran made in 2006 about operating video coding systems in software and hardware implementations provide at least as much detail as the specification of the ’618 patent. *Compare* EX1001, 25:22-42, 28:66-29:7, with EX1006, ¶¶77-85. EX1003, ¶200.

B. Combining Mulroy, H.264/AVC, And Raveendran

A POSITA would have been motivated to combine the video coding methods taught by Mulroy and H.264/AVC with the hardware and/or software implementations taught by Raveendran, and would have had a reasonable expectation of success in doing so, because Raveendran provides express teachings, suggestions, and/or motivations to implement such video coding methods in specific hardware and/or software environments, and its disclosure reflects that an ordinary level of skill would easily do so. Although Mulroy and H.264/AVC do not expressly disclose hardware and/or software implementations, a POSITA would have recognized that such implementations would have been necessary to perform the video coding methods they teach. Raveendran, in turn, expressly teaches the

implementation in hardware and/or software of video coding methods such as H.264/AVC in specific hardware and software environments. EX1006, ¶¶77-86. Raveendran teaches methods that are “[s]tandards [c]ompliant” with standards such as H.264/AVC (EX1006, ¶¶70-72) and further teaches that “the methods described herein may be implemented on a variety of communication hardware, processors and systems known by one of ordinary skill in the art” (EX1006, ¶83). Raveendran also gives express examples of such communication hardware, processors and systems. EX1006, ¶¶77-86; EX1003, ¶201.

Thus, when implementing Mulroy and H.264/AVC, a POSITA would have been motivated, with a reasonable expectation of success, to do so in hardware and/or software implementations, as described in Raveendran. The POSITA would only need to combine known prior art elements, such as the methods of Mulroy-H.264/AVC and the specific known “communication hardware, processors and systems known by one of ordinary skill in the art” (EX1006, ¶83) taught by Raveendran, to achieve predictable results, namely encoding and decoding video as taught by Mulroy-H.264/AVC. The POSITA knew how to do so, as Raveendran explains that its disclosure “enable[s] any person skilled in the art to make or use the various embodiments.” EX1006, ¶86. EX1003, ¶202.

The obviousness to combine these references is further supported by the ’618 patent’s limited disclosures on implementation, admitting that one of skill in the art

would not have needed further disclosure to expect successful implementation. For example, the '618 patent's discussion of software (EX1001, 25:1-2, 28:46-47) and hardware (EX1001, 25:26-30, 29:3-7) implementations is given at a high level, and does not include any discussion of the network being used. In contrast, Raveendran's discussions of software and hardware implementations gives at least as much detail and includes a discussion of the network architecture used. EX1006, ¶¶77-85. EX1003, ¶203.

C. The Mulroy-H.264/AVC-Raveendran Combination

The resulting Mulroy-H.264/AVC-Raveendran combination, which includes Mulroy-H.264/AVC described above implemented in hardware/software environments as taught by Raveendran, renders claims 8-19 obvious as discussed in the following sections. EX1003, ¶204.

1. Claim 8

[8.1] A decoder configured to decode an encoded representation of a picture in a video stream of multiple pictures, the decoder comprising:

Mulroy-H.264/AVC-Raveendran renders this obvious because Mulroy discloses a decoder configured to decode encoded representations. EX1004, ¶¶18-21. Mulroy further describes a remote receiver that functions as a decoder. EX1004, ¶¶30-36; EX1003, ¶205.

[8.2] at least one processor; and

Mulroy-H.264/AVC-Raveendran renders this element obvious because Raveendran teaches implementing a decoder with a processor. EX1006, ¶84; EX1003, ¶206.

[8.3] a memory storing instructions which, when executed by the at least one processor causes the decoder to:

Mulroy-H.264/AVC-Raveendran renders this element obvious because Raveendran teaches using memory to store instructions that are executed by a processor to cause an encoder/decoder to carry out its various operations. EX1006, ¶85; EX1003, ¶207.

[8.4] retrieve buffer description information defining a plurality of reference pictures, wherein the buffer description information is retrieved from the encoded representation of the picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.2); EX1003, ¶208.

[8.5] determine, based on the buffer description information, a reference picture identifier that identifies a respective reference picture among the plurality of reference pictures, the respective reference picture comprising a decoding reference for the picture, wherein the decoder is configured to

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.3); EX1003, ¶209.

[8.6] i) retrieve, based on the buffer description information, a respective delta identifier comprising a difference between the reference picture identifier and a picture identifier identifying the picture, and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.4); EX1003, ¶210.

[8.7] ii) calculate the reference picture identifier based on the picture identifier and the respective delta identifier; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.5); EX1003, ¶211.

[8.8] update a decoded picture buffer based on the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.6); EX1003, ¶212.

2. Claim 9

[9.1] The decoder according to claim 8, wherein the memory stores further instructions which, when executed by the at least one processor causes the decoder to:

Mulroy-H.264/AVC-Raveendran renders this element obvious because Mulroy-H.264/AVC-Raveendran renders claim 8 obvious and because Raveendran discloses a “software module” or “instructions” stored in memory that are “executed by a processor” to perform a method. *Supra* §IX.C (claim 8); EX1006, ¶¶84-85, 17; EX1003, ¶213.

[9.2] retrieve the buffer description information defining multiple reference pictures from the encoded representation of the picture; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.2); EX1003, ¶214.

[9.3] determine, based on the buffer description information,

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 2.2); EX1003, ¶215.

[9.4] i) a picture identifier identifying a respective reference picture among the multiple reference pictures as the decoding reference for the picture and

Mulroy-H.264/AVC-Raveendran renders this element obvious because Mulroy discloses it. *Supra* §VIII.D (element 2.3); EX1003, ¶216.

[9.5] ii) a picture identifier identifying a respective reference picture among the multiple reference pictures as a decoding reference for a subsequent, according to a decoding order, picture in the video stream.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 2.4); EX1003, ¶217.

3. Claim 10

[10.1] The decoder according to claim 8, wherein the memory stores further instructions which, when executed by the at least one processor causes the decoder to further configured to:

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §§VIII.D (claim 8), IX.C (element 9.1); EX1003, ¶218.

[10.2] determine whether the reference picture identified by the reference picture identifier is one of missing or non-existing; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.2); EX1003, ¶219.

[10.3] responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, generate a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.3); EX1003, ¶220.

4. Claim 11

[11.1] The decoder according to claim 10, wherein generating the non-existing picture with parameters comprises at least one of:

Mulroy-H.264/AVC-Raveendran combination renders claim 10 obvious, as discussed above. *Supra* §IX.C (claim 10). For Mulroy-H.264/AVC-Raveendran to render this claim obvious, it need only disclose or render obvious one of the four options for generating the non-existing picture. *Supra* §VIII.D (element 4.1). Mulroy-H.264/AVC-Raveendran renders claim 11 obvious because Mulroy-H.264/AVC-Raveendran renders obvious at least elements 11.2 and 11.5, as noted below. EX1003, ¶221.

[11.2] setting a picture order count (POC) of the non-existing picture to a POC of the reference picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.2); EX1003, ¶222.

[11.3] setting an additional_picture_id of the non-existing picture to an additional_picture_id of the reference picture;

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 11.2 and 11.5. Element 11.3 is not addressed at this time. EX1003, ¶223.

[11.4] setting a temporal_id of the non-existing picture to a temporal_id of the reference picture; and

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 11.2 and 11.5. Element 11.4 is not addressed at this time. EX1003, ¶224.

[11.5] marking the non-existing picture with a non-existing mark and a used for reference mark.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.5); EX1003, ¶225.

5. Claim 12

[12.1] A decoder configured to decode an encoded representation of a picture in a video stream of multiple pictures, the decoder comprising:

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §IX.C (element 8.1); EX1003, ¶226.

[12.2] a data retriever circuit configured to retrieve buffer description information defining a plurality of reference pictures, wherein the buffer description information is retrieved from the encoded representation of the picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. Mulroy-H.264/AVC renders obvious retrieving buffer description information defining a plurality of reference pictures, wherein the buffer description information is retrieved from the encoded representation of the picture. *Supra* §VIII.D (element 1.2). Raveendran teaches implementing video coding methods, such as the teachings of Mulroy-H.264/AVC, in “circuits” such as an ASIC, FPGA, or other programmable logic device. EX1006, ¶84. A POSITA would have been motivated with a reasonable expectation of success to apply the teachings of Raveendran when implementing the obvious method of Mulroy-H.264/AVC, because Raveendran’s disclosure “is provided to enable any person skilled in the art to make or use the various embodiments.” EX1006, ¶86; *supra* §§VIII.C, IX.B. A POSITA thus would have found it obvious to implement the known Mulroy-H.264/AVC method with an application specific integrated circuit (data retriever circuit) in order to “perform the function[]” as taught by Raveendran, because Raveendran provides an express teaching, suggestion, and/or motivation to do so. EX1006, ¶84; EX1003, ¶227.

[12.3] a picture identifier determiner circuit configured to:

Mulroy-H.264/AVC-Raveendran renders this element obvious. Raveendran describes implementing H.264/AVC methods in hardware circuits, such as an application specific integrated circuit or another hardware component. EX1006, ¶84. Further, Mulroy-H.264/AVC renders obvious the steps of determining a picture identifier. A POSITA thus would have found it obvious to implement the known Mulroy-H.264/AVC method of determining a picture identifier with an application specific integrated circuit (picture indicator determiner circuit) to “perform the function[]” as taught by Raveendran, because Raveendran provides an express teaching, suggestion, and/or motivation to do so. EX1006, ¶84; EX1003, ¶228.

[12.4] determine, based on the buffer description information, a reference picture identifier that identifies a respective reference picture among the plurality of reference pictures, the respective reference picture comprising a decoding reference for the picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.3); EX1003, ¶229.

[12.5] determine whether the reference picture identified by the reference picture identifier is one of missing or non-existing;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.2); EX1003, ¶230.

[12.6] responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, generate a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.3); EX1003, ¶231.

[12.7] a buffer manager circuit configured to update a decoded picture buffer based on the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. Mulroy-H.264/AVC renders obvious updating a DPB based on the reference picture identifier. *Supra* §VIII.D (element 1.6); EX1003, ¶232.

Raveendran further teaches implementing video coding methods, such as the teachings of Mulroy-H.264/AVC, in a circuit. EX1006, ¶84. A POSITA thus would have found it obvious to implement the known Mulroy-H.264/AVC method of updating a decoded picture buffer with an application specific integrated circuit (buffer manager circuit) to “perform the function[]” as taught by Raveendran, because Raveendran provides an express teaching, suggestion, and/or motivation to do so. EX1006, ¶84; EX1003, ¶233.

6. **Claim 13**

[13.1] The decoder according to claim 12, wherein generating the non-existing picture with parameters comprises at least one of:

Mulroy-H.264/AVC-Raveendran renders claim 12 obvious. *Supra* §XI.C (claim 12). To render this claim obvious, Mulroy-H.264/AVC-Raveendran need only disclose or render obvious one of the four options for generating the non-existing picture. *Supra* §VIII.D (element 4.1). As discussed below, Mulroy-H.264/AVC-Raveendran renders obvious at least elements 13.2 and 13.5, and thus renders claim 13 obvious. EX1003, ¶234.

[13.2] setting a picture order count (POC) of the non-existing picture to a POC of the reference picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.2); EX1003, ¶235.

[13.3] setting an `additional_picture_id` of the non-existing picture to an `additional_picture_id` of the reference picture;

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 13.2 and 13.5, so element 13.3 is not addressed at this time; EX1003, ¶236.

[13.4] setting a `temporal_id` of the non-existing picture to a `temporal_id` of the reference picture; and

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 13.2 and 13.5, so element 13.4 is not addressed at this time. EX1003, ¶237.

[13.5] marking the non-existing picture with a non-existing mark and used for reference mark.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.5); EX1003, ¶238.

7. **Claim 14**

[14.1] A receiver comprising:

To the extent the preamble is limiting, Mulroy-H.264/AVC-Raveendran renders it obvious because Mulroy discloses the operation of a receiver. EX1004, ¶30. EX1003, ¶239.

[14.2] an input section circuit configured to receive encoded representations of multiple pictures in a video stream;

Mulroy-H.264/AVC-Raveendran renders this element obvious. Mulroy describes a remote receiver that receives pictures in a video stream that are encoded as NALUs containing H.264/AVC slice data. EX1004, ¶30, FIG. 1, FIG. 4. Raveendran further teaches implementing video coding methods, such as the teachings of Mulroy-H.264/AVC, in a circuit. EX1006, ¶84. A POSITA thus would have found it obvious to implement the known Mulroy-H.264/AVC method of receiving encoded pictures in a video stream with an application specific integrated circuit (input section circuit) in order to “perform the function[.]” as taught by

Raveendran, because Raveendran provides an express teaching, suggestion, and/or motivation to do so. EX1006, ¶84; EX1003, ¶240.

[14.3] a decoder circuit configured to decode the encoded representations of the multiple pictures; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §IX.C (element 8.1). A POSITA would have found it obvious to implement the known Mulroy-H.264/AVC decoder with an application specific integrated circuit (decoder circuit) to “perform the functions” of the decoder as taught by Raveendran, because Raveendran provides an express teaching, suggestion, and/or motivation to do so. EX1006, ¶84; EX1003, ¶241.

[14.4] an output section circuit configured to output decoded pictures of the video stream, wherein the decoder circuit comprises:

Mulroy-H.264/AVC-Raveendran renders this element obvious. The '618 patent describes that the “output section...is configured to output decoded pictures.” EX1001, 3:63-64. Mulroy describes this output section in its description that when a frame is decoded “the newly decoded frame is inserted into the buffer” for use. EX1004, ¶32. A POSITA would have understood that the newly decoded frame inserted into the buffer, in addition to being available as a reference picture, would also be output for eventual display, because the typical purpose of decoding the video stream is to display it. *E.g.*, EX1005, 1, 3. Mulroy also discloses output of the

H.264 Decoder going to a “Renderer” (EX1004, FIG.1), and that the “video transmission system” depicted in FIG. 1 “performs the following functions” such as “H.264 real-time decode and display” (EX1004, ¶¶4, 8, 10). EX1003, ¶242.

A POSITA thus would have found it obvious to implement the known Mulroy-H.264/AVC method of outputting decoded pictures of the video stream with an application specific integrated circuit (output section circuit) to “perform the function[]” as taught by Raveendran, because Raveendran provides an express teaching, suggestion, and/or motivation to do so. EX1006, ¶84; EX1003, ¶243.

[14.5] a data retriever circuit configured to retrieve buffer description information defining a plurality of reference pictures, wherein the buffer description information is retrieved from the encoded representation of a picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §IX.C (element 12.2); EX1003, ¶244.

[14.6] a picture identifier determiner circuit configured to

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §IX.C (element 12.3); EX1003, ¶245.

[14.7] determine, based on the buffer description information, a reference picture identifier that identifies a respective reference picture among the plurality of reference pictures, the respective reference picture comprising a decoding reference for the picture, wherein the picture identifier determiner is configured to

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.3); EX1003, ¶246.

[14.8] i) retrieve, based on the buffer description information, a respective delta identifier comprising a difference between the reference picture identifier and a picture identifier identifying the picture, and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.4); EX1003, ¶247.

[14.9] ii) calculate the reference picture identifier based on the picture identifier and the respective delta identifier; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.5); EX1003, ¶248.

[14.10] a buffer manager circuit configured to update a decoded picture buffer based on the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §X.G (element 12.7); EX1003, ¶249.

8. Claim 15

[15.1] The receiver according to claim 14, wherein the decoder circuit is further configured to perform operations comprising:

Mulroy-H.264/AVC-Raveendran renders this element obvious, as discussed above. *Supra* §IX.C (claim 14); EX1003, ¶250.

[15.2] determining whether the reference picture identified by the reference picture identifier is one of missing or non-existing; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.2); EX1003, ¶251.

[15.3] responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, generating a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.3); EX1003, ¶252.

9. Claim 16

[16.1] The receiver according to claim 15, wherein generating the non-existing picture with parameters comprises at least one of:

Mulroy-H.264/AVC-Raveendran renders claim 15 obvious. *Supra* §IX.C (claim 15). Additionally, for Mulroy-H.264/AVC-Raveendran to render this claim obvious, it need only disclose or render obvious one of the four options for generating the non-existing picture. *Supra* §VIII.D (element 4.1). Mulroy-

H.264/AVC-Raveendran renders this claim obvious because it renders obvious at least elements 16.2 and 16.5, as discussed in the following paragraphs. EX1003, ¶253.

[16.2] setting a picture order count (POC) of the non-existing picture to a POC of the reference picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VII.D (element 4.2); EX1003, ¶254.

[16.3] setting an `additional_picture_id` of the non-existing picture to an `additional_picture_id` of the reference picture;

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 16.2 and 16.5, so element 16.3 is not addressed at this time. EX1003, ¶255.

[16.4] setting a `temporal_id` of the non-existing picture to a `temporal_id` of the reference picture; and

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 16.2 and 16.5, so element [16.3] is not addressed at this time. EX1003, ¶256.

[16.5] marking the non-existing picture with a non-existing mark and used for reference mark.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.5); EX1003, ¶257.

10. Claim 17

[17.1] A computer program product comprising a non-transitory computer-readable medium storing program instructions for decoding an encoded representation of a picture in a video stream of multiple pictures, the program instructions when executed by a processor of a node in an access network cause the node to perform operations comprising:

Mulroy-H.264/AVC-Raveendran renders this element obvious because Raveendran discloses “a computer readable medium” with instructions for executing a method for construction of a video sequence. EX1006, ¶17. Raveendran also describes “access point 504x” (node) as “a device in an access network.” EX1006, ¶¶78, 81, and a “receive [] data processor 558” within access point 504x that processes the video stream and provides decoded data. EX1006, ¶78. A POSITA would have found it obvious to implement Mulroy-H.264/AVC in hardware and/or software described by Raveendran, because Raveendran provides express teachings, suggestions, and/or motivations to do so. *Supra* §IX.B; EX1003, ¶258.

[17.2] retrieving, from the encoded representation of the picture, buffer description information defining a plurality of reference pictures;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.2); EX1003, ¶259.

[17.3] determining, based on the buffer description information, a reference picture identifier that identifies a respective reference picture among the plurality of reference pictures, the respective reference picture comprising a decoding reference for the picture, wherein determining the reference picture identifier comprises:

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.3); EX1003, ¶260.

[17.4] (i) retrieving, based on the buffer description information, a delta identifier comprising a difference between the reference picture identifier and a picture identifier identifying the picture; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.4); EX1003, ¶261.

[17.5] (ii) calculating the reference picture identifier based on the picture identifier and the delta identifier; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.5); EX1003, ¶262.

[17.6] updating a decoded picture buffer based on the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 1.6); EX1003, ¶263.

11. Claim 18

[18.1] The computer program product according to claim 17, wherein the instructions comprise further instructions that are executable by the processor of the node in the access network to perform operations comprising:

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §IX.C (claim 17); EX1003, ¶264.

[18.2] determining whether the reference picture identified by the reference picture identifier is one of missing or non-existing; and

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.2); EX1003, ¶265.

[18.3] responsive to determining the reference picture identified by the reference picture identifier is one of missing or non-existing, generating a non-existing picture with parameters set to parameters of the reference picture identified by the reference picture identifier.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 3.3); EX1003, ¶266.

12. Claim 19

[19.1] The computer program product according to claim 18, wherein generating the non-existing picture with parameters comprises at least one of:

Mulroy-H.264/AVC-Raveendran renders claim 18 obvious. *Supra* §IX.C (claim 18). To render this claim obvious, the combination need only disclose or render obvious one of the four options for generating the non-existing picture. *Supra* §VIII.D (element 4.1). As discussed in the following paragraphs, Mulroy-

H.264/AVC-Raveendran renders obvious at least elements 19.2 and 19.5, and thus render claim 19 obvious. EX1003, ¶267.

[19.2] setting a picture order count (POC) of the non-existing picture to a POC of the reference picture;

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.2); EX1003, ¶268.

[19.3] setting an `additional_picture_id` of the non-existing picture to an `additional_picture_id` of the reference picture;

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 19.2 and 19.5. Element 19.3 is not addressed at this time. EX1003, ¶269.

[19.4] setting a `temporal_id` of the non-existing picture to a `temporal_id` of the reference picture; and

Mulroy-H.264/AVC-Raveendran renders obvious at least elements 19.2 and 19.5. Element 19.4 is not addressed at this time. EX1003, ¶270.

[19.5] marking the non-existing picture with a non-existing mark and used for reference mark.

Mulroy-H.264/AVC-Raveendran renders this element obvious. *Supra* §VIII.D (element 4.5); EX1003, ¶271.

X. NO OBJECTIVE INDICIA OF NON-OBVIOUSNESS

In the dispute between Petitioner and PO before the International Trade Commission (*In the Matter of Certain Electronic Computing Devices, and*

Components and Modules Thereof, Inv. No. 337-TA-1337), PO has contended that secondary considerations support a finding of nonobviousness, but PO's arguments at the ITC are either conclusory or lack any nexus to the claims of the '618 patent. PO asserts that its method of video compression was unexpectedly efficient, but Petitioner is aware of no evidence for how the claims of the '618 patent would result in a more efficient encoding and/or decoding process. Furthermore, the elements of the '618 patent such as using absolute differences to identify reference pictures were previously disclosed by Mulroy. PO also contended in the ITC that the technology described in the '618 patent received industry praise, but relies on an internal memo written by a named inventor and on other documents that give PO's development mixed reviews, stating that PO's proposal required improvement. Plaintiff's other claims of copying, awards, and commercial success all assume a nexus between the claims of the '618 patent and the H.265/HEVC standard. But the H.265/HEVC standard is the subject of thousands of patents and PO has not shown that the technology claimed in the '618 patent drove any of the success of the H.265/HEVC. Thus, the secondary considerations that PO cites in the ITC do not show that the challenged claims are non-obvious. EX1003, ¶¶76-78, 272.

XI. CONCLUSION

Petitioner requests institution for claims 1-7 on Ground 1 and claims 8-19 on Ground 2 as specified in this petition.

Respectfully submitted,

Dated: December 10, 2024

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**CERTIFICATE OF COMPLIANCE WITH
TYPE-VOLUME LIMITATION PURSUANT TO 37 C.F.R. § 42.24**

This brief complies with the type-volume limitation of 37 C.F.R. § 42.24(a)(1)(i).

The brief contains 13,798 words, excluding the parts of the brief exempted by 37 C.F.R. § 42.24(a).

The brief has been prepared in a proportionally spaced typeface using Microsoft Word for O365 in a 14-point Times New Roman font.

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CERTIFICATE OF SERVICE
IN COMPLIANCE WITH 37 C.F.R. § 42.6(e)(4)

The undersigned certifies that the **Petition for *Inter Partes* Review of U.S. Patent No. 10,708,618 and Exhibits 1001 – 1016** were served on December 10, 2024, via **Express Mail** on the Patent Owner at the following address of record as listed on the USPTO Patent Center:

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